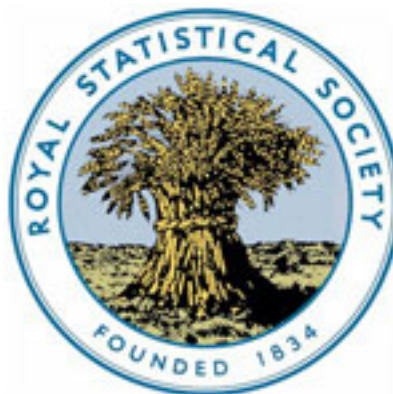# The Measurement of Occupational Gender Segregation: Current Problems and a New Approach

By ROBERT M. BLACKBURN†,   JANET SILTANEN   and   JENNIFER JARMAN

Cambridge University, UK   *Edinburgh University, UK*   *Dalhousie University, Halifax, Canada*

SUMMARY

This paper demonstrates the weaknesses of the two principal measures used in British occupational segregation research—the index of dissimilarity and the sex ratio index. It takes a fresh look at the conceptual and statistical issues involved and proposes a solution through a new approach using marginal matching. Contrary to the findings of previous researchers, the analysis of British census data reveals that there has been little change in segregation levels between 1951 and 1981 in England and Wales.

1. INTRODUCTION

The clustering of women and men in different occupations is a prominent feature of the employment structure and a significant dimension of gender inequality. Indeed, the observation of high levels of occupational gender segregation over most of this century has prompted many economists, sociologists and others to reconsider commonly accepted arguments concerning the dynamics of allocating employment. There is much theoretical interest in uncovering the social processes that result in gendered employment distributions, and given the concern to develop effective policy mechanisms to combat gender inequality in the labour market this interest has a sharp practical edge. Occupational segregation in itself entails inequalities and it provides a basis for their perpetuation. For example, it is argued to be one of the foundations of the gap in wages between women and men, and, as many have noted, policy initiatives targeting gendered inequalities in wages (such as equal pay legislation) are effectively inoperative in the context of a gender-segregated employment structure (Gregory, 1992; Coyle and Skinner, 1988; Dex and Shaw, 1986; Fox and Fox, 1987; Organisation for Economic Co-operation and Development, 1985; Treiman and Hartmann, 1981). Thus there have been initiatives to promote change in the distribution of female and male labour.

In view of the social and political importance of the extent of occupational gender segregation, it is not surprising that much of the research in this area has focused on establishing trends. What is surprising is that the statistical resources used in the analysis of trends are fairly rudimentary, and not well designed to capture processes

†*Address for correspondence*: Sociological Research Group, Faculty of Social and Political Sciences, University of Cambridge, Free School Lane, Cambridge, CB2 3RQ, UK.
E-mail: RMBl@UK.AC.CAM.PHX

of change in the differential distribution of women and men in the employment structure. The consequences of this imprecise statistical approach, and low level of statistical development, can be quite severe for theoretical and policy development.

The situation in British research is a case in point. For many years, the definitive statement of trends in occupational segregation by sex has been the research done by the Department of Employment (Hakim, 1979, 1981), recently updated by Hakim (1992). The main conclusion of this research is that over the 20th century occupational gender segregation has been decreasing, and this long-term decline was accelerated by the introduction of the Sex Discrimination Act in 1975. An examination of this research, however, has argued that it misidentifies the trend in occupational gender segregation and the effect of the mid-1970s legislation on that trend (Siltanen, 1990a, b). The central problem with Hakim's trend analyses is that they use an index that is not appropriate for the identification of change over time. A component of the reported 'decline' in occupational gender segregation is actually due to the sensitivity of the index to changes in women's share of the labour force. Such a situation raises the real possibility that researchers and policy makers have been working with an incorrect view of recent trends in occupational gender segregation in the British employment structure.

The problem faced by the Department of Employment research, and indeed by any research of this kind, is how to identify the substantive change under investigation as distinct from other changes that may be occurring simultaneously. Before our research, which is developed in Blackburn, Siltanen and Jarman (1993), Jarman et al. (1993) and Siltanen et al. (1992), this problem had not been satisfactorily resolved. We argue elsewhere (Blackburn, Jarman and Siltanen, 1993) that the strategy followed by the Organisation for Economic Co-operation and Development (OECD) in its research on occupational segregation—that of using two indices instead of one—merely adds confusion to an already problematic situation. It is our view that to develop a solution to this problem we must establish a clear idea of what is being measured and the properties appropriate for a measure of occupational gender segregation, and a clear idea of how adequate existing measures are with respect to these properties. This task has been neglected in research on occupational gender segregation, and it is one to which the current paper addresses itself.

