A new basic model of the Irish economy

By C. E. V. Leser

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The problems involved in the construction of econometric macro-models are well known and have been discussed extensively in general terms, and also in relation to Irish data [2, 5] One of the difficulties arises out of the nature of the model and the purposes which it is intended to serve. If the equations of the model are designed to explain the working of the economy, they may not be very suitable for short-term forecasting; if on the other hand they make considerable use of leading indicators and other forecasting devices, their theoretical content may be very limited.

Another antithesis is that between small-scale and large-scale models, the relative merits of which were extensively debated in the discussion on a paper by Friend and Jones [4]. A small-scale model containing only a few equations is obviously less ambitious in scope than a very large and complex model, but on the other hand permits more intensive testing of various alternatives. This applies particularly to interdependent systems, in which the specification of any one equation affects the estimation of several or even all the other equations.

In a recursive model which specifies that there is no true cross-relationship between the endogenous variables but only an influence in one direction, the difficulties are not so great as it is possible to start from a small basic model and to enlarge it by adding further equations. Since each equation of such a system may be individually estimated, alternative variants of one equation may be considered without having to worry about the remainder

These reasons of convenience do not by themselves justify the use of recursive systems if genuine inter-dependence is specified on theoretical grounds. Recursive models have, however, been used with advantage in the field of demand and supply analysis on the micro-level, and their application in the macro-economic field may deserve further consideration wherever the specification of a causal chain appears to be at least a reasonable working hypothesis.

The model introduced here is designed to explain short-term movements, from one year to another, in some of the key national accounts variables. The relationships are such as to allow theoretical interpretation provided the specification is correct; failing the latter, they may still be used as prediction relationships. The model may be used in connection with short-term fore-casting though it is not specifically designed for that purpose, as it does not explicitly introduce short-term indicators such as quarterly or monthly data which could be used for forecasting purposes.

The model is fully recursive, specifying clearly the direction in which the relationships are supposed to work. It is a basic model with imports of goods and services, gross national product, personal disposable income and personal expenditure as endogenous variables, all of them in current prices. It could well be further extended to cover price indices and constant price terms, employment and other variables of this kind.

The variables of the model are:

M	imports of goods and services
Y	gross national product at market prices
Y_d	personal disposable income
C	personal expenditure
G	public authorities'net current expenditure
I	gross domestic fixed capital formation
X	exports of goods and services
B_a	value of physical changes in agricultural stocks
B_n	value of physical changes in non-agricultural stocks
e	weekly earnings index in transportable goods industries
z, z'	dummy variables

All variables are measured in £ mill. in current prices, except for the dummies which will be explained later and the annual earnings index numbers which have October 1953 as base and which refer to October except that the September index was used for 1965. Imports and exports follow the old official definition, including all factor income flows. Personal disposable income is defined as personal income less direct taxes on personal income and thus represents personal expenditure plus personal savings.

After some experiments, the structural equations were formulated as follows, apart from dummy variables:

$$\Delta M = \alpha_1 + \beta_{11} \Delta I + \beta_{12} (\Delta X + \Delta B_a)$$

$$\Delta Y - \Delta G = \alpha_2 + \beta_{21} \Delta I + \beta_{22} (\Delta X + \Delta B_a) + \beta_{23} \Delta e$$

$$\Delta Y_d = \alpha_3 + \beta_{31} (\Delta Y - \Delta G)$$

$$\Delta C = \alpha_4 + \beta_{41} \Delta Y_d + \beta_{42} \left(\frac{Y_d - C}{Y_d} \right)_{-1}$$

to which may be added the identity

$$\Delta B_n = (\Delta M + \Delta Y) - (\Delta C + \Delta G + \Delta I + \Delta X + \Delta B_a)$$

the symbol Δ indicating year-to-year changes.

The first equation represents an import function. It tacitly assumes that a change in imports depends on changes in fixed capital formation and exports as well as on an expected change in personal expenditure, which in turn has a constant term and variable terms depending on fixed investment and exports. For this purpose, agricultural stock changes are treated as potential exports and are therefore separated from non-agricultural stock changes and added on to actual exports.

The second equation which may be described as a production decision function is similarly specified. Government expenditure is assumed to be fully translated into home production but without any multiplier effect. The price element in the valuation of national product is taken care of by industrial earnings as a cost indicator.

The very simple form of the income formative equation which follows implies that only that part of gross national product which is not induced by government spending influences personal disposable income. This may not apply in a country which makes extensive use of budget surpluses and deficits to influence consumer spending, but appears valid in the Irish context where balanced budgets have hitherto been the rule and therefore an increase in government expenditure was fully matched by increased taxation.

In the consumption function given by the fourth equation, β_{41} represents the short-term propensity to consume, and in addition there is an adjustment from the existing ratio C/Y_d towards a long-term equilibrium value

$$\left(\frac{C}{Y_d}\right)_e = 1 + \frac{\alpha_4}{\beta_{42}} \qquad \begin{pmatrix} \beta_{42} > 0 \\ \alpha_4 < 0 \end{pmatrix}$$

This would be in accordance with the permanent income hypothesis, and would still comply with it if the specification was less restrictive.

Finally, non-agricultural stock changes are neither taken as exogenous nor directly estimated by the model equations but obtained by difference. The structure of the model is considerably simplified by this procedure.

