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Notes and Comments

What Went Wrong with Ireland's Recent Postcensal Population Estimates?*

J. G. HUGHES
The Economic and Social Research Institute

Introduction

The preliminary results of the 1979 Census (Ireland, 1979) indicated that the population was nearly 3.0 per cent greater than had been expected on the basis of the annual estimates of the population which were issued by the Central Statistics Office (CSO) for the years 1972 to 1978. The errors of closure for the years preceding each of the postwar censuses since 1951 are given in Table 1 from which it will be seen that the percentage error in 1978 was over twice as great as the previous largest error in 1950 and over five times as great as the average error for the years from 1950 to 1970.[1] Some international comparisons of errors of closure are given by Shryock *et al.* (1971, p. 106) and these show that the errors ranged from 1.1 per cent for West Germany in 1950 and 0.17 per cent for England and Wales in 1951 to 0.06 per cent for Australia in 1961. These figures and those shown in Table 1 indicate that there has been a significant deterioration in the reliability of Ireland's recent postcensal population estimates. Since reliable annual population estimates are needed by policy makers and planners, amongst others, to assist them in the preparation and evaluation of their programmes, it is important to know what went wrong with the recent estimates so that those who use them are alerted to possible sources of error in future estimates.

*This note utilises the results of an earlier study (Hughes, 1977). Conversations with Joe Durkan and Brendan Walsh encouraged me to pursue the question. Peter Mooney and this journal's referees provided helpful comments on an earlier draft. None of them, of course, are responsible for the contents or the views expressed herein.

1. The error of closure is the difference between the actual and expected population. Errors of closure cannot be calculated for census years since the CSO does not issue a population estimate for years in which a census occurs.

Table 1: *Postcensal and intercensal estimates of the population, various post-war years*

Year	(000's)			*Error of closure as a percentage of postcensal estimate*
	Postcensal estimate	*Intercensal estimate*	*Error of closure*	
1950	3,006	2,969	−37	1.2
1955	2,909	2,921	12	0.4
1960	2,834	2,832	−2	0.1
1965	2,855	2,876	21	0.7
1970	2,944	2,950	6	0.2
1978	3,221	3,311	90	2.8

Sources: *Quarterly Reports on Births, Deaths and Marriages,* June 1950, June 1955, June 1960, June 1965, Sept. 1970, June 1975, and Sept. 1978; *Report on Vital Statistics,* 1975.

Note 1: The postcensal figures for 1950 and 1955 and the intercensal figure for 1950 are mid-year estimates. All other figures refer to the position in April.

2: The postcensal estimates refer to years following the most recent census and they take that census into account. The intercensal estimates refer to intercensal years and they take the results of the censuses at the beginning and end of the period into account.

The obvious source of information about what went wrong is the Central Statistics Office since it has indicated that in preparing its estimates of the population for the years 1972 to 1978 "there was substantial underestimation of the level of net immigration" (*The Irish Times,* 14 Sept., 1979). However, the CSO has not given any further information on why this underestimation occurred nor has it ever published details of the method by which it estimates the net migration flows which it uses to derive its annual population estimates. It is, of course, prepared to give some indication of its method of estimating the population to those interested persons who make direct enquiries, but this information is so general, at least as far as information given in response to an earlier paper by the author (Hughes, 1977) is concerned, that one could not reproduce the annual population estimates on the strength of it. In addition, such information is given on a confidential basis and the use which one can make of it is extremely limited. In the absence of detailed published information from the CSO on the estimation of the population in each year, one can attempt to find out what went wrong with the recent postcensal estimates by trying to reconstruct these estimates from information which is in the public domain. This note, therefore, will set out the details of one method which the CSO may have used to derive its recent postcensal population estimates.

It is assumed, of course, that the discrepancy between the actual and expected population shown by the 1979 Census is not due to the inclusion in

the 1979 Census of people who were not enumerated in the 1971 Census for one reason or another. There has been widespread speculation that there was serious undercounting in the 1971 Census and that this accounts for the unexpected increase in the population since 1971. The CSO has said that there is no evidence of such undercounting in the 1971 Census and Walsh's (1979) analysis of the preliminary results of the 1979 Census supports this view. The possibility remains, of course, that both the 1971 and the 1979 Censuses are subject to error and that certain groups were omitted from both censuses. While every effort should be made to reduce such errors of omission to a minimum, their occurrence in both censuses would ensure that the unprecedented estimated increase in net immigration which took place during the period 1971–79 could not have been due to enumeration error.