Although indices of occupational gender segregation are all intended to measure the same thing, little attention has been given to the meaning of the concept. Segregation is the tendency for women and men to be employed in different occupations. Such separation creates gendered occupations which are disproportionately 'female' or 'male', so segregation may be defined as the tendency for women to work in female occupations and men in male occupations. Therefore, the level of segregation is, we suggest, best conceived as the strength of relationship between gendered occupations and the sex of the workers.

This sort of relationship has traditionally been measured by statistics of association, and we show how segregation indices are related to these statistics. We confront the problem of how to isolate and measure change in segregation, and we then propose an approach which we believe yields a more adequate, and therefore more useful, picture. As the reader will see, there is no quick statistical solution to this problem, and a more creative approach involving the arrangement of data is necessary.

The discussion is presented in five sections. First, we look at the mathematical

form of segregation indices. We introduce the basic segregation table, since all the major segregation indices can be expressed in more familiar forms in terms of association statistics of the table. We illustrate this with the two main indices used in British research to trace change in occupational gender segregation, showing how they are related to this table. Relating indices to the basic segregation table helps to make clear that the various indices are attempts to measure the association between the variables of the table, i.e. between gendered occupations and the sex of the workers. In addition to introducing conceptual clarity, this is useful in evaluating available indices and developing a satisfactory measure.

In the next section we then go on to discuss two criteria which are essential for a satisfactory measure, and we argue that neither of the indices under consideration, nor indeed any existing measure of association, meets these criteria. In the third section we introduce our measurement solution which is based on selecting the division between female and male gendered occupations to match the marginals of the basic segregation table. In the fourth section, we present data to show the comparison between our proposed solution and the two indices. Finally we present an overview of the argument.

2.   INDICES OF SEGREGATION

In this section we consider the mathematical forms of two prominent indices of segregation, to identify the theoretical implications of their construction and to assess their adequacy as measures. A full range of segregation indices is considered in Blackburn, Siltanen and Jarman (1993). Table 1 presents the basic segregation table. It groups occupations into two categories, male and female, and sets out the distribution of men and women between them. Thus n_{ij} denotes the number of workers of sex i ($i = 1, 2$) in gendered occupational group j ($j = 1, 2$).

What the table does not define is the numbers of men and women in individual occupations. If there are K occupations of which K_1 are male occupations and K_2 are female occupations, and k represents an individual occupation, then n_{ijk} is the general term for the number of men or women in occupation k in occupational gender category j ($k = 1, \ldots, K_j$).

All the terms of the basic segregation table are obtained by summing over $k = 1$,

TABLE 1
*Basic segregation table: men and women in male and
female occupations*

	Occupations		
	Male	Female	
Men	n_{11}	n_{12}	$n_{1.}$
Women	n_{21}	n_{22}	$n_{2.}$
	$n_{.1}$	$n_{.2}$	$n_{..}$

..., K_j; $\Sigma_k n_{ijk} = n_{ij.}$. For simplicity, the dot notation indicating summation is dropped where this is unambiguous.

The basic segregation table has not been defined in previous analyses of segregation measures. However, we shall see that it is an extremely useful innovation which greatly simplifies the assessment of indices. It clearly expresses the relationships between sex and gendered occupations, and does so in a familiar form, so that we can bring to bear our knowledge concerning such tables.

We could order the occupations by the increasing proportion of female workers in them, and obtain a $2 \times K$ table. However, as will become apparent, for the present purposes it is necessary to collapse this into the 2×2 form. This means that the analyst must choose a dividing point in the ordered occupations to split them into male and female (where j changes from 1 to 2). For the indices that we are about to consider, the point of zero segregation has been used as the dividing point between female and male occupations. This means that female occupations have disproportionately large numbers of female workers, in the sense that women make up a larger proportion of the workers in the occupation than in the labour force as a whole, and similarly for male occupations. We define zero segregation as the observed outcome where there is no relationship in the table, rather than an underlying situation where random factors would produce an expected deviation from our zero. (See Cortese *et al.* (1976a, b) and Taeuber and Taeuber (1976) on the merits of the alternatives.) If a zero relationship ever occurred it would not be possible to construct this table, but in practice random fluctuations in the sex proportions in each occupation would determine the construction of the table. In fact, in most data sets there is a considerable amount of segregation. Given this, the question that we are seeking to answer is, how strong is the tendency for women and men to be clustered apart from each other in the disproportionately female and male occupations?

