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Irish Migration, All or Nothing Resolved?

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Précis: Some issues concerning the data are first discussed. Various migration equations for Ireland are estimated and the coefficient differences explained. Despite having a large proportion of explained variation the coefficient estimates in the equations are unstable and are very weak in predicting both the trend and absolute level of the net migration flow. It is concluded that an exogenous estimator of migration flows at the moment gives better predictions than the currently used models which endogenise net migration.

I INTRODUCTION

In an economy with an open labour market such as Ireland it is important to gauge the direction and size of the net migration flow because of its effect on population and labour force size. While many attempts[1] have been made to explain the net migration flow between Ireland and Great Britain there has been general agreement that it is a function of both income and unemployment variables in both counties. Despite this, widely varying estimates of the coefficients of these variables have been produced. This paper shows that while these differences are easily explained the migration equations are unable to predict the pattern of Irish migration whether one uses the official migration series or an alternative series based on population estimates from the Electoral Register. Although the Lianos (1970) model may be preferable to the one commonly used in Irish studies this also fails to predict with any acceptable degree of accuracy.

II BACKGROUND

Taking the period since 1951 there have been large fluctuations in the

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1. Among the most recent attempts are: O'Herlihy (1966); Walsh (1968), (1974), (1978); Geary and McCarthy (1976); Bradley, Fitzgerald and McCarthy (1978); and Keenan (1978), amongst others.

level of net migration. Table 1 below gives the migration estimates from April 1951 to April 1979.

Table 1: *Net migration 1951-1979*

Year	*Net migration ('000)*
1951-1961	–408.8
1961-1971	–134.5
1971-1979	+106.8

(–) = net outflow (+) net inflow

Source: Census of Population 1979 and earlier years.

The above represent estimates of net migration as revealed by census data. As such, we can be sure that they are fairly accurate figures for the net migration flows over each census period. There remains the problem, however, of distributing these census estimates between the inter-censal years. Two alternative methods of distribution are available, one traditionally used by the Central Statistics Office and another of recent origin suggested by the work of Whelan and Keogh (1980). It is to these that we now turn.

Hughes (1977 and 1980) has shown that the CSO use the relationship between net passenger movements and the net migration data to derive the inter-censal distribution. However, as Hughes has demonstrated, there is little stability in the relationship between these two series, so that the net passenger movements data cannot be used to predict migration levels. Furthermore, as the experience of the 1970s has shown, the net passenger movements series can give a false indication of direction of the net flow. It is, therefore, difficult to justify its use in distributing the census migration total over the inter-censal years. The distribution derived by the CSO is implicit in their yearly population estimates. Hughes (1977) has derived this implicit series using the population identity, that net migration in period t equals the change in population minus the natural increase in period t. Hughes' estimates of the January to January migration series are presented in Table A.1. as the *CSO Migration Estimates* updated in view of the results of the 1979 Census. On examination the yearly data give some ground for caution. Over the period since the 1956 Census two of the largest numerical shifts in the CSO migration series occur between the year of a census and the immediately following year. The two relevant cases are the data for the year following the 1961 and 1971 Census; these show a reduction in net emigration of 27,000 for the year ended April 1962 and over 15,000 for the year ended April 1972. The shifts in the series in the immediately preceding and following years are much smaller in magnitude. These shifts may be explained by the upturn in the economic situation at the beginning of the 'sixties and the approach to full employment in the early 'seventies. Alternatively, it may be that the distribution of the migration total between the inter-censal years is inadequate (especially since the 1966 Census). It is, therefore, worth considering whether an alternative distribution performs any better in the migration equations which have been in common use.

An alternative distribution may be derived by using the relationship between the Electoral Register and population data at census years. Whelan and Keogh (1980) have shown that the factor derived by taking the ratio of census year population to the Electoral Register estimate for the same period, may be held constant and used to derive inter-censal population forecasts from the Electoral Register estimate of the corresponding period. These population forecasts together with data on the natural increase may be used to derive the implicit forecast of migration. When these forecasts are compared to the actual net migration flow as revealed by the census the margin of error is low. *Ex post* estimates of the net migration flow which exactly equal the net migration total as revealed by the census may be derived from the population estimates derived by a simple linear interpolation of the ratio of census year population to census year Electoral Register data in successive census years multiplied by the corresponding Electoral Register figures. Whelan and Keogh's (1980) results suggest that one can be more confident about these estimates than those derived using net passenger movements data. These estimates shifted to a January base are presented as the *new migration series* in Table A.1. It is evident that the latter series is much more volatile than the CSO series.[2] The regression coefficients presented below have been estimated using both series and the results are commented on later.