The Population Components Method and Estimates of Annual Net Migration

The approach which the CSO uses to derive its postcensal population estimates is the population components method. This consists of adding the population on the date of the last census to the natural increase and net migration which have occurred since then to derive an estimate of the population in the month of April in each year. The estimating equation is

$$P_e = P_c + B - D + M$$

where P_e is the estimated population in April, P_c the population on census day, B the number of births, D the number of deaths and M net migration. Reliable information on births and deaths is available from the compulsory registration of these events. There are no direct measures of migration flows so the CSO has to make an estimate of this component before it can derive its annual population estimate. While precise details of how the annual net migration estimate is made have not been published, it has been indicated in a note which used to accompany the annual population estimates (Ireland, 1946) and in a recent paper by an official of the Central Statistics Office (Keating, 1976-77, p. 116) that the estimate is based on net passenger movement data. It is clear, therefore, that an answer to the question about what went wrong with the postcensal population estimates can only be provided by examining the relationship between the annual net migration estimates and the annual net passenger movement data. While the CSO does not publish its annual net migration estimates, possibly because they are the least reliable component of the annual population estimate, it is possible to derive these estimates from the published annual population figures by simply subtracting the population estimate for one year plus the natural increase from the population estimate for the following year. The information which one needs to do this and the net migration series which is implicit in the

postcensal population estimates for the years 1971/72 to 1977/78 are given in Table 2, together with the intercensal population estimates and their implicit net migration estimates for the same period. The intercensal population estimates are derived after each census by the CSO by allocating the net

Table 2: *Natural increase, postcensal and intercensal estimates of the population and their implied net migration series, 1971/72 – 1978-79 (000's)*

		Postcensal estimates		*Intercensal estimates*	
Year	*Natural increase*	*Mid-April population*	*Implied net migration April-March*	*Mid-April population*	*Implied net migration April-March*
1971/72	35.3	2,978	0.7	2,978[c]	10.7
1972/73	35.2	3,014	1.8	3,024	12.8
1973/74	34.7	3,051	3.3	3,072	16.3
1974/75	33.9	3,089	4.1	3,123	19.1
1975/76	34.6	3,127	0.4	3,176	15.4
1976/77	34.0	3,162	–4.0	3,226	9.0
1977/78	35.4	3,192	–6.4	3,269	6.6
1978/79	38.1	3,221	n.a.	3,311	15.9

Sources: Census of Population, *Preliminary Report*, 1979. *Report on Vital Statistics*, 1974. *Quarterly Report on Births, Deaths and Marriages*, 1974 to 1979. *The Irish Times*, 11 October, 1979.

[c] = Census figure; n.a. = not available.

migration which the census has shown to have occurred during the intercensal period to individual years. It will be seen from Table 2 that the postcensal estimate of the population in April 1978 was 3,221,000 while the intercensal estimate put the population at 3,311,000. The difference of 90,000 between the two estimates, it will be seen, is entirely due to net immigration. The postcensal population estimates implied a zero net migration balance over the period April 1971 to April 1978. The 1979 Census results showed that, far from there being a zero net migration balance over this period, there was a net inflow of migrants unparalleled in any intercensal period during the last century and possibly also for the last century and a half (see Hughes, 1977, pp. 1–2, for a discussion of this possibility). It is worth noting from Table 2 that while the CSO was unable to accurately predict the level of net migration during the years since the 1971 Census, it assumes that the pattern of annual net migration is similar in both its postcensal and intercensal estimates – the correlation between the two net migration series is .91 which is significant at the 5 per cent level.

It has already been noted that the CSO has not made public any specific details of the relationship between annual net migration and annual net

passenger movement which it uses to derive its postcensal population estimates. O'Herlihy (1966, p. 38), however, assumed that the net passenger movement data could be used as an approximate measure of annual net migration and he estimated a number of emigration equations in which the dependent variable was annual net passenger movement. Walsh (1968, p. 18) examined the relationship between the intercensal net migration figures and the net passenger movement figures for the intercensal periods 1951-56, 1956-61, and 1961-66 and he concluded that "the net passenger movement data are highly inaccurate estimates of net migration". Hughes (1977, p. 22) re-examined the relationship between census estimates of net migration and net passenger movement estimates and found that if passenger movement between the Republic and Northern Ireland was excluded from the passenger movement figures, the two estimates were almost identical for the intercensal periods 1951-56 and 1956-61, while the passenger movement estimate excluding cross-Border movement was much closer to the census estimate for the intercensal period 1966-71 than the passenger movement estimate which included cross-Border movement.[2] Hughes also established that the strongest association between the annual net migration estimates and annual net passenger movements is obtained when cross-Border movement is excluded from the passenger movement figures. The existence of a reasonably strong association between the annual net migration estimates and annual net passenger movements excluding cross-Border movement suggests the hypothesis that the CSO may have made its recent postcensal population estimates by using a net migration equation for some period ending in 1971, in which one of the explanatory variables is annual net passenger movement excluding cross-Border movement, to predict annual net migration for the years 1971/72 to 1977/78. The annual net migration estimate would then have been inserted into the population component equation to derive the annual postcensal population estimates.