First, we consider how the indices attempt to measure segregation by looking at their formal structure. We begin with the two principal indices in current use. These are

(a)   SR—the sex ratio index used by Hakim in the major British analysis (Hakim, 1981) and

(b)   ID—the index of dissimilarity, which is the most widely used; it is the principal index used in the USA and is also used in British research (see Rubery and Tarling (1988)).

2.1. *Sex Ratio Index*

The sex ratio index SR is defined as

'the difference between the level of over-representation [of women] in typically female jobs and the level of under-representation in typically male jobs'

(Hakim (1981), p. 523). Over- and under-representation are measured by the ratio of the observed percentage of the female labour force in a job category to the expected percentage if the representation of women in the category were the same as in the labour force as a whole (i.e. if there were no segregation). Although Hakim refers to percentages of the female labour force it is probably easier to think of actual numbers. Thus SR may be thought of as the ratio given by the observed

number of women in female occupations divided by the expected number of women in these occupations, less the equivalent ratio (observed:expected) of women in male occupations. Whichever way we conceptualize it, the index may be formally expressed as

$$SR = \frac{n_{22}/n_{2.}}{n_{.2}/n_{..}} - \frac{n_{21}/n_{2.}}{n_{.1}/n_{..}}$$

$$= \frac{n_{22}}{n_{2.}n_{.2}/n_{..}} - \frac{n_{21}}{n_{2.}n_{.1}/n_{..}}.$$

It seems a good idea to use the ratios of actual to expected frequencies, but unfortunately this is not the case. The main problems may be seen by considering

$$SR = (n_{..}/n_{2.})(n_{22}/n_{.2} - n_{21}/n_{.1}).$$

From this it can be seen that the index varies directly with $n_{..}/n_{2.}$ (the inverse of the female share of the labour force) which is also its upper limit. This makes proper comparisons impossible unless the female share of the labour force ($n_{2.}/n_{..}$) is constant; but in fact it has been steadily increasing throughout the industrialized world. Also, an SR-value can be calculated for men, which is quite different (varying with the inverse of the male share of the labour force, $n_{..}/n_{1.}$) and follows a different pattern of change (Siltanen, 1990a). This also is an unsatisfactory feature; it shows that the index is based on a more limited definition of the pattern of segregation, reflecting what is happening to women or to men, but not women and men in relation to one another.

These basic faults can easily be corrected if we create a standardized form SR* by dividing by $n_{..}/n_{2.}$. This gives us an index which is symmetrical for men and women and has a range from 0 to 1:

$$SR^* = n_{22}/n_{.2} - n_{21}/n_{.1}.$$

The important thing to note is that we can now relate the sex ratio index of segregation to the basic segregation table. In its standardized form SR is a familiar *statistic of association*, the difference of proportions (D_c) comparing columns of the basic segregation table:

$$SR^* \equiv D_c.$$

We shall consider the adequacy of the standardized SR* as a measure of segregation after we have looked at the formal structure of ID.

2.2. *Index of Dissimilarity*

The index of dissimilarity ID is the most widely used measure of segregation. It has reached a level of popular acceptance where it is often presented as *the* way to measure segregation, as though it were completely unproblematic. The index is normally defined as

$$ID = \frac{1}{2} \sum_{k=1}^{K} \left| \frac{n_{2k}}{n_{2.}} - \frac{n_{1k}}{n_{1.}} \right|$$

but may equally well be expressed as

$$\text{ID} = \frac{1}{2} \sum_{j=1}^{2} \sum_{k=1}^{K_j} \left| \frac{n_{2jk}}{n_{2..}} - \frac{n_{1jk}}{n_{1..}} \right|.$$

By definition, in female occupations

$$n_{22k}/n_{2..} > n_{.2k}/n_{...} > n_{12k}/n_{1..}.$$

Similar conditions apply to male occupations. Thus

$$\text{ID} = \frac{1}{2} \left\{ \sum_{k=1}^{K_2} \left(\frac{n_{22k}}{n_{2..}} - \frac{n_{12k}}{n_{1..}} \right) + \sum_{k=1}^{K_1} \left(\frac{n_{11k}}{n_{1..}} - \frac{n_{21k}}{n_{2..}} \right) \right\}$$

$$= \frac{n_{11}}{n_{1.}} - \frac{n_{21}}{n_{2.}}$$

$$= D_r,$$

the difference of proportions between rows of the basic segregation table.