Before proceeding to outline the theoretical framework for the analysis it is necessary to comment on the Labour Force estimates for the period 1972 onwards. On the evidence of the Labour Force Surveys (1975 and 1977) the official labour force figures under-estimated the true figures over this period. The method used to calculate the official figures for non-census years is a very simple one[3] and has led to large errors in the past. (For example, see the 1971 labour force estimates before the 1971 census became available.) Recently published official figures give revised estimates of the labour force for 1980 and the Labour Force Survey years 1975, 1977 and 1979. There was a substantial upward adjustment in the labour force estimates despite the fact that a change in definition of what constitutes "out of work" lowered the total in the unemployed category. The upward adjustment, therefore, is mainly attributable to an underestimate of numbers employed. It is apparent that all the estimates for the post-1971 census years will be adjusted upwards, in due course. For the purposes of this paper the new

2. This was also noted as a characteristic of the forecast series derived by Whelan and Keogh (1980).

3. For example, the out of work figure published in Table 1 of *The Trend of Employment and Unemployment* since the 1971 census results became available equals the total on the Live Register at mid-April of each year (excluding short time workers) minus 5.2 thousand. This 5.2 thousand being the difference between the mid-April Live Register figure in 1971 and the census estimate of the number unemployed at the time. The employment figures for the inter-censal years are similarly calculated using for example the quarterly industrial inquiry estimates of employment in manufacturing, males employed in agriculture from the June agricultural enumeration together with the relevant census totals. This method led to an overestimation of the labour force for 1971 before the 1971 census results became available whereas it is clear that there has been a large scale underestimation of the post 1971 labour force.

labour force estimates cannot be directly used, mainly because of the problem with the unemployment estimates. Instead, alternative estimates are derived as the total of the old unemployment estimates and the new "total at work" estimates for these years, to derive labour force estimates more in line in conceptual framework with the 1971 and pre-1971 labour force estimates. These figures are then used as the basis for recalculation of the labour force for other years in the 1970s.[4] In Table 2 below these new estimates are presented and compared to the previous estimates.

Table 2: *Estimated labour force 1972-1978*

Year	*Official Estimates**	*New Estimates*	*Difference ('000)*
1972	1121	1128	7
1973	1123	1137	14
1974	1131	1148	17
1975	1139	1158	19
1976	1142	1176	34
1977	1145	1191	46
1978	1148	1212	64

*Published in *The Trend of Employment and Unemployment,* 1978

III MODELS OF MIGRATION

With the exception of the O'Herlihy and Lianos models the models favoured by the authors considered in this paper have their origin in the framework outlined by Walsh (1974). In that paper Walsh outlined the basic formulation of the structural equations of a migration model of Ireland/Great Britain migration as:

$$M_{ijt} = \alpha + \beta_1 Y^*_{it} + \beta_2 Y^*_{jt} \quad (1)$$

$$M_{jit} = \alpha' + \beta'_1 Y^*_{it} + \beta'_2 Y^*_{jt} \quad (2)$$

$$N_{ijt} = (\alpha - \alpha') + (\beta_1 - \beta_1') Y^*_{it} + (\beta_2 - \beta_2') Y^*_{jt} \quad (3)$$

where

M_{ijt} = Gross migration from i to j in period t.

N_{ijt} = Net migration from i to j in period t.

Y^*_{it} = Expected lifetime net advantage that would accrue to the typical potential migrant in location i.

4. The labour force participation rate for the years 1971, 1975, 1977, and 1979 was calculated and the participation rate for the missing years was estimated using a linear interpolation of the available rates. The labour force equals the estimated multiplied by the official population estimate for the corresponding year.

If it is assumed that the coefficient $\beta_1 - \beta_1' = -(\beta_2 - \beta_2')$ then the level of net migration is seen to depend on the difference in expected lifetime net advantage. This latter variable is not directly observable and the different specifications of the migration equations referred to above arise mainly out of different possibilities regarding the specification of the Y* variables. The equation specification of Geary and McCarthy (1976), Keenan (1978) and in various Central Bank[5] model specifications of the macro economy, postulate static or stationary expectations, with expectations based on the current values of an income variable in the country in question. Walsh (1974) estimated equations based on this static expectations assumption however, his preferred specification was that expectations are based on an adaptive expectations hypothesis such that expectations reflected the previous periods value plus some fraction of the difference between current income in period t and the expectation of period t–1. In all these models the probability of not receiving the expected net advantage in location i at period t is approximated by the current unemployment rate in that location. As is well known the adaptive expectations hypothesis gives rise to a lagged dependent variable in the estimating equation whereas the preferred specification of the other authors excludes this variable. The two basic formulations of the migration equation arising from the above are:

$$N_{ijt} = C_0 + C_1 (Y_i - Y_j)_t + C_2 (U_i - U_j)_t + D_t \tag{4}$$

$$N_{ijt} = K_0 + K_1 (Y_i - Y_j)_t + K_2 (U_i - U_j)_t + K_3 N_{t-1} + Z_t \tag{5}$$

where

Y_{it} = Real income in period t in location i.

