

Segregation and Inequality

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1 Introduction

The importance of occupational gender segregation is well established and needs no explanation. However, there remains considerable confusion on the precise meaning of the term, and how segregation should be measured. In the first place it is necessary to distinguish segregation from the related but logically distinct concepts of concentration and exposure. Then the actual measurement should not be contaminated by other aspects of the labour market or the occupational classification used. Finally, and most importantly from a theoretical perspective, we need to distinguish how far the segregation entails gender inequality and how far it is simply a matter of different but equal patterns of employment for women and men. In considering these issues we shall draw on data from economically developed countries, mainly but not exclusively located in Europe. These are countries which tend to have relatively high levels of gender segregation.

Defining Segregation

Frequently *segregation* has been used in a broad sense to include *concentration* (e.g. Anker 1998, Lewis 1985, Armstrong and Armstrong 1978) as well as segregation in the narrower, more precise sense in which we use it. While this broad sense may be useful in identifying the general area of the two related concepts, it introduces confusion in more precise analyses as the concepts refer to different sorts of patterning by gender, as made clear in the important article by James and Taeuber (1985). Less often *exposure* has been treated as an aspect of segregation, but they are really quite distinct ideas. It is useful, therefore to set out the precise meaning of each concept.

Exposure refers to the extent to which one sex comes into contact with the other in the work environment. It is not gender symmetrical, and varies with the gender composition of the labour force. The more men outnumber women in the labour market, the lower their exposure to women and the higher women's exposure to men.

Concentration is a measure of the gender composition of the workforce in a single occupation or a set of occupations, typically expressed as the percentage of women in the occupation(s) under consideration. An important aspect of concentration is that, logically, it cannot be gender symmetrical, except in the limiting case of 50% women and 50% men in an occupation.

Segregation concerns the tendency for women and men to be employed in different occupations from each other across the entire spectrum of occupations under analysis. Unlike concentration it is gender symmetrical: so far as men are separated from women in employment, so are women equally separate from men. Whereas concentration refers to the representation of one sex *within occupations*, segregation refers to the separation of the two sexes *across occupations* (Siltanen, Jarman and Blackburn 1995:4-5).

Both segregation and concentration are concerned with the distribution of men and women in occupations. Indeed segregation may be seen as the resultant outcome, in the labour market concerned, of all the separate levels of concentration in individual occupations. There is a

tendency for occupations to polarise into ones with high female or high male concentrations (Jarman et al. 1999, Boyd, Mulvihill and Myles 1991), and segregation measures the extent of this polarisation. As we shall see, the treatment of the concepts in analysis has to be different; we focus on segregation with procedures that are only possible with the precise measure of segregation.

Later on we shall need to distinguish vertical and horizontal component dimensions of segregation. *Vertical* segregation refers to the element of gender inequality in segregation, while *horizontal* segregation refers to difference without inequality. To avoid confusion, the resultant of these components will be called *overall* segregation, but where the context makes the meaning clear we shall also use the traditional single word ‘segregation’ (Blackburn and Jarman 1997).

Measuring segregation

Almost all measures of segregation, whether relating to gender, ethnicity or plants, use a simple dichotomy. For gender the dichotomy is between ‘male’ and ‘female’ occupations, as well as the obvious dichotomy between men and women. The classification of occupations is based on the proportions of workers who are men or women: female occupations are those where the proportion of women is greater than the proportion in the labour force, and correspondingly, male occupations contain more than the expected proportion of men. This set of segregation measures can best be understood as aspects of the *Basic Segregation Table* - the 2 x 2 table shown in Figure 1. The most effective have a range from 0 to 1, where 0 indicates no tendency for men and women to work in different occupations, while 1 represents total segregation with each occupation staffed solely by men or solely by women. Some other segregation measures have an essential component with this 0 to 1 range, but are then weighted by some function of the marginal totals of the table. Such weighting is clearly undesirable as it brings in non-segregation components and creates an unbounded range.

**Figure 1 The Basic Segregation Table:
Women and Men in ‘Female’ and ‘Male’ Occupations**

	Men	Women		
‘Female’ Occupations	F _f	M _f		N _f
‘Male’ Occupations	F _m	M _m		N _m
	F	M		N

Where

N is the total labour force

N_f is the total number of workers in ‘female’ occupations

F is the number of women in the labour force

F_f is the number of women in ‘female’ occupations,
and so on.

Then the Index of Dissimilarity, the most widely used measure - especially in the USA where it was sometimes described as *the* measure of segregation - , is the difference of column proportions. That is:

$$ID = F_f/F - M_f/M$$

The Sex Ratio is, $SR = N/F[F_f/N_f - F_m/N_m]$ and if standardised to lie between 0 and 1 we have $SR^* = F_f/N_f - F_m/N_m$, which is the other difference of proportions.

Other segregation measures may similarly be related to the simple Basic Segregation Table. Prior to the introduction of this Table, it was the practice to define segregation measures with long formulae. For instance, the Index of Dissimilarity has as many terms as occupational categories, which can be several hundred. The simple difference of proportions makes it much easier to recognise its properties and limitations, as well as easier to calculate. However, although it is many years since it was introduced (Blackburn, Siltanen and Jarman 1990) and it has been described in several publications (e.g., Blackburn, Jarman and Siltanen 1993, Blackburn, Jarman and Siltanen 1995, Siltanen, Jarman and Blackburn 1995, Blackburn and Jarman 1997), there appear to be many who still prefer the complicated traditional approach.