Hence, although ID is normally expressed in terms of summations over all occupations, we see that the male and female occupational groupings can be derived from ID. In this form we find that ID may be more clearly expressed as a simple *statistic of association*. Thus, we have the striking result that the two major indices of segregation (admittedly one in standardized form) are simply the two difference of proportions measures in the basic segregation table. This fact greatly facilitates a consideration of the adequacy of both measures and helps to clarify the criteria for satisfactory measurement of occupational gender segregation.

3. CRITERIA FOR A SATISFACTORY MEASURE

To ascertain criteria that are appropriate for a satisfactory measure of occupational segregation, we need to be clear about what we want to be measured. In keeping with previous approaches, we conceptualize segregation as the tendency for women and men to be separated in different occupations (or industries). Making this explicit leads on to the logical point that if women are separate from men then, equally, men are separate from women. Thus, segregation entails both men and women in a symmetrical relationship and can be measured as the extent of their separation from one another in the employment structure. As explained earlier, this may be conceived as the strength of the relationship between the sex of the workers and the gendering of occupations—how far men are concentrated in male occupations (or industries) and women in female occupations. Some indices, including the unstandardized sex ratio SR, do not meet the basic requirement of symmetry and are not compatible with an adequate theoretical conception of segregation.

For any measure of segregation to be satisfactory it must be substantively intelligible and it must allow consistent interpretation so that comparisons are meaningful. SR* and ID satisfy the first requirement in relation to segregation. However, a *consistent* interpretation is a bigger problem. Without such consistency, no index can be regarded as substantively or statistically adequate, and on these grounds we shall show that both SR* and ID must be rejected.

In considering the formal criteria of assessment we have built on the valuable discussion by James and Taeuber (1985) who proposed a set of criteria for a satisfactory measure of segregation. We have extended the set and elsewhere we discuss in detail the suitability of these criteria for measures of occupational gender segregation (see Blackburn, Siltanen and Jarman (1993)). Here we shall concentrate on the two most stringent criteria, which both SR* and ID fail to meet. The first criterion is described by James and Taeuber (1985) as 'composition invariance' but for clarity we refer to it as 'sex composition invariance'. The second, which we propose as also relevant to occupational segregation measures, is 'gendered occupations invariance'.

Sex composition invariance is a particularly important criterion, which we have already had reason to apply. It requires that the measurement of segregation should not be affected statistically by the sex composition of the labour force, i.e. by the relative proportions of women and men. We need to be quite clear what this means, since it is to be expected that variations in labour force composition will have social consequences affecting the level of segregation. Such effects should be taken into account in a measure of segregation. What needs to be avoided is any effect which is purely artefactual, in that variation in the sex composition of the labour force causes changes in the observed values of a measure which are unrelated to changes in actual segregation.

SR provides a straightforward example; we saw that it is D_c (ranging from 0 to 1) multiplied by $n_{..}/n_{2.}$ (which in principle has no upper bound). Thus, SR is strongly influenced by $n_{..}/n_{2.}$, i.e. by the sex composition of the labour force. The standardized version SR* corrects for this crude effect but this is not sufficient to ensure sex composition invariance.

In terms of the basic segregation table, sex composition invariance requires the measurement of segregation to be independent of the relative values of the column marginals $n_{1.}$ and $n_{2.}$. Similar considerations apply to the row marginals $n_{.1}$ and $n_{.2}$, which are involved in *gendered occupations invariance*. Just as sex composition invariance specifies that the measurement of segregation should not be artefactually affected by the sex composition of the labour force, so gendered occupations invariance excludes artefactual effects from the occupational structure. It concerns the two occupational categories (male and female occupations), and the requirement is that variation in the relative size of gendered occupational categories should not affect the measurement of segregation.