U_{it} = Unemployment rate in period t in location i.

Z_t = Autocorrelated disturbance term.

D_t = Random disturbance term.

Various *ad hoc* adjustments to Equation (4) have been suggested as a means of improving the forecasting capability of the equation. One of these was the inclusion by Keenan (1978) of the change in total employment to mirror labour market conditions more accurately given the weak association which can exist between employment and unemployment in an open labour market.

O'Herlihy's (1966) model is the earliest of the Irish migration equations considered. Various equation estimates are presented and a preferred equation states that migration is a function of the unemployment rate in Ireland, the ratio of money wages in both countries and a time trend. The specifica-

5. See Central Bank of Ireland (1977); Bradley, Kelleher and McCarthy (1977); Bradley, Fitzgerald and McCarthy (1978).

tion is *ad hoc* and the dependent variable as an indicator of migration is net passenger movements. While the results of the re-estimation of an O'Herlihy type equation are presented later it is clear that the equation specification is not consistent with the theoretical framework developed later by Walsh (1974). It is clear that a correct specification of the unemployment variable when the dependent variable is standardised to a migration rate is an unemployment rate variable and so the original specification is adjusted accordingly in the estimation below.

The estimating Equations (4) and (5) above differ from that derived by Lianos (1970) from a stock flow model of migration behaviour. Whereas the Walsh framework suggests that the inter-area income differential influences migration the Lianos estimating equation has migration as a function of the change in the inter-area income differential. This latter model may best be presented with a modification to the original stock formation equation in view of the error in the original outlined in Kirwan's (1979) exposition.

$$L^t_{ij} = a_0 + a_1 \Delta(Y_i - Y_j)_t + U_t \tag{6}$$

$$L^*_t = \sum_{t=0}^{t} L^t_{ij} - \sum_{t=1}^{t} N_{t-1} \tag{7}$$

$$\overline{N}_t = b^0_0 L^*_t + W_t \tag{8}$$

where

L^t_{ij}	=	The change in number of potential net migrants between areas i and j because of the change in the inter-area income differential in period t.
$\Delta(Y_i - Y_j)$	=	Change in intra-area income differential.
L^*_t	=	Total number of potential net migrants in period t.
N_t	=	Actual net migration between the two areas in period t.
U_t, W_t	=	Random disturbance terms.

The above model yields an estimating equation,

$$N_t = a_0 b_0 + a_1 b_0 \Delta(Y_i - Y_j)_t + (1 - b_0) N_{t-1} + (W_t - W_{t-1} + b_1 U_t) \tag{9}$$

The above specification of the income variable seems preferable to that of the previous studies as, *certeris paribus,* the stock of potential migrants should remain constant when the income differential between the two countries is unchanged. Any change in the number of potential migrants because of new entrants to the labour force is approximated by the intercept in the above equation. Although not in the original model, before estimating this equation it was decided to construct the income variable to account for employment prospects in both countries. It is, therefore, further postulated that the coefficient for the change in income, in each country, $a_1 b_0$ is a linear function of the probability of being employed in that country. In particular, it is assumed that $a_1 b_0 = kE_i$ for each country i, where E = employment rate. The effect is to multiply the income variable for each country by the employment rate to create a variable titled *the change in the expected income differential* which is used in the estimation of Equation (9) above.

IV RECONCILING AND EVALUATING DISPARATE ESTIMATES

Outlined in Table 3 below are the original estimates of the income and unemployment coefficients as published in the cases listed. These coefficient estimates are not comparable for a variety of reasons.

Table 3: *Estimates of the Irish unemployment and income coefficients in a selection of migration studies*

Author	*Date period*	*Unemployment coefficient*	*Income coefficient*
O'Herlihy (1966)	1948-63	2.0 (n.a.)	−1.92 (n.a.)
Walsh (1974)	1951-71	0.40 (0.09)*	−0.47 (0.18)
Geary and McCarthy (1976)	1951-71	0.81 (0.21)	−0.06 (0.02)
Bradley, Fitzgerald & McCarthy (1978)	1953-75	0.88 (0.02)	−0.18 (0.17)
Keenan (1978)	1955-76	1.17 (0.28)	−0.02 (0.003)

*The figures in parentheses are the standard errors of the estimates except n.a. = Not available.

