The Distribution of Personal Wealth in Ireland—A Comment

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Précis: This paper focuses attention on two aspects of P. M. Lyons' work on the distribution of personal wealth in Ireland. First, using a statistical procedure devised from some well-known results, the validity of his assumption that in 1966 nearly two-thirds of the Irish adult population owned no wealth is examined. Serious doubt is cast on the assumption and, hence, on his estimate of the Irish distribution of wealth. An alternative assumption is therefore suggested and a new wealth distribution estimated. Being derived from Lyons' own data which have already been heavily criticised, no special claim to accuracy is made for the new estimate. This is not so much the fault of Lyons as of the Authorities for the grossly inadequate situation with regard to official data on wealth in Ireland. Secondly, and quite apart from the previous issue, Lyons' comparison of the distribution of wealth in Ireland with that in the United Kingdom is examined critically, and new comparisons are presented which suggest that while the distribution of wealth in Ireland may well be more inequitable than that in the UK, the difference is not nearly so great as Lyons' work suggests.

I

In a recent article, Lyons (1975) draws attention to several deficiencies inherent in the use of the mortality multiplier approach to the estimation of the size distribution of personal wealth. Concentrating on just one of these, namely, t h possibility of inaccurate mortality multipliers, he then analyses the impact of the application of alternative assumptions about mortality multipliers to his 1966 Irish estate duty data. The resulting estimates of the distribution of wealth do not vary appreciably with the different sets of mortality multipliers. Hence, it would seem that the conclusions concerning the distribution of wealth in Ireland which emerged from Lyons' original (1972) study were not influenced by the choice of mortality multiplier.

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However, as Lyons points out, this extension of his work by no means proves that his original findings were correct. For they may have been influenced by the other deficiencies of the basic approach which he mentions but does not investigate, such as the possibility that the deceased and their estates were not representative of the population of wealth-owners and their wealth.[1] Moreover, they may well have been influenced by considerations which Lyons does not mention. One such consideration, which the present authors feel merits close attention, concerns Lyons' own assumption that all of the estates of deceased persons which were not examined by the Estate Duty Branch of the Revenue Commissioners (and hence not examined by him) were of zero value. It is this assumption that is the basis of the "conclusion" of Lyons that in 1966 "Nearly two-thirds of the adult population owned no wealth . . ."; that ensures that "There is substantial inequality in the distribution of wealth"; and that accounts for the ". . . unusual path of the Irish Lorenz curve . . ." for wealth ownership. In view of the importance of reliable information on the distribution of wealth, it requires to be demonstrated, as much as does the acceptability of particular mortality multipliers and the representativeness of deceased persons, that the zero wealth assumption is valid for Ireland, or is at least a good approximation, producing no undue distortion of the estimate of the distribution of wealth. Otherwise, certain of the findings of Lyons concerning the distribution of wealth lose a great deal of their value; indeed, it could be argued that they remain little more than assumptions.

The main purpose of the present paper is to examine the acceptability of the zero wealth assumption. In Section II, the degree of distortion produced by the assumption is assessed statistically. The result casts serious doubt on the validity of the assumption; an alternative assumption is therefore suggested. In Section III, Lyons' original comparison of the distribution of wealth in Ireland with that in the United Kingdom is questioned, and a new comparison is presented which uses a measure of the inequality in the distribution of wealth in Ireland based on the findings of Section II. The conclusion emerges that while the distribution of wealth in Ireland appears to be more inequitable than that in the United Kingdom, the difference is not nearly so great as is suggested by the earlier work of Lyons.

II

The estate duty data that were used by Lyons to estimate the distribution of personal wealth in Ireland covered only about 37 per cent of the estates of the adult persons who died in the period considered.[2] It was necessary, therefore, for

1. Lyons is currently investigating the representative nature of the deceased persons covered by his estate duty data (see Lyons (1975), p. 338, footnote 2). One assumes that his investigation includes an assessment of the extent of such things as evasion of estate duty, undervaluation o assets, and omissions of various assets from the estate duty returns, issues which are discussed in detail by Atkinson (1972), Lyons (1974), Polanyi and Wood (1974), and Geary (1975).