An immediate response to the requirements of sex composition and gendered occupations invariance might be to consider a measure of segregation such as the odds ratio or some function of it. However, the odds ratio does not meet the requirements for measuring segregation. We should note that the maximum value of the odds ratio does not correspond to the definition of total segregation. Furthermore, although it is certainly true that multiplying any row or column of the basic segregation table by a constant term will leave the odds ratio unchanged, the marginals of the table are not independent. This may be seen most clearly by recalling that the basic segregation table depends implicitly on ordering the underlying occupations by male and female composition and classifying as female those occupations which have proportionately more females than the labour force as a whole. Multiplying by a constant in the underlying table can lead to a change in the classification of some occupations from male to female and vice versa, and hence will affect the derived basic segregation table and consequently the measures

of segregation based on it. Thus even a measure such as the odds ratio does not satisfy the criteria for a suitable measure of segregation.

In fact, there are no statistics of association which meet the criteria. Blackburn and Marsh (1991) and Blackburn, Siltanen and Jarman (1993) have provided an extended discussion of this issue. We have shown that the two main indices of segregation, ID and SR (or more precisely SR*) are really statistics of association and it follows that they are not free of the unwanted influences.

4. NEW APPROACH: MARGINAL MATCHING

There is no straight statistical solution to the problem of ensuring sex composition and gendered occupations invariance. The approach that we propose involves basing a measure on a modification of the basic segregation table. Here we emphasize again that segregation should be understood as a relationship rather than a quantity to be measured from some fixed point. The tendency to use income inequality as a model for segregation measurement may have encouraged the 'quantity' approach, in the form of constructing indices. However, once we recognize that the measurement of segregation is the same as measuring association we can draw on a different sociological tradition where inequality is seen as a relationship measured by statistics of association. As the problem in using such statistics for the study of change in gendered occupational distributions lies with the marginals, the best tactic is to confront the problem directly. We propose to do this by introducing the procedure of *marginal matching* (Blackburn and Marsh, 1991; Blackburn, Siltanen and Jarman, 1993).

Since the division between female and male occupations must be determined by the investigator, it can be chosen to achieve comparability between tables. To do this the occupations must be ordered by the ratio of female to male incumbents (n_{2jk}/n_{1jk}). This provides a gendered occupations dimension along which we can choose any suitable cutting point to distinguish two categories of female and male occupations. The choice of cutting point is crucial. Rather than basing it on the over-representation or under-representation of a gender group in relation to its share of the labour force (as for SR* and, implicitly, ID), it is chosen to provide matched distributions in the two marginals of the basic segregation table. This means that female occupations are defined as those with the highest ratio of women to men which together contain the same numbers of workers as there are women in the labour force (we may think of this as moving along from the female extreme of the dimension until the cumulative number of workers equals the total number of women). In the basic segregation table, $n_{.1}$ now equals $n_{1.}$ and $n_{.2}$ equals $n_{2.}$. Thus, the marginals of the table are symmetrical. Whatever happens to the numbers of women and men in the labour force, the classification of occupations is adjusted to preserve this symmetry.

Several statistics of association now coincide and we refer to them as MM (reflecting the dependence on marginal matching). The statistics include the two differences of proportions, D_c and D_r and τ_B which is the product moment correlation coefficient r with dummy variables. If and only if the table is symmetrical (i.e. with matched marginals), τ_B meets the requirements for a completely satisfactory, undistorted correlation coefficient. It can therefore be interpreted as measuring the extent to which the two variables vary together, i.e. the extent to which female

occupations actually are staffed by women and male occupations by men. The essential point is that the interpretation is the same for all tables.

Now at last we have a measure which allows for compositional changes. The degree of gender concentration in female (and male) occupations may vary, but the relationship of segregation is measured consistently in all cases. As the sex composition of the labour force varies, so also does the cutting point distinguishing female and male occupations, for this is how changes in sex composition and gendered occupations are taken into account.

We may regard the matching process as based on total segregation. The size of the female category is defined so that it could contain all the women workers and no men, whereas the male occupations would contain all the men and only men — total segregation. Although the dividing point between male and female occupations is varied, the definition of zero segregation is unchanged, since a relationship tending to 0 would show up equally well with matched marginals.

It might seem that what we are doing is simply recommending another statistic, MM ($= \tau_B$), as an index of segregation. This would miss the point of the essential and novel step, where the data are organized to match marginals before a measure is applied. Far from proposing an 'ideal' index, we have demonstrated that consistent measurement of segregation cannot be achieved through the selection of the 'right' statistic, and a much more fundamentally new approach is necessary.