In order to move towards a state in which the alternative models can be compared and evaluated it is necessary to estimate the models on a common dependent variable over a common sample period. The migration series used as the dependent variable in deriving the estimates in Table 3 is different in each case. This is no fault of the authors concerned but rather arises because of confusion over the data to which the annual population estimates refer in non-census years (Hughes 1977). In the same paper Hughes (1977) states that the population estimates are mid-April estimates and subsequently derived the migration series referred to earlier. The dependent variable used in the remainder of this paper is the ratio of the January to January net migration series in period t to the total labour force in t–1. In this way the dependent variable has the same dimension as the right hand side variables. Also, I have tried to keep as closely as possible to the specification of variables suggested by each author.

In all cases the models were estimated using a single equation estimation method. The migration equation estimates of Geary and McCarthy (1976) and Keenan (1978) are determined within a simultaneous equation system non-linear in endogenous variables. Because of this the latter models were estimated using non-linear two-stage least squares. As the reduced form of these two models will be highly non-linear and difficult if not impossible to write analytically, the forecasts presented below are derived by simulation of the entire model, given the values of the predetermined variables, using Newton's solution algorithm. Except in the above cases all the coefficient estimates presented in Tables 4 and 5 below were derived using ordinary least squares. The equations of Bradley, Fitzgerald and McCarthy, Geary and McCarthy, and Keenan when estimated over the extended sample period 1954-1977 using the official migration series were found to exhibit autocorrelation at the 0.05 significance level. This presented some special problems in the choice of coefficient estimates which are outlined later.

The full set of coefficient estimates for each equation using both migration series from 1954-1970 are presented in Table 4 below. None of the estimated equations exhibit positive autocorrelation at the 0.01 significance level although the DW statistic of Keenan's equation is in the uncertain region. In O'Herlihy's equation there is a high degree of collinearity among the exogenous variables making the coefficient estimates unreliable. A prominent feature of the remaining coefficient estimates is that the unemployment coefficient in the Walsh case is consistently below that in the other equations. The difference cannot be partly attributed to the fact that the Geary and McCarthy and Keenan estimates are non-linear two-stage least squares estimates, as an estimation of the equation by OLS reveals almost identical coefficients over this sample period. The difference is explained mainly by a scale effect on the unemployment variable and the presence of the lagged endogenous variable in the Walsh specification. All the above equations use the same unemployment rate for the UK but differences arise in the choice of an Irish unemployment rate. Walsh uses the unemployment rate of non-agricultural insured persons on the Live Register whereas in the other studies the ratio of the number out of work to the total labour force as published in *The Trend of Employment and Unemployment* is used.

The former series is on average nearly 1.4 times larger than the latter and so has the effect of reducing the unemployment coefficient in the Walsh case. Furthermore, although derived from the same theoretical framework the Walsh equation is a disequilibrium flow equation and so the equilibrium value of the unemployment coefficient should be compared with the equilibrium values in the other equations. The equilibrium values of the unemployment coefficient are 0.83 and 0.91 using the official and the new migration data, respectively. Although the effect is small in the former cases the equilibrium unemployment coefficient is nearly double the disequilibrium coefficient

Table 4: *Coefficient estimates with standardised dependent variable (1954-1970).*

Author	*Migration series*	*Intercept*	*Unemployment*	*Coefficients* *Income*	*Lagged endogenous*	*Other***	*Adjusted* R^2	*Durbin d or h statistic*
O'Herlihy	Official Series	0.05	0.66	−0.04		−0.001(T)	0.89	d=2.22
(1966)		(0.04)*	(0.26)	(0.04)		(0.0005)		
	New Series	0.01	0.28	0.002		−0.002(T)	0.64	d=1.67
		(0.09)	(0.56)	(0.09)		(0.001)		
Walsh	Official Series	−0.03	0.75	−0.10	0.10		0.87	h=0.45
(1974)		(0.006)	(0.16)	(0.04)	(0.19)			
	New Series	−0.02	0.48	−0.01	0.47		0.61	***
		(0.02)	(0.35)	(0.08)	(0.3)			
Geary &	Official Series	−0.03	1.45	−0.07			0.83	d=1.33
McCarthy		(0.01)	(0.23)	(0.05)				
(1976)	New Series	−0.04	1.73	−0.02			0.67	d=2.04
		(0.01)	(0.36)	(0.09)				
Bradley,	Official Series	−0.03	1.25	−0.10			0.84	d=1.38
Fitzgerald		(0.006)	(0.23)	(0.04)				
& McCarthy	New Series	−0.03	1.51	−0.08			0.69	d=2.01
(1978)		(0.01)	(0.39)	(0.07)				
Keenan	Official Series	−0.04	1.50	−0.07		0.31(E)	0.85	d=1.27
(1978)		(0.01)	(0.22)	(0.04)		(0.29)		
	New Series	−0.04	1.83	−0.01		0.19(E)	0.64	d=2.02
		(0.01)	(0.40)	(0.08)		(0.53)		
Lianos	Official Series	0.004		−0.22	0.82		0.73	h=0.26
(1970)		(0.004)		(0.11)	(0.15)			
	New Series	−0.005		−0.16	0.75		0.61	h=0.03
		(0.005)		(0.16)	(0.16)			