2. There were 32,956 adult deaths in 1966; however, only 12,250 estates were examined by the Estate Duty Branch of the Revenue Commissioners (see Lyons (1972), p.161).

Lyons either to ignore the many unexamined estates, which would have meant that the distribution of wealth produced by the mortality multiplier method would have been based on an estimated number of wealth-owners considerably less than the total adult population, or to make an assumption about their values. Lyons chose to make an assumption, namely, that all of the unexamined estates, hence all of the wealth-holdings of nearly two-thirds of the population, had a net value of zero.[3] His justification for this seems to have been that compared with an assumption of a value of fifty pounds for each unexamined estate, the zero wealth assumption did not appreciably affect the estimate of the total amount of personal wealth in Ireland (see Lyons, 1972, p. 167). It does not necessarily follow from this, however, that estimates of the *distribution* of wealth are correspondingly insensitive to different assumptions about the values of the unexamined estates, especially when the proportion of such estates is so high. Yet Lyons did not investigate this. Consequently, doubt exists about the accuracy of his estimate of the distribution of wealth, at least over the lower wealth categories; for the unexamined estates were small estates whose value did not exceed £5,000.

In contrast, less doubt would seem to surround Lyons' estimate of that part of the distribution relating to large wealth-holdings; for the estates that were covered by the estate duty data included all of the large estates, that is estates whose value exceeded £5,000. Indeed, given his recent findings about mortality multipliers, and assuming that the estates of the deceased are representative of the wealth of the living,[4] Lyons' estimate of the distribution of wealth over the higher wealth categories may be quite accurate. For the purposes of this paper this assumption is accepted since it provides a basis for examining the validity of the zero wealth assumption. The basis is to be found in the remarkable stability of the form of wealth distributions.

The size distribution of personal wealth, like the size distributions of various other economic variables, is skew and persistently exhibits the same sort of characteristics for different countries and different time periods.[5] Consequently, it lends itself to mathematical description. Two important functions which have been used for the description of wealth distributions are the so-called Pareto law and the lognormal distribution.

The Pareto law may be written as

$$n(w) = \alpha w^{-\beta}, \tag{1}$$

where $n(w)$ is the number of persons with wealth exceeding the value w, and α and β are constants. $n(w)$ will, by its definition, decrease monotonically with

3. In the United Kingdom the practice is to ignore unexamined estates. This difference in approach is discussed in Section III.

4. It seems reasonable to the present authors to retain the assumption that the deceased are representative, at least until such time as Lyons reports on his study of the issue.

5. See Cramer (1971), p. 46. Incidentally, it was probably because Lyons' estimated distribution did not conform with expectations based on this stable form that he described his Lorenz curve representation of it as "unusual".

increasing w. The great drawback of the Pareto law is that it applies strictly only to wealth-holdings exceeding a certain lower limit, say w^*. In practice, this limit is usually quite high, so that the law applies to a minority of wealth-owners. Despite this, the Pareto law is widely accepted, and the estimated value of β is used as a measure of the inequality in the distribution of wealth, a high value of β corresponding to a steeper decline of $n(w)$ with increasing w, and thus in some sense to a greater degree of wealth equality.

The lognormal distribution may be written as

$$F(w) = N(\log_e w; \mu, \sigma^2) = \int_{-\infty}^{\log_e w} \frac{1}{\sigma\sqrt{2\pi}} \exp\left[\frac{-1(x-\mu)^2}{2 \quad \sigma^2}\right] dx, \qquad (2)$$

where $F(w)$ is the proportion of persons with wealth not exceeding the value w, and μ and σ^2 are, respectively, the mean and variance of the distribution of the natural logarithm of wealth. While the Pareto law applies to a minority of high wealth-holdings alone, the lognormal distribution applies to virtually the full wealth range, although in practice discrepancies often occur in the tails of the distribution. When the lognormal distribution is used, its parameter σ is used as the measure of the dispersion or inequality of the distribution of wealth.