Rather than thinking of segregation as a quantity, it should be understood in terms of the closeness of relationship. Thus the strength of the approach is not that it gives a 'true' measure of segregation, whatever that might mean, but that it gives measures which are comparable across situations. It may not be the answer to all problems in this area but we believe that it is a very powerful tool, allowing analyses of changes which were not previously possible. The approach can, of course, be used to look at segregation in sections of the labour market as well as the overall level and can be used with appropriate industrial as well as occupational data.

5. IMPROVING MEASUREMENT OF OCCUPATIONAL GENDER SEGREGATION: ILLUSTRATION

To illustrate the significance of using a valid measure, we show the pictures presented by different measures of the levels of occupational segregation in England and Wales from 1951 to 1981. Census data are used in calculating the measures, and since it is the same data set in each case all differences are due to the characteristics of the various measures.

To facilitate comparisons the graphs show the percentage changes in each measure from the 1951 value. Thus the 1951 value is set to 0, and the graphs display the patterns of increase or decrease over the 30-year period. In this way we can see how segregation is supposed to have been changing according to the various measures.

Fig. 1 presents the various versions of the main British measure, the sex ratio index. SR_f denotes the female version which is the version usually referred to as the sex ratio (using the symbol SR, as we have done earlier in this paper). It was used in the Department of Employment study (Hakim, 1981) and has been widely accepted as expressing the trend in occupational gender segregation. This appears to show a dramatic 20% decline in segregation. However, we pointed out that there
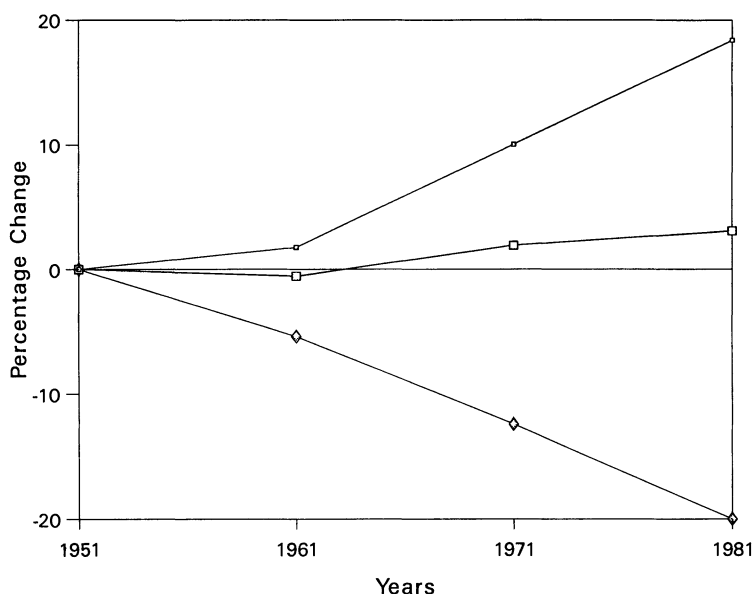
Fig. 1.   Changes in SR_m ($\square$), SR^* ($\square$) and SR_f ($\Diamond$), England and Wales, 1951–81

is also a male version of the sex ratio, SR_m, and this shows an almost equally dramatic increase in segregation. It makes no sense to conclude that women were becoming less segregated from men at the same time as men were becoming more segregated from women, and these results must be seen as strongly contradictory. The standardized version, SR^*, shows a trend well between these extremes. The differences reflect the pronounced opposite influences on the male and female indices of the sex composition of the labour force — striking failures to meet the criterion of sex composition invariance.

We now turn to the three measures that are unweighted statistics of association: SR^* and ID, the two differences of proportions in the basic segregation table, and MM, the correlation coefficient in the marginally matched segregation table. As may be seen in Fig. 2, none of these indicate such extreme patterns of change and may be regarded as giving more accurate accounts of the changes in occupational gender segregation. However, they still tell quite different stories. SR^* suggests there was an increase in segregation over the period whereas ID suggests a decrease. The most valid measure, MM, shows that in 1981 the level of segregation was virtually the same as in 1951.

If the net result was no change, it does not mean that nothing was happening in the 30-year period. During the 1950s MM shows that segregation was declining; then this was reversed in the 1960s. Segregation remained level in the 1970s, and analysis of Labour Force Survey data suggests that it remained level through the early 1980s, decreasing somewhat in the late 1980s.