The latest available figures for the variables from 1953 to 1965 were taken from official publications [1,3] and converted into first differences, thus giving 12 observations. Furthermore, dummy variables were used for the import and consumption functions. In the import function z indicates the anticipation of import levies in 1955, their introduction in 1956 and removal or reduction in 1958: thus

$$z = \begin{cases} 1 \text{ for } 1954\text{-}5,\ 1957\text{-}8 \\ -2 \text{ for } 1955\text{-}6 \\ 0 \text{ otherwise} \end{cases}$$

There appeared to be a similar but lagged effect in the consumption function, the dummy variable z' for which was taken as

$$z' = z + z_{-1}$$

thus

$$z' = \begin{cases} 1 \text{ for } 1954\text{-}5,\ 1957\text{-}8,\ 1958\text{-}9 \\ -1 \text{ for } 1955\text{-}6 \\ -2 \text{ for } 1956\text{-}7 \\ 0 \text{ otherwise} \end{cases}$$

Least-square estimation then yielded the following results:

$$\Delta M = \underset{}{1.200} + \underset{(0.1717)}{0.8238}\ \Delta I + \underset{(0.1216)}{0.5574}\ (\Delta X + \Delta B_a) + \underset{(2.242)}{11.416}\ z$$

$$\Delta Y - \Delta G = \underset{}{1.623} + \underset{(0.2761)}{0.5491}\ \Delta I + \underset{(0.1629)}{0.9214}\ (\Delta X + \Delta B_a) + \underset{(0.6776)}{1.7976}\ \Delta e$$

$$\Delta Y_d = \underset{}{-3.980} + \underset{(0.0815)}{0.9762}\ (\Delta Y - \Delta G)$$

$$\Delta C = \underset{}{-32.520} + \underset{(0.0685)}{0.6469}\ \Delta Y_d + \underset{(100.58)}{508.81}\left(\frac{Y_d - C}{Y_d}\right)_{-1} + \underset{(2.071)}{4.325}\ z'$$

All regression coefficients are significant at the 10% level, and all except those of ΔI in the second and z' in the fourth equation at the 5% level at least. The coefficients of determination and standard errors of estimate (in £ mill) are as follows:

	R^2	S_e
ΔM	.948	5.30
$\Delta Y - \Delta G$	.944	7.09
ΔY_d	.935	6.91
ΔC	.937	5.84

The coefficients of determination are high for equations in terms of first differences. This is satisfactory though it does not prove the specification to be correct as there is a fair degree of correlation between most national accounts data even in terms of first differences. There remain moderately high unexplained elements in the endogenous variables as evidenced by the standard errors of estimate. If the dummy variable was ommitted from the consumption function we would obtain $R^2 = .903$ therein.

The first two equations show that fixed investment has a larger effect upon imports than have exports, whilst the opposite applies to domestic production. This is what we should expect to find. The sum of the coefficients of ΔI in the two equations is greater than 1, as is also the sum of coefficients of $\Delta X + \Delta B_a$; thus the increase in imports and home production which is meeting increased personal expenditure seems to vary very largely in step with the increase in exogenous demand.

The consumption function shows that in the short run about two-thirds of any addition to personal disposable income tends to be spent. In the long run, however, the proportion of disposable income spent

appears to adjust itself to about .936 since:

$$1 - \frac{32.520}{508.81} = .9361$$

Personal disposable income, personal expenditure and non-agricultural stock changes could be expressed in terms of predetermined variables if desired. It should be noted that government expenditure does then disappear from these equations.

The model may be applied to 1965-6 and to 1966-7, though conditions in 1966 have shown so many abnormal features that this does not constitute a fair prediction test; it rather shows what might have been expected to happen in more normal circumstances. Using official and N.I.E.C. estimates and forecasts [3,6], estimating Y_d as 816 in 1966 for the purpose of the 1967 consumption forecast and assuming a 1966-7 earnings increase of 3% or 6.5 index points, we obtain for the exogenous variables

	1965-6	1966-7
ΔI	-2	17
ΔX	31	33
ΔB_a	-14	-2
ΔG	9	9
Δ^e	23.0	6.5
$\left(\frac{Y_d - C}{Y_d}\right)_{-1}$	.0949	.0944

The predicted changes in the endogenous variables then are as follows :

	1965- 6		1966- 7	
	Model	Official or NIEC	Model	Official or NIEC
ΔM	9	5	32	40
ΔY	67	47	60	67
ΔY_d	53		46	
ΔC	50	24	45	44
ΔB_n	2	4	-10	6

Thus the model gives an estimate of how much sharper gross national product and personal expenditure would have risen in 1965-6 in the absence of strikes and credit restrictions other than those holding back capital formation. On the other hand, a pure model prediction would give a smaller rise in imports and gross national product than the N. I. E. C. forecast, and with $B_n = 6$ for 1966, this would imply a fall in non-agricultural stocks in 1967 by £4 mill. In an actual prediction one would be inclined to make allowance for the deficiencies in ΔM and ΔY for 1965-6, though it is difficult to see to what extent.

A number of questions remain unanswered. To what extent do the equations formulated and estimated here have real structural content, and alternatively how useful are they for prediction ; or else has the model fallen between two stools? If using it for short-term forecasting, should one make use of independent information about the endogenous variables, particularly about non-agricultural stock changes, and if so, in what way? There is no simple answer to these questions. What seems to have been established is the possibility of building a reasonably satisfactory recursive macro-economic model which includes a consumption function as an integral part, and which permits further elaboration by both improving the existing and adding on further relationships.

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