Cramer (1971, p. 71) shows how the relationship between the parameter β of the Pareto law and the parameter σ of the lognormal distribution can be approximately established by equating the constant $-\beta$ to the corresponding elasticity $\frac{d \log_e(1-F(w))}{d\log_e w}$ of the lognormal distribution, evaluated at some convenient point in the upper wealth range for which the Pareto constant is representative. Using a value of wealth of $w = e^{\mu+\sigma}$, which corresponds to the 84th percentile of the wealth distribution, Cramer obtains the relationship

$$\beta = \frac{1{\cdot}525}{\sigma}, \qquad (3)$$

which, he asserts, works well as an approximation to the correspondence between the two parameters.

This well-known analytical base, together with an accurate estimate of the upper part of the wealth distribution, can be exploited to formulate a statistical test of the validity of the zero wealth assumption as follows. First, a value for w^* can be determined and the Pareto constant β evaluated for the part of the distribution covering wealth-holdings in excess of the value w^*. Secondly, the corresponding value of the lognormal parameter σ can be obtained using equation (3). Thirdly, a value for σ can be calculated using the remaining part of the distribution below w^*. If the lower part of the distribution has been obtained using an assumption about the values of certain unexamined estates, the calculated

value of σ, σ_c say, will clearly be influenced by that assumption. However, on the null hypothesis H_0 that the assumption about the unexamined estates is valid and causes no undue distortion of the distribution, there will be no statistically significant difference between σ_c and the value of σ, σ_p say, predicted using (3). Now σ_p is obtained from data which is independent of that used to obtain σ_c. Furthermore, both σ_p and σ_c relate to normal populations. Finally, therefore, standard statistical techniques can be used to test the significance between them. If they are found to be statistically different, then H_0 should be rejected and the alternative hypothesis H_A that there is significant distortion in the lower part of the distribution accepted. In such a case, it would seem reasonable to conclude that the distortion is due to the invalidity of the assumption made about the unexamined estates.

This procedure was carried out by the present authors using the data contained in Table 6.2 of Lyons (1972, p. 168), of which the figures for large wealth-holdings are considered to be accurate. By inspection, after plotting the values of $n(w)$ and w on double logarithmic graph paper, a value of $w^* = £15{,}000$ was chosen. The value of the Pareto constant β for the distribution of wealth in Ireland above this value of w^* was found, using an ordinary least squares regression of $\log_e n(w)$ on $\log_e w$, to be 1·90 to two places of decimals.[6] Equation (3) then yielded $\sigma_p = 0{\cdot}803$, and direct computation gave $\sigma_c = 1{\cdot}443$.[7] The difference between these two values was assessed by means of the variance ratio $\sigma_c^2/\sigma_p^2 = 3{\cdot}229$ which is distributed as Fisher's F with 10 degrees of freedom in the numerator and 15 degrees of freedom in the denominator. Since the ratio is significantly different from unity at the 5 per cent probability level, the null hypothesis H_0 was rejected in favour of the alternative H_A. In view of the remarks in footnote 7, the degree of distortion is probably somewhat greater than is actually suggested by the difference between σ_p and σ_c. It was concluded that Lyons' zero wealth assumption produces an estimate of the lower part of the distribution of wealth in Ireland that appears to be considerably distorted and inconsistent with the more accurate estimate of the upper part of the distribution, and therefore is not a valid assumption to make.

The question then arose as to what might constitute a more appropriate assumption about the value of the unexamined estates and *pari passu* of the wealth of the "residual" two-thirds of the population. An answer to this question was obtained using the intermediate results produced in carrying out the test of the assumption of zero wealth. σ_p, having been derived from information that is

6. The detailed regression results are given in the Appendix.

7. In calculating σ_c Lyons' zero wealth assumption could not be used in a strict sense since the logarithm of zero is indeterminate. Instead, a value of £1 was used as an approximation. This, together with the fact that the part of the wealth distribution for wealth from £5,000 to £15,000 is probably quite accurate, biases the test procedure in favour of Lyons' assumption, making it more difficult to demonstrate that the assumption produces distortion. It should also be noted that ignoring the data for wealth-holdings over £15,000 when calculating σ_c produces no appreciable changes in the values for F(w).