The lack of overall change since 1951 has occurred despite factors such as the growth of the service sector, the decline of the manufacturing sector, the increase in the number of women in the labour force, the growth of part-time employment, the rise of the second-wave feminist movement and policies and public pressure
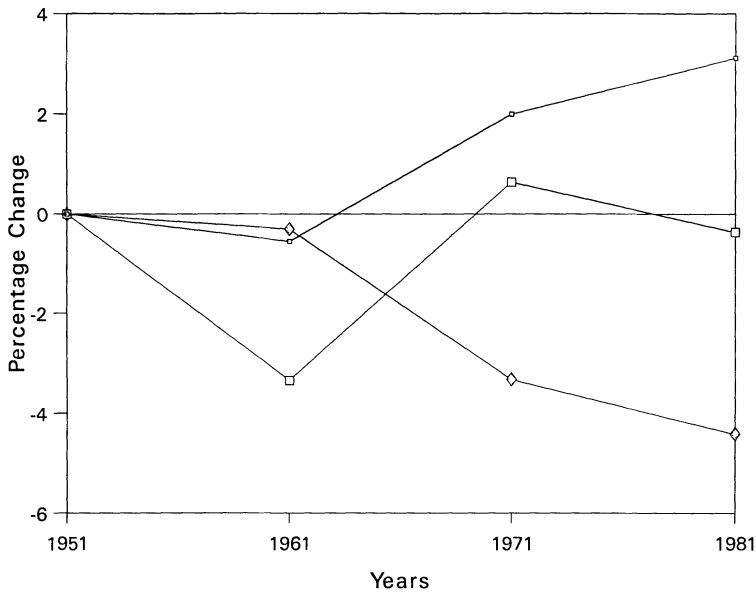
Fig. 2.   Changes in SR* (□), MM (□) and ID (◊), England and Wales, 1951–81

to encourage women to move into non-traditional jobs. Much attention has been focused on the progress of women into professional and managerial occupations. The finding of an overall lack of change in segregation indicates that there have been other occupations which have become more male or more female than they were before. This needs further research, but points to the need for a re-evaluation of the last 20 years of employment policies targeted at women workers. It also indicates that the stratification inequalities of the female labour force would be particularly important to explore, to investigate specifically whether or not women who are already favourably placed are gaining openings while the situation of their more disadvantaged sisters remains grim.

6.   CONCLUSION

We have indicated the extensive and fundamental nature of a problem of analysis which severely challenges the credibility of much research in the field of occupational gender segregation, and we have put forward a new approach.

The problem lies in the sensitivity of *measures* of segregation to changes in the basic pattern of employment, quite apart from the effects of such changes on segregation, i.e., as changes take place in the proportions of men and women in the labour force or the numbers of workers in different occupations, this has effects on the measures of segregation in addition to those due to changes in the actual level of segregation. This is a serious obstacle to any sort of comparative analysis. There can hardly be any progress in the study of segregation without comparisons across time and place, and yet measures have been developed without sufficient understanding of the requirements of comparative and historical analysis. Although our solution may not be applicable to all facets of the study of segregation,

we are convinced that it does provide a consistent measure, permitting sound comparisons.

It is central to our approach that segregation is conceived as a *symmetrical relationship*. It is the relationship between gendering of occupations and the sex of the workers, measuring the strength of the tendency for men and women to work in different occupations. There is gender symmetry because, in so far as women are segregated from men, men are segregated from women. Significantly, this definition brings segregation explicitly into the realm of association. It is a relationship of the sort that has usually been measured by statistics of association, but there is no such statistic which can serve independently as a satisfactory measure of segregation. Accordingly a new approach has been developed and demonstrated.

The development of a satisfactory segregation measure requires 'marginal fixing' in the specific form of marginal matching. We have demonstrated the technical possibility and the theoretical desirability of providing symmetrical marginals in modified versions of the basic segregation table. In such circumstances MM represents a fully adequate measure of segregation. The problems which stem from changes in sex composition and gendered occupations distributions are taken account of by the arrangement of the data (rather than by the properties of any statistic). This use of marginal matching, with MM to measure the strength of relationship, allows analyses of occupational gender segregation which were not previously possible.