*The figures in parentheses are the standard errors of the estimates.

**T = time trend and E = change in total employment.

***The h test breaks down. The OLS residuals were regressed on the residuals lagged one period and all the predetermined variables in the equation. The coefficient of the lagged residuals was not significant indicating no autocorrelation problem.

when the new migration series is used. As noted in Walsh (1974) the presence of the lagged endogenous gives rise to a multicollinearity problem. This is confirmed again in the above by a Farrar-Glauber test and was evident from a simple correlation coefficient between the lagged endogenous and the income variable of over 0.8. Because of this the absolute values of the disequilibrium coefficient estimates should be treated with caution.

The remaining differences in coefficient estimates are attributable to different specifications of the income variable.[6] There is no *a priori* reason for choosing one specification of the income variable rather than the other, yet it is clear that the specification has effects on the coefficient values and so cautions against the use of point estimates in making general statements about the effects of income or the unemployment rate on migration. Given that the true distribution of the migration data over the intercensal years is unknown, it is disturbing to note that in switching the dependent variable from the official migration series to the new Electoral Register based series the proportion of explained variation falls in every case and the income coefficient is no longer significant whichever model is used. On the evidence presented in Table 4, it would be difficult to justify a preference for one particular equation. In choosing the best equation it is not sufficient that it explains a large percentage of the total variation in the migration series. Unless these can predict reasonably accurately, however, there will be problems in using one of them to endogenise migration flows in models of the Irish labour market.

V STABILITY AND FORECASTING

To examine the behaviour of the equation estimates over time all the above equations were re-estimated over the extended sample period 1954-1977. The coefficient estimates presented in Table 5 below are not corrected for autocorrelation. This does not appear to be a problem when estimates are based on the new migration series but arises in four equations when the official migration series is used. The Durbin-Watson statistic in O'Herlihy's case is in the uncertain region between the lower and upper bounds of the statistic at the 0.01 and 0.05 significance levels. In the equations of Geary and McCarthy, Bradley, Fitzgerald and McCarthy, and Keenan the DW statistic indicates positive autocorrelation at the 0.05 level and is in the uncertain range at the 0.01 level. The OLS standard errors and related statistics are biased when autocorrelation is present. At least in the latter cases it is

6. The following income variables for Ireland were used in the equations considered: average earnings per hour of men in Transportable Goods Industries (TGI) deflated by the CPI (O'Herlihy); average weekly earnings men in manufacturing industry deflated by CPI (Walsh, and Keenan); non-agricultural wages and salaries per hour deflated by personal consumer expenditure deflator from the National Accounts (Bradley, Fitzgerald and McCarthy and Lianos); hourly earnings in TGI persons aged 18 and over deflated by personal consumer expenditure deflator for the National Accounts (Geary and McCarthy). The UK earnings series in all cases is hourly earnings of male manual workers in the UK deflated by the Retail Price Index.

desirable to correct for autocorrelation. This correction itself posed a problem.

A second order autocorrelation adjustment using a Cochrane-Orcutt search procedure was first used. While this was found to sufficiently diminish the autocorrelation problem many elements of the equation changed dramatically. The results are available in Table A.2, below. The unemployment coefficient derived is at least two standard errors less in absolute value than the OLS estimate for each equation. The income coefficient also shifts considerably while the adjusted R^2 is no longer significant at the 0.01 level in the Geary and McCarthy, and Keenan equations. Although the RHO 1 parameter estimate is greater than one, the sum of the autocorrelation coefficients is satisfactory being less than one.

In order to examine the iterative process for convergence in this procedure the RHO parameters for twenty successive steps were examined for one of the equations. Given that the actual procedure involves many more calculations before the printed solution is arrived at any conclusions must be tentative. However, it appears that convergence may be occuring to two different and diverging sets of coefficient estimates. One set of estimates suggesting that the relationship described by the equations is at best weak and the alternative convergent point suggesting a higher adjusted R^2 and more significant coefficient estimates. Further evidence for this is suggested by the results using two other methods of autocorrelation correction, namely, the two-stage Durbin and two-stage Cochrane-Orcutt procedure, (see Maddala 1977). With the exception of the unemployment coefficient estimate in the Geary and McCarthy case these produce estimates which are broadly similar and are also similar to the estimates derived at each alternative stage of the full Cochrane-Orcutt iterative procedure.