Unfortunately all the segregation measures related to the Basic Segregation Table are influenced by the relative size of the marginal totals. To overcome this problem the Marginal matching measure MM was introduced. This uses a different definition of male and female occupations. The female occupations are defined as those with the highest proportion of female workers for which the total number of workers equals the number of women in the labour force, and similarly the number of workers in male occupations equals the total number of men. This produces a symmetrical Matched Segregation Table, where $N_f = F$ and $N_m = M$. It is worth noting that in a situation of total segregation ($ID = 1$) the Basic Segregation Table becomes this symmetrical table.

Several statistics of association now coincide, including both differences of proportions (the equivalents of ID and SR^*) and Tau_b . This in itself may be regarded as desirable, but the real benefit is the control of effects from the marginals. Changes in the numbers of men and women in the labour force affect the marginal totals of the basic segregation table, and so have unwanted effects on the values of statistics such as ID. Marginal matching ensures that the ratios of the marginal totals are always equal, and so overcomes the problem.¹

Although the measures discussed so far use just a simple dichotomy between ‘male’ and ‘female’ occupations, they are actually very effective for measuring overall segregation. They are measures internal to the data; that is, the criterion categorising occupations for one variable is the other variable - gender. Thus the strength of relation in the segregation table

¹ For a full discussion of these various segregation measures and the segregation tables see Blackburn, Jarman and Siltanen (1993), Siltanen, Jarman and Blackburn (1995) and Blackburn, Siltanen and Jarman (1995).

directly measures the degree of segregation². The more men are concentrated in male occupations and women are in female occupations, the larger are the diagonal cells of the table and the larger is the measure of segregation. MM is therefore an ideal measure, while ID and SR* generally give fairly similar results and are also useful.

Standardisation

There remains, nevertheless, a fundamental problem in the comparative use of segregation measures. All available measures are influenced by the number of occupational categories in the data. We can see this clearly at the extremes; if there were only one category there would be zero segregation, while if there were a unique occupation for every worker there would be total segregation. Between these extremes measured segregation increases with the number of occupations. Across 32 countries of varying size and economic development, including those of Table 1, MM is significantly correlated 0.55 with the number of occupations (Blackburn, Jarman and Brooks 2000). It is, therefore, necessary to standardise measurement, which we do on a notional 200 occupations, and the correlation with the number of occupations virtually disappears (0.018). With only a small number of occupations the error component may be relatively large, so we recommend at least 20 occupations and preferably more. As the number approaches 200 the error problem is greatly reduced, and increasing the number of occupations has a declining effect. Thus 200 occupations is a good basis for standardisation. The standardised MM is denoted as MM_{200} ³, and presently we shall have reason to introduce other standardised measures, O_{200} , V_{200} and H_{200} .

Table 1 illustrates the effect of standardisation on the measurement of segregation in 16 industrially developed countries. While most of these countries are European, not all the economically successful countries are included, depending on availability of reliable data. We might expect the effect of standardisation would be to bring measured segregation levels closer together for countries with different occupational sample sizes; however, we see that the range of values is actually increased. Most notably, Sweden replaces Finland as the most segregated country, changing from fifth place to first with a notably high value.

² MM may also be expressed in a summation over all occupations i in a formula similar to that for ID.

$$MM = \frac{1}{p} [E(F_i/F - M_i/M) + E(M_i/M - F_i/F)]$$

where the value of p is determined by $\sum_{i=1}^p EN_i = F$ (Blackburn, Jarman and Siltanen 1994)

³ $MM_{200} = MM_{200E} \times MM_n / MM_{nE}$ where MM_n is the observed value for n occupations and MM_{nE} is the corresponding expected value, given by $MM_{nE} = 1 - 1/n + 0.6(\log_{10}n)^{0.93}$. Thus $MM_{200E} = 0.56567$.

Table 1 Standardised MM₂₀₀ and Unstandardised MM

<u>Country</u>	<u>#Occupations</u>	<u>MM₂₀₀</u>	<u>MM</u>
Sweden	52	.683	.601
Finland	478	.623	.661
Canada	41	.604	.516
Norway	490	.601	.638
UK	526	.595	.635
Australia	283	.587	.602
Hungary	126	.583	.561
Austria	77	.566	.520
Switzerland	541	.557	.595
France	454	.552	.584
USA	488	.548	.583
Spain	82	.538	.498
New Zealand	305	.512	.528
Poland	373	.500	.522
Japan	294	.443	.455
Italy	249	.424	.431

Source: UN 1996 and occupational data supplied by the ILO.
Countries listed by MM₂₀₀ (descending values).

2 Segregation and Inequality

While occupational gender segregation is of interest in itself, a major element of the interest concerns the inequality entailed in the gendered occupational distribution. To a large extent it has been assumed that segregation is a measure of gender inequality, or at least that it is a strong indicator of such inequality (Yamagata et al. 1997, Walby 1997, Reskin and Roos 1990, Bradley 1989). However, a consideration of the levels of segregation in the industrially developed countries casts serious doubt on such assumptions (Blackburn, Jarman and Brooks 2000).

When we compare the position of women in the 16 industrially developed countries of Table 1, we find a pattern which is the opposite of what might be expected on conventional views of segregation. For instance, the correlation between the level of segregation, measured by MM₂₀₀, and adult literacy among women is 0.46⁴. Contrary to what might have been expected, the greater the degree of segregation, the more women are advantaged in terms of

⁴ The correlation coefficients here and in Table 2 are Spearman's rho because of the distribution of values, though results using Pearson's product-moment correlation would be essentially the same.

the level of literacy. This is part of a general trend as we may see by considering the Gender Related Development Index (GDI) and the Gender Empowerment Measure (GEM) which is actually a women's empowerment measure. Table 1 displays the relationships.

Table 2 Association Between Segregation, MM₂₀₀, and Measures of Gender Equality for Industrialised Countries

	GDI	GEM
MM ₂₀₀	0.618	0.603
Significance	0.005	0.007
N	16	16

Source: United Nations, Human Development Report 1