The problems that follow from attempting trend analysis with inadequate measures are illustrated in our application to census data. The index of dissimilarity and the three versions of the sex ratio all give widely different accounts of what was happening, and all are inaccurate. The measure that is most commonly used—and believed—in Britain is the sex ratio (female version), which indicates a dramatic decline, whereas ID, the most popular index elsewhere, shows a more modest decline; both turn out to be misleadingly optimistic, as any change has been negligible.

To conclude, we believe that we have developed procedures for analysing occupational gender segregation which meet fundamental principles of good measurement. Such principles have not been sufficiently attended to in previous research. We trust that, with procedures that are theoretically and technically sound, the analysis of this form of gender inequality will now progress substantially.

ACKNOWLEDGEMENT

REFERENCES

Blackburn, R. M., Jarman, J. and Siltanen, J. (1993) The analysis of occupational gender segregation over time and place: considerations of measurement and some new evidence. *Work, Emplymnt Soc.*, 7, 3.

Blackburn, R. M. and Marsh, C. (1991) Education and social class: revisiting the 1944 Education Act with fixed marginals. *Br. J. Sociol.*, **42**, 507–536.

Blackburn, R. M., Siltanen, J. and Jarman, J. (1993) Measuring occupational gender segregation. *Working Paper 3*, 2nd edn. Sociological Research Group, University of Cambridge, Cambridge.

Cortese, C. F., Falk, R. F. and Cohen, J. K. (1976a) Further considerations on the methodological analysis of segregation indices. *Am. Sociol. Rev.*, **41**, 630–637.

—— (1976b) Reply to Tauber and Tauber. *Am. Sociol. Rev.*, **41**, 889–893.

Coyle, A. and Skinner, J. (1988) *Women and Work – Positive Action for Change.* London: Macmillan.

Dex, S. and Shaw, L. (1986) *British and American Women at Work – Do Equal Opportunities Policies Matter?* London: Macmillan.

Fox, B. and Fox, J. (1987) Occupational gender segregation of the Canadian labour force, 1931–1981. *Can. Rev. Sociol. Anthr.*, **24**, 374–397.

Gregory, J. (1992) Equal pay for work of equal value: the strengths and weaknesses of legislation. *Work, Emplymnt Soc.*, **6**, 461.

Hakim, C. (1979) Occupational segregation: a comparative study of the degree and pattern of the differentiation between men and women's work in Britain, the United States, and other countries. *Department of Employment Research Paper 9.* Department of Employment, London.

—— (1981) Job segregation; trends in the 1970s. *Emplymnt Gaz.*, **89**, 521–529.

—— (1992) Explaining trends in occupational segregation: the measurement, causes, and consequences of the sexual division of labour. *Eur. Sociol. Rev.*, **8**, 127–152.

James, D. R. and Taeuber, K. E. (1985) Measures of segregation. In *Sociological Methodology* (ed. N. B. Tuma), pp. 1–31. San Francisco: Jossey-Bass.

Jarman, J., Blackburn, R. M. and Siltanen, J. (1993) Measuring segregation: a feminist methodology. In *Inequalities in Employment: Inequalities in Home Life* (eds G. Dunne, R. M. Blackburn and J. Jarman). Cambridge: Sociological Research Group.

Organisation for Economic Co-operation and Development (1985) *The Integration of Women into the Economy.* Paris: Organisation for Economic Co-operation and Development.

Rubery, J. and Tarling, R. (1988) Women's employment in declining Britain. In *Women and Recession* (ed. J. Rubery), pp. 100–132. London: Routledge and Kegan Paul.

Siltanen, J. (1990a) Social change and the measurement of occupational segregation by sex: an assessment of the sex ratio index. *Work, Emplymnt Soc.*, **4**, 1–29.

—— (1990b) Further comment on the sex ratio index. *Work, Emplymnt Soc.*, **4**, 599–603.

Siltanen, J., Jarman, J. and Blackburn, R. M. (1992) Gender inequality in the labour market, occupational concentration and segregation, a manual on methodology. *Working Paper.* International Labour Office, Geneva.

Taeuber, K. E. and Taeuber, A. F. (1976) A practitioner's perspective on the index of dissimilarity. *Am. Sociol. Rev.*, **41**, 884–889.

Treiman, D. and Hartmann, H. (1981) *Women, Work and Wages: Equal Pay for Jobs of Equal Value.* Washington DC: National Academy Press.