regarded as accurate, was taken to be of the correct order of magnitude for the lognormal description of the Irish wealth distribution. The problem then was to determine that value of average wealth per person for the residual population which, together with the figures for those shown by Lyons as possessing positive wealth less than $w^* = £15{,}000$, would give a value of $\sigma_c' = \sigma_p = 0{\cdot}803$. This value was calculated to be about thirty pounds for each of the 1,120,278 persons in the residual.[8] As Lyons (1972, p. 167) points out, this kind of magnitude is not sufficient to affect the estimate of the total amount of personal wealth in Ireland by very much, but as has been shown in this Section, it is sufficient to have a statistically significant effect on the form of the distribution of wealth.

III

A final issue for consideration concerns the impact of the modified estimate of the distribution of wealth implied by the results of the previous Section on Lyons' original conclusions about the distribution of wealth in Ireland and his comparison of the wealth distributions for Ireland and the United Kingdom. Because the thirty pounds wealth assumption for each of the persons in the residual class does not, despite its significance for the form of the wealth distribution, affect the estimate of the total amount of personal wealth appreciably, it does not markedly affect the conclusion of Lyons that there is substantial inequality in the distribution of wealth in Ireland. Specifically, the thirty pounds assumption gives a result that suggests that the wealthiest 5 per cent of the Irish population owns about 70 per cent of the wealth, as compared with Lyons' figure of 72 per cent. Furthermore, it suggests that the bottom 65 per cent of the population, rather than owning no wealth, owns about 2 per cent of the wealth.

It is anticipated that many will argue, perhaps along the lines of Polanyi and Wood (1974) or Smith (1972) and McCarthy (1972), that the value of thirty pounds produced by the technical exercise of Section II is too low. In this connection it should be emphasised that the figure of £30, like the values of σ_p and $\hat{\beta}$ which produced it, is subject to certain confidence limits. When these confidence limits are used, it transpires that a maximum value of approximately £150 for the average wealth of each residual class member is also consistent with the value of σ_p obtained using equation (3). This figure suggests that the wealthiest 5 per cent of the population owns about 66 per cent of the wealth, and that the poorest 65 per cent owns about 7 per cent of the wealth. Nonetheless, the conclusion appears to stand that personal wealth in Ireland is distributed very inequitably.[9]

8. The nature of the calculation is outlined in the Appendix.

9. It is noteworthy that further increases in the value of wealth assumed to be owned by the residual group do not appreciably affect the proportion of wealth owned by the wealthiest 5 per cent of the population. For example, an assumption of £300 still leaves the wealthiest 5 per cent with 62 per cent of the wealth.

A useful means of assessing the degree of inequality in the distribution of wealth is by comparison with other countries. Lyons compares his estimate of the Irish distribution with the distribution of wealth in the United Kingdom. His Lorenz curve representations of the distributions suggest a considerably greater inequality of wealth in Ireland than in the UK (see Lyons, 1972, p. 170, Fig. 6.1). This difference can be conveniently expressed using the well-known Gini coefficient, although the limitations of such measures of inequality as this should be borne in mind. The Gini coefficient for Lyons' Irish Lorenz curve is 89·9 per cent; for the UK Lorenz curve it is 65·5 per cent. The difference is indeed substantial.

However, quite apart from the issues so far raised in the present paper, it can be argued that Lyons' comparison is invalid. The Lorenz curve for the UK is based on information derived using a different approach from that used by Lyons. Whereas Lyons makes his zero wealth assumption about the estates that were not examined by the Revenue Commissioners, the UK Inland Revenue authorities ignore their unexamined estates. The UK method produces a distribution which ignores approximately 50 per cent of the undoubtedly poorer part of the population, and hence a Lorenz curve which indicates a somewhat more equitable wealth distribution than is probably the case. On the other hand, as has been shown in Section II, the Lyons method, because of its zero wealth assumption, produces a Lorenz curve that overstates the degree of inequality. The fact that the Lorenz curves of the two different approaches are not strictly comparable, clearly exaggerates the difference between the inequality of wealth in Ireland and the UK.