All the estimated equations whose results are presented in Table 5, and Table A.2, were tested for stability using a standard F test. In nearly all cases the null hypothesis of zero instability was rejected at the 0.05 level suggesting that instability of coefficient estimates is a major problem. The two exceptions to this were the Bradley, Fitzgerald and McCarthy equations and the Lianos equation when estimated using the official migration series. This coefficient instability has implications for the forecasting power of each equation which are confirmed by the results presented in Table A.3, below. The forecasts are *ex post* forecasts based on the 1970 coefficient estimates together with actual values of the predetermined variables during the period 1970-1977. The percentage errors are very large in most years and the forecasts from the estimates based on the new migration series are at least no better than those derived using the official series. The Geary and McCarthy equation and the Keenan equation forecast with the same scale of errors when the equations are estimated by OLS so that their performance cannot be attributed to bad tracking by other equations in their respective models. It was noted above that the DW statistic for Keenan's equation estimated over the sample period 1954-1970 was in the uncertain region; however, if these estimates are corrected for autocorrelation both instability and large forecasting errors are still present. Undoubtedly the Bradley, Fitzgerald and

Table 5: *Coefficient estimates with standardised dependent variable (1954-1977)*

Author	*Migration series*	*Coefficients* Intercept	*Unemployment*	*Income*	*Lagged Endogenous*	*Other***	*Adjusted* R^2	*Durbin d or h statistic*
O'Herlihy	Official Series	0.09	0.18	–0.06		–0.002(T)	0.89	d=1.26
(1966)		(0.03)*	(0.21)	(0.04)		(0.001)		
	New Series	–0.01	0.16	0.06		–0.003(T)	0.70	d=1.69
		(0.06)	(0.38)	(0.06)		(0.001)		
Walsh	Official Series	–0.02	0.32	–0.04	0.70		0.90	h=1.07
(1974)		(0.01)	(0.12)	(0.02)	(0.14)			
	New Series	–0.01	0.36	–0.07	0.40		0.55	***
		(0.01)	(0.34)	(0.07)	(0.33)			
Geary &	Official Series	–0.03	1.34	–0.13			0.81	d=0.96
McCarthy		(0.01)	(0.25)	(0.02)				
(1976)	New Series	–0.04	1.45	–0.11			0.59	d=1.98
		(0.02)	(0.43)	(0.03)				
Bradley,	Official Series	–0.03	1.20	–0.11			0.85	d=0.96
Fitzgerald		(0.01)	(0.22)	(0.01)				
& McCarthy	New Series	–0.04	1.31	–0.11			0.65	d=2.08
(1978)		(0.01)	(0.40)	(0.02)				
Keenan	Official Series	–0.04	1.49	–0.10		0.32(E)	0.83	d=0.89
(1978)		(0.01)	(0.26)	(0.02)		(0.27)		
	New Series	–0.05	1.72	–0.08		0.61(E)	0.62	d=2.00
		(0.02)	(0.45)	(0.03)		(0.46)		
Lianos	Official Series	0.001		–0.05	0.91		0.87	h=0.63
(1970)		(0.002)		(0.06)	(0.09)			
	New Series	0.002		0.04	0.77		0.54	h=0.13
		(0.005)		(0.14)	(0.17)			

*The figures in parentheses are the standard error of the estimates.

**T = time trend and E = change in total employment.

***See note Table 4.

McCarthy equation performs best with more success in predicting the official migration series than the new alternative series, however, excluding the first period forecast the errors are large.

No instability was evidenced in the above equations for the earlier period 1954-1960 on the basis of a standard F test. Rather, in general, a much larger proportion of the variation in either migration series is explained over the period 1954 to 1977 than over the period 1960 to 1977, again suggesting that the problem arises because of the net inflow in the 1970s, rather than some structural change in an earlier period which is omitted from the above equations. Furthermore, the unemployment rate used in the above equations (excluding Walsh's) was derived using the new labour force estimates presented in Table 2 and the official unemployment figures as published in *The Trend of Employment and Unemployment.* Recent new estimates for 1975 and 1977 of 73,000 and 89,000 respectively should not be interpreted as implying a lower appropriate unemployment rate than that used here. The reason is that these new estimates are not consistent with the previous official estimates because of a change in classification and coverage in the new figures. If these latter figures were used to replace the old estimates there would be a severe discontinuity in the unemployment series, which cannot be eliminated because only these two observations are available for the entire sample period.