Reproduction of CSO's Annual Net Migration Estimates

The hypothesis concerning the way in which the CSO may have made its recent postcensal estimates of annual net migration can be tested by regressing the annual net migration series (M) on the annual net passenger movement series excluding cross-Border passenger movement (NP) and other variables which the CSO might have used for various periods ending in 1971. One can then predict annual net migration for the years 1971/72 to 1977/78 using these regression equations and compare the resulting estimates with the

2. Separate figures are available on net passenger movement by sea and air between the Republic and Rest of the World and by rail and bus between the Republic and Northern Ireland. The cross-Border figures probably do not give an accurate picture of net migration between the two parts of Ireland because of passenger movement by private transport.

CSO's postcensal estimates to see if any of the regression equations enable one to reproduce the CSO's postcensal estimates. The other explanatory variables which were used in these tests were a dummy variable for 1967 (Z), a time trend (t) and time squared (t^2). The dummy variable was included because the net passenger movement figures in 1967 were affected by travel restrictions between Ireland and Britain due to an outbreak of foot and mouth disease in Britain. The time variables were included to see if the CSO's postcensal net migration estimates were affected by the strong downward trend which has been apparent in the annual net migration series since the late 1950s. The time periods for which regression equations including some or all of these variables were fitted were 1951-71, 1957-71, 1961-71, and 1966-71. A comparison of the migration estimates yielded by each equation for the years 1971/72 to 1977/78 indicated that the estimates which were nearest to the CSO's postcensal estimates for these years were given by the following equations:

Period: 1951-1971

$$M = \underset{(16.08)}{0.88}\ NP + \underset{(2.09)}{17.98}\ Z \qquad \bar{R}^2 = .93 \qquad SEE = 7.94 \qquad DW = 2.48$$

Period: 1966-1971

$$M = \underset{(3.76)}{0.75}\ NP + \underset{(1.42)}{13.09}\ Z \qquad \bar{R}^2 = .85 \qquad SEE = 3.99$$

There are no intercept terms in these equations since the proportional functional form was found to give the closest fit to the annual net migration estimates and it was also found to give the closest approximations to the CSO's postcensal net migration estimates when the fitted regression equations were used for prediction purposes. It should be noted that the coefficients of determination and the Durbin-Watson statistic for these equations have taken account of the adjustments which must be made when there is no constant term in the regression equation.

The predictions of annual net migration which are yielded by the two regression equations when the annual net passenger movement figures for the years 1971/72 to 1977/78 are plugged in are shown in Table 3, together with the actual net passenger movement figures. Both equations give net migration estimates which are strongly correlated with the CSO's postcensal estimates of net migration. The equation for the longer period, 1951-71, gives predictions which are somewhat less strongly correlated ($r = .871$) with the CSO's postcensal estimates than the predictions given by the equation for the shorter period, 1966-71 ($r = .966$). The absolute differences between the CSO's estimates and the predictions given by the two regression equations are greater in the case of the equation for the years 1951-71, although both

Table 3: *Net passenger movement excluding cross-Border movement and regression predictions of annual net migration, 1971/72 - 1977/78*

Year	Net passenger movement (000's)	Regression predictions of net migration using equation for	
		1951-71 (000's)	1966-71 (000's)
1971/72	3.8	3.3	2.9
1972/73	1.2	1.1	0.9
1973/74	12.5	11.0	9.4
1974/75	8.9	7.8	6.7
1975/76	−2.3	−2.0	−1.7
1976/77	−8.5	−7.5	−6.4
1977/78	−5.8	−5.1	−4.4

Sources: *Irish Statistical Bulletin,* 1969 to 1978, *Economic Series,* 1977-1979, 31 August, 1979, and regression equations in text.

equations predict that total net migration over the period 1971/72 to 1977/78 would be approximately zero. The regression results, therefore, indicate that the pattern of annual net migration during the years 1971/72 to 1977/78 may have been estimated by the CSO on the basis of a proportional relationship between annual net migration and annual net passenger movement either for the period 1951-71 or 1966-71. The equation for the period 1966-71 would give predictions for individual years which are closer to the actual postcensal estimates than predictions using the equation for the period 1951-71. It is clear from Tables 2 and 3, of course, that the regression estimates differ significantly from the offical estimates in certain years. Thus, there appear to be other determinants of the CSO's postcensal estimates which have not been detected in the course of trying to reproduce the CSO's figures by regression methods. It may be, of course, that the CSO used some arithmetic rule of thumb to derive the recent postcensal estimates and that this rule is not detectable by the regression method used in this note. Recognition of this possibility does not undermine the present results since the regression approach has yielded net migration estimates which closely approximate the official estimates, however they were derived. It can, therefore, be concluded that what went wrong with the recent postcensal population estimates appears to be that the CSO relied to a considerable extent on the annual net passenger movement figures excluding cross-Border movement as an accurate indicator of annual net migration when the relationship which undoubtedly existed between the two series in the past had broken down. It has already been noted that the census and net passenger movement estimates excluding cross-Border move-

ment were almost identical for the intercensal periods 1951-56 and 1956-61. Since then, however, the figures have been as follows:

	Census estimate	*Net passenger movement estimate (excluding cross-Border movement)*	*Difference as percentage of census estimate*
1961-66	−80.6	−125.7	55.9
1966-71	−53.9	−82.7	53.4
1971-79	+106.8	+15.8	85.2

It will be seen that the net passenger movement estimate overestimated the net outflow in the intercensal periods 1961-66 and 1966-71 by about the same percentage while it significantly underestimated the net inflow in the most recent intercensal period. If the percentage difference between the census estimate and the net passenger movement estimate of intercensal net migration had remained relatively constant, as it did for the intercensal periods 1961-66 and 1966-71, one could probably continue to use the net passenger movement data as an indicator of annual net migration once one had discovered the scaling factor which one should apply to the net passenger movement estimate. The errors of closure shown in Table 1 for 1965 and 1970 might have been affected by such a process. However, it is clear from the large increase in the percentage difference between the census and net passenger movement estimates for the period 1971-79 relative to the preceding intercensal period that the assumption of a predictable relationship between the level of annual net migration and annual net passenger movement is no longer tenable. Some other method of estimating annual net migration, and hence the current population, should be found. Durkan (1979) has suggested a number of ways in which direct information on migration flows might be collected (e.g., by sample surveys or by extracting information on previous residence from social security records in Ireland, Britain and a number of other countries). In addition to providing information on the level of annual net migration, direct enquiries would provide a check on the accuracy of the net passenger movement data as an indicator of the trend in net migration from year to year. In the absence of any other information on annual net migration, the CSO has continued to use the passenger movement data as an indicator of trend as has already been noted. The use of these data as an indicator of the trend in annual net migration is given some support by the work of Walsh (1974) and Geary and McCarthy (1976) in which it was established that annual net migration is responsive to changes in unemployment rates and wage rates in Ireland and Britain. The annual

net migration series does, therefore, appear to reflect the kind of rational behaviour one would expect on the basis of labour market models. However, since there is always some likelihood of the observed relationship between migration, unemployment and wages having arisen by chance, it is important that some independent evidence on the reliability of the net passenger movement data as an indicator of trend be provided in view of the unreliability of the data as an indicator of the level of annual net migration.

Conclusions

The annual postcensal population figures for the years 1972-78 appear to have been incorrectly estimated because the Central Statistics Office was unable to track the scale of the net immigration which took place in each year since the 1971 Census. This failure seems to have stemmed from the CSO's use of an indicator (i.e., annual net passenger movement excluding cross-Border movement) of the level of annual net migration which failed to pick up the magnitude of the reversal which had taken place in Ireland's migration pattern during the 1970s.

The question which now arises is, how are annual population estimates to be made in the future? The CSO has said in a press release on 10 October, 1979 that it had prepared internal population projections which were in line with the population figures revealed in this year's census and that "account was taken of the trends shown during the period 1971-1979 by a number of relevant indicators – the number of persons on the Register of Electors . . . , the number of Children's Allowances . . . and net passenger movements . . .". Apart from the fact that it is little consolation to be told, as Walsh (1979, p. 4) has noted, "that the CSO had available current estimates much more accurate than the ones actually published!", one would like to know how the internal estimates were made because Whelan (1977) has pioneered the development of a method of estimating the annual population which uses only census and Electoral Register data and which gave the most accurate pre-1979 Census estimates of the annual population.

Pending publication of the details of the method which the CSO is currently using to make annual population estimates or the adoption of direct methods of measuring migration flows, there are a number of other approaches to the question which users of annual population estimates might like to keep in mind. The Electoral Register method, already mentioned, seems very promising. Another possibility would be to use housing stock and housing completions data in conjunction with information on headship rates to derive an annual population estimate.[3] Blackwell and Keehan (1976) have used a similar approach to infer dwelling needs from population projections.

3. I am indebted to one of this journal's referees for this suggestion.

These methods attempt to estimate the population without any reference to the net migration component, although net migration estimates would, of course, be implicit in any estimates which are made. One could also attempt to estimate annual net migration by using migration equations similar to those reported in Walsh (1974) and Geary and McCarthy (1976). The method would be to plug in the known unemployment and wage variables each year, get a net migration estimate and insert this into the population component equation to derive an annual population estimate. All of these and other methods (e.g., the use of data relating to different cohorts in the population such as school enrolments and labour force statistics) are worth investigating if reliable annual population estimates are to be produced in the future.

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