More meaningful comparisons can be made by modifying the Irish and/or the UK Lorenz curve in one of three ways. First, both curves could be drawn using the UK approach, that is ignoring the residual group entirely; secondly, both could be drawn using Lyons' method, including the residual group under the zero wealth assumption; and thirdly, both could be drawn using the residual group but employing a different, and perhaps more realistic, assumption about the value of its members' wealth.

Each of these methods was examined by the present authors. The first yielded a Lorenz curve for Ireland whose Gini coefficient was 70·8 per cent, and a Lorenz curve for the UK whose Gini coefficient was 65·5 per cent; the second produced curves whose Gini coefficients were 89·9 per cent for Ireland and 82·8 per cent for the UK.[10] Since the first method tends to underestimate, and the second tends to overestimate, the inequality of the wealth distribution, these two sets of Gini coefficients may be viewed as upper and lower limits to the measure of inequality.

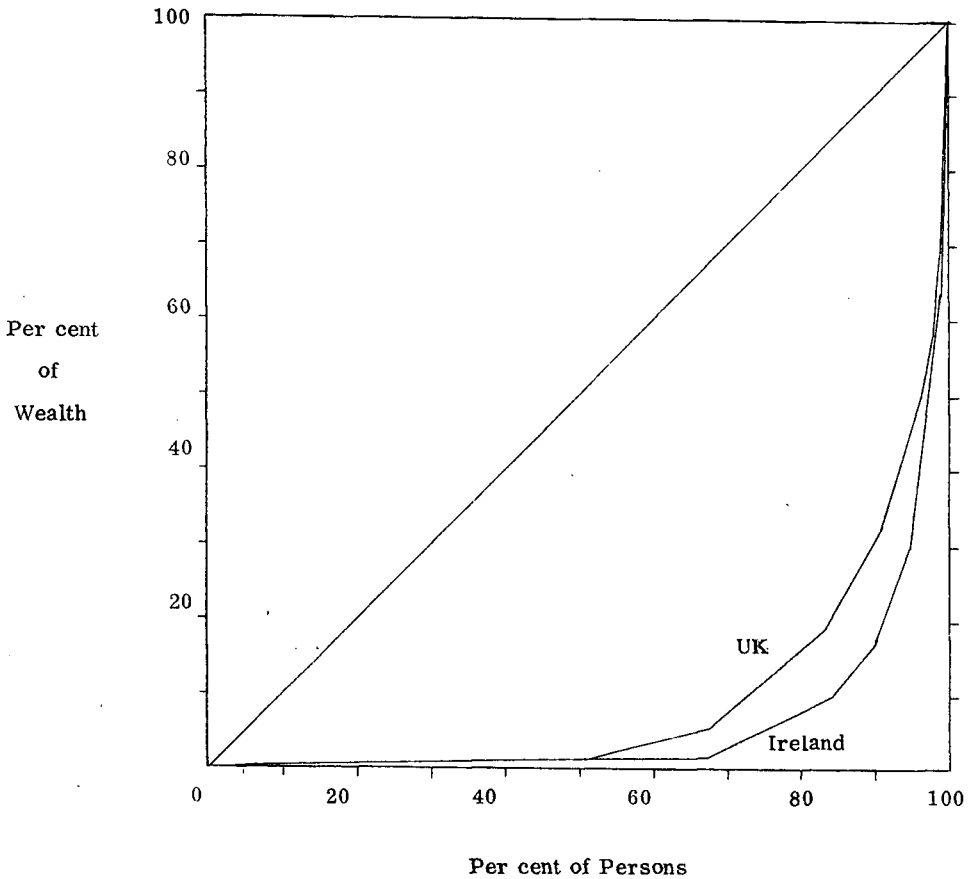
Two variants of the third method were used, each employing findings from

10. The actual Lorenz curves are given in the Appendix. Incidentally, these Gini coefficients provide an additional insight into the illogicality of Lyons' method of comparison. Had he used the UK method to determine his Lorenz curve, and had the UK Inland Revenue used a zero wealth assumption to determine theirs, his conclusion concerning the inequality of the distribution of wealth in Ireland and the UK would have been reversed, since the Irish Gini coefficient would have been 70·8 per cent and the UK Gini coefficient would have been 82·8 per cent.