VI CONCLUSION

Neither the traditionally used Walsh type models nor the adjusted Lianos model can adequately explain the pattern of net migration between Ireland and Great Britain implicit in the official population estimates of the CSO or the alternative estimates based on the Electoral Register data. Because of the Whelan and Keogh (1980) results indicating a superior predictive capability from the latter type series, the new alternative migration estimates are preferred to the official CSO figures. However, one cannot be sure whether the models considered here are inadequate or whether an alternative unknown distribution of the Census migration estimates is the correct distribution and will lead to non-rejection of one of the above models as an explanation of migration behaviour. If one is satisfied with the migration series derived from the Electoral Register based population estimates then it is clear that at the moment the best available predictions of migration come from the use of the Whelan and Keogh technique. Furthermore, this technique is based on two variables which are likely to be exogenous to most labour market models, i.e., the ratio of the number on the Electoral Register in the census year to the latest available census population estimate and the number on the Electoral Register in each subsequent year. If the objective in building a model of the Irish labour market is to simulate for various policy changes using a historical data set then clearly a migration equation must enter the model. It is clear, however, that if one of the above equations is used the performance of the migration equation will be poor. If one of the objectives, however, is to predict the net migration flow over the intercensal period before census results are available then clearly the best forecasts will be the exogenous forecasts based on the Whelan and Keogh technique. If an alternative model is developed which better predicts the migration flows than the use of this technique, then it should be used to endogenise the forecast of these flows in labour market models.

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Table A.1.*

Year	Labour force ('000)	Total unemployment ('000)	Total employment ('000)	CSO Migration estimates ('000)	New migration series	Real non-agricultural earnings per hour (1970=100)	Real male earnings per hour in transportable goods industry (1970=100)
1953	1231	65	1166	–35.0	–48.3	47.5	57.3
1954	1228	65	1163	–43.0	–30.2	49.2	58.0
1955	1208	62	1146	–47.9	–51.5	50.6	59.5
1956	1188	63	1125	–41.8	–56.4	52.4	61.2
1957	1162	78	1084	–53.9	–56.9	52.1	60.2
1958	1141	73	1068	–39.3	–51.9	52.8	61.0
1959	1129	69	1060	–37.9	–37.9	55.0	62.8
1960	1118	63	1055	–42.1	–23.7	59.6	66.5
1961	1108	56	1053	–20.1	–22.6	63.5	69.0
1962	1114	56	1058	–10.9	–32.6	67.3	74.2
1963	1122	56	1066	–13.4	–11.6	69.2	74.7
1964	1124	53	1071	–19.4	– 3.4	74.1	78.8
1965	1120	51	1069	–20.5	–10.8	74.8	78.0
1966	1118	52	1066	–14.1	–15.4	78.0	82.0
1967	1116	56	1060	–15.9	–20.9	81.8	85.6
1968	1123	60	1063	–14.8	– 2.3	85.8	88.5
1969	1122	56	1066	– 8.2	– 6.1	91.8	93.2
1970	1118	65	1053	– 3.2	– 7.6	100.0	100.0
1971	1120	65	1055	4.4	6.5	105.1	106.3
1972	1128	71	1057	13.6	18.1	111.9	111.0
1973	1137	66	1071	15.5	16.5	119.3	118.4
1974	1148	64	1084	18.1	4.0	123.3	122.7
1975	1158	90	1068	16.9	7.1	131.6	129.1
1976	1176	108	1068	10.1	41.7	129.1	124.9
1977	1191	108	1083	7.3	–12.6	130.1	130.1

Real male weekly earnings in manufacturing industry (1970=100)	*Perecentage of non-agricultural insured persons unemployed*	*Real male earnings per hour in manufacturing industry (1970=100)*	*Percentage unemployed in Great Britain*	*Real male weekly earnings in manufacturing industry in the U.K. (1970=100)*
55.1	9.6	57.8	1.7	61.6
56.7	8.1	59.9	1.4	64.7
58.7	6.8	61.7	1.1	67.0
59.0	7.7	63.7	1.2	68.4
58.6	9.2	65.3	1.5	69.8
58.9	8.4	65.9	2.0	69.4
60.9	8.6	69.4	2.1	74.4
65.3	8.0	73.8	1.7	77.9
68.3	6.7	75.4	1.5	78.6
71.7	5.7	77.5	2.0	79.7
73.4	6.1	79.1	2.4	82.5
75.7	5.7	81.9	1.7	85.6
74.8	5.6	85.9	1.5	88.2
80.9	6.1	87.4	1.5	87.5
81.6	6.7	89.7	2.4	90.4
86.5	6.7	90.6	2.5	92.4
93.2	6.4	93.2	2.5	94.8
100.0	7.2	100.0	2.6	100.0
103.7	7.2	102.2	3.4	99.2
109.1	8.1	108.1	3.7	106.1
116.8	7.2	111.3	2.6	110.8
117.7	7.9	114.2	2.6	111.9
125.5	12.2	113.7	4.1	108.1
124.6	12.3	110.4	5.6	107.0
128.1	11.8	104.8	6.1	101.7

*Except where otherwise stated the above data refers to Ireland.