FIGURE 1: *Lorenz curve representation of the distribution of wealth in Ireland and the United Kingdom.*

Assumed value of residual wealth per person:
Ireland—£30; UK—£45.

Gini coefficient (%):
Ireland—87·9; UK—81·6.



Section II. For the Irish Lorenz curve, the residual values for wealth of £30 per person and £150 per person were adopted. For the UK curves it was thought desirable to try and allow for the likely difference in average wealth-holdings suggested by the higher GDP *per capita* in the UK. Accordingly, the figures of £30 and £150 were inflated by a scale factor given by the ratio of the 1966 value of GDP *per capita* in the UK to the corresponding real GDP *per capita* figure for Ireland, adjusted slightly for the fact that the UK residual group constitutes a smaller percentage of total population than does the Irish residual. Thus for the UK residual group, values of wealth of £45 and £225 per person were used. The Lorenz curves for the lower residual wealth figures, which are depicted in Figure 1, gave Gini coefficients of 87·9 per cent for Ireland and 81·6 per cent for the UK; for the higher residual wealth figures they gave Gini coefficients of 80·9 per cent for Ireland and 76·1 per cent for the UK.[11]

Whereas the difference in the Gini coefficients for Ireland and the UK derived from Lyons' Lorenz curves is 24·4 per cent, none of the new comparisons whose results are presented here yield Gini coefficients for the two countries that differ by more than about 7 per cent. Moreover, the differences produced by the different methods are all of the same lower order. The conclusion seems clearly to be that while the inequality in the distribution of wealth in Ireland is certainly substantial, the difference between the inequality in Ireland and that in the UK is not nearly so great as Lyons suggests.

Finally, it should be stated that no special claim to accuracy is made for the new estimates of the distribution of wealth in Ireland given in this paper. Due to the heavy criticism that has been made of the data of Lyons which were used in the study (see McCarthy, 1972, and Smith, 1972) the inferences that have been made are of an inevitably provisional nature. Furthermore, there are no suitable alternative data. Despite the work of Lyons, and the discussions about data that it engendered, there remains a fundamental paucity of official statistical information on wealth in Ireland. Indeed, in view of the data problem, which necessitates the kind of statistical speculation about the degree of wealth inequality described in this paper, it seems rather remarkable that important legislation on capital taxation has just passed through the Oireachtas so apparently smoothly. In addition to the methodological criticisms of Lyons' work, therefore, the present paper should be viewed as a plea for a radical improvement of the situation which obtains with regard to official statistics in the area of Irish wealth (and income) distribution.

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11. The Lorenz curves for the higher residual wealth values are given in the Appendix.

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APPENDIX

(i) *Estimation of the Pareto constant, β*

Taking logarithms of both sides of equation (1) above gives the following log-linear representation of the Pareto law:

$$\log_e n(w) = \log_e a - \beta \log_e w. \tag{A.1}$$

Using the data for Ireland contained in Table 6.2 of Lyons (1972, p. 168), and a lower wealth limit, w^*, of £15,000, the ordinary least squares estimate of equation (A.1) is

$$\log_e n(w) = 6{\cdot}772 - 1{\cdot}898 \log_e w \; ; \tag{A.2}$$

the t value for the regression coefficient, $\hat{\beta}$, is $-40{\cdot}49$, and R^2 is 0·995.

It should be mentioned that since the $n(w)$ are cumulative figures, successive observations are not independent, and the representation that was adopted suggests a somewhat better fit than is in fact the case. Even so, the agreement of the data for wealth above w^* with the Pareto law is striking.

(ii) *Calculation of average wealth for the residual population*

Let z_i denote the logarithm of the midmark of the ith wealth class of the 10 wealth classes below $w^* = £15{,}000$ in Table 6.2 of Lyons (1972, p. 168), and f_i denote the number of persons in the ith wealth class. Let z_r denote the logarithm of the average wealth per person in the residual population, and f_r denote the number of persons in the residual. Then, adapting the standard formula, the standard deviation σ_c' can be written as

$$\sigma_c' = \sqrt{\frac{f_r z_r^2 + \sum_{i=1}^{10} f_i z_i^2}{f_r + \sum_{i=1}^{10} f_i} - \left[\frac{f_r z_r + \sum_{i=1}^{10} f_i z_i}{f_r + \sum_{i=1}^{10} f_i}\right]^2} \tag{A.3}$$

Now f_r and the f_i and z_i ($i = 1, 2, \ldots 10$) are known from Lyons, Table 6.2. Lyons assumed that z_r was equal to zero. The aim here is to calculate z_r given the value for σ_c of 0·803, that is the value which is equal to the value of σ_p obtained from the estimate of the Pareto constant β using equation (3). Substituting from Lyons' Table 6.2 and transforming equation (A.3) gives the following quadratic equation in z_r:

$$0{\cdot}2243 z_r^2 + 0{\cdot}0127 z_r - 0{\cdot}5399 = 0{\cdot}0. \tag{A.4}$$

Routine solution of (A.4) for z_r gives a value whose antilogarithm is approximately £30.

(iii) *Lorenz curves for alternative estimates of the distribution of wealth in Ireland and the UK*

Diagrams I and II, respectively, contain Lorenz curves which depict the lower

and upper limit of inequality of the estimated distributions of wealth for Ireland and the UK.

Lyons' Lorenz curves for Ireland and the UK correspond, respectively, to the curve for Ireland in Diagram II and the curve for the UK in Diagram I.

It should be noted that the difference between the Irish and UK Lorenz curves is affected by the fact that the UK residual is a smaller percentage of the total adult population than is the Irish residual. This effect is especially noticeable in Diagram II. For Diagram III, like Figure I, some attempt was made to allow for the effect.

DIAGRAM I: *Lower limit of inequality.*

Residual population ignored:
Ireland—1·120 million persons (approximately 65% of the adult population).
UK—18·032 million persons (approximately 50% of the adult population).

Gini coefficient (%):
Ireland—70·8; UK—65·5.