Table A.2. *Coefficient estimates derived using different autocorrelation corrective procedures*

Model	*Corrective procedure*	*Intercept*	*Unemployment*	*Income*	*Change in employment*	*RHO 1*	*RHO 2*	*Adjusted R^2*	*Durbin d statistic*
		Coefficients							
Geary and	Two Stage Durbin	–0.02	1.07	–0.12		0.61	–0.32	0.73	1.36
McCarthy		(0.01)	(0.27)	(0.12)					
(1976)	Two Stage Cochrane-	–0.02	1.13	–0.11		0.36	–0.02	0.69	1.06
	Orcutt	(0.01)	(0.29)	(0.02)					
	Cochrane-Orcutt	–0.001	0.57	–0.03		1.09	–0.15	0.20	1.94
	Search	(0.02)	(0.29)	(0.05)					
Bradley,	Two Stage Durbin	–0.03	1.03	–0.11		0.64	–0.38	0.81	1.55
Fitzgerald		(0.01)	(0.23)	(0.02)					
McCarthy	Two Stage Cochrane-	–0.03	1.07	–0.11		0.37	–0.09	0.79	1.16
(1978)	Orcutt	(0.01)	(0.25)	(0.02)					
	Cochrane-Orcutt	–0.01	0.66	–0.08		1.03	–0.24	0.40	1.92
	Search	(0.01)	(0.24)	(0.03)					
Keenan	Two Stage Durbin	–0.03	1.21	–0.10	0.19	0.69	–0.35	0.75	1.58
(1978)		(0.01)	(0.28)	(0.02)	(0.19)				
	Two Stage Cochrane-	–0.03	1.20	–0.09	0.27	0.48	0.01	0.68	1.15
	Orcutt	(0.01)	(0.31)	(0.02)	(0.21)				
	Cochrane-Orcutt	–0.01	0.83	–0.05	0.15	1.05	–0.18	0.29	1.96
	Search	(0.01)	(0.32)	(0.03)	(0.17)				

*The figures in parentheses are the standard errors of the estimates, these take into account the fact that the RHO parameters have been estimated.

Table A.3: *(1) Forecast for the post-1971 Census period (1971-1977) using the official series*

	Forecast migration level (official series) as a per cent of the labour force						
Model	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*
O'Herlihy (1966)	0.11	–0.15	–0.24	–0.52	–1.44	–0.28	0.95
Walsh (1974)	0.22	–0.29	–0.21	–0.77	–1.79	–0.81	0.87
Geary & McCarthy (1976)	0.27	–0.12	–1.15	–0.53	–1.47	–0.83	0.70
Bradley, Fitzgerald & McCarthy (1978)	0.40	0.19	–0.19	0.15	0.10	0.17	1.61
Keenan (1978)	0.35	0.13	–0.86	–0.53	0.07	–0.01	0.87
Lianos (1970)	–0.73	–0.83	–0.23	–0.82	0.47	0.57	1.92

Table A.3: *(2) Forecast for the post-1971 Census period (1971-1977) using the new series*

	Forecast migration level (new series) as per cent of the labour force						
Model	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*
O'Herlihy	–0.35	–0.49	–0.08	–0.19	–1.62	–1.26	–0.81
Walsh	–0.77	–0.98	–1.17	–1.60	–3.05	–3.05	–2.50
Geary & McCarthy	–0.06	–0.54	–1.78	–1.48	–3.05	–3.35	–2.62
Bradley Fitzgerald & McCarthy	0.53	0.25	–0.35	0.02	–0.35	–0.28	1.21
Keenan	–0.05	–0.33	–1.54	–1.17	–1.85	–1.80	–1.05
Lianos	–0.82	–0.99	–0.60	–1.13	–0.19	–0.20	0.74

Table A.3: *(3) Actual migration level as per cent of the labour force*

Series	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*
Official Estimates	0.39	1.21	1.37	1.59	1.47	0.87	0.62
New Estimates	0.58	1.62	1.49	0.35	0.62	3.60	–1.07