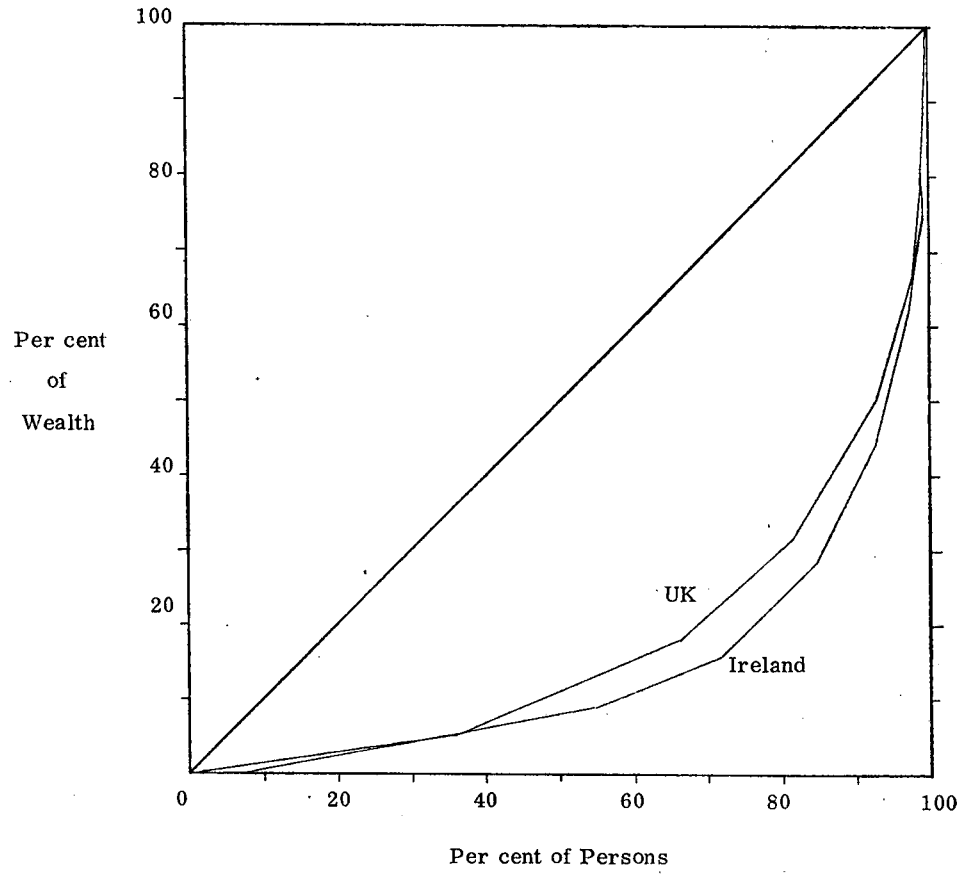

DIAGRAM II: *Upper limit of inequality.*

Assumed value of residual wealth per person:
Ireland—£0·0; UK—£0·0.

Gini coefficient (%):
Ireland—89·9; UK—82·8.

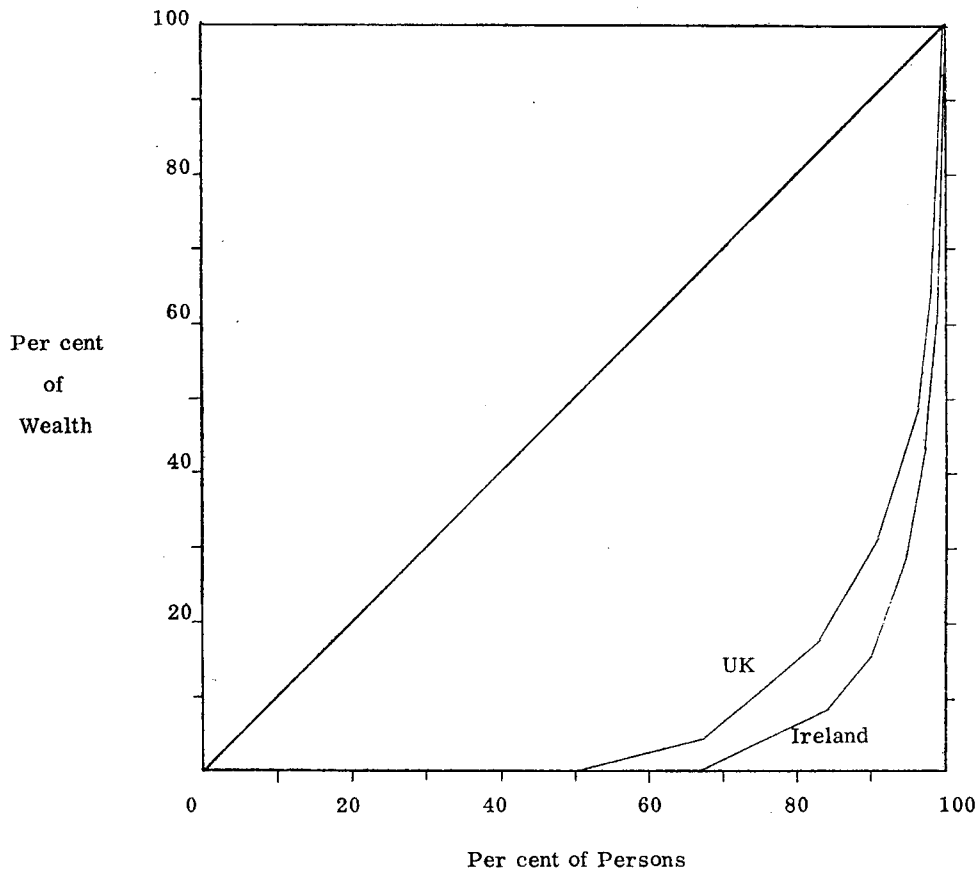

DIAGRAM III:

Assumed value of residual wealth per person:
Ireland—£150; UK—£225.

Gini coefficient (%):
Ireland—80·9; UK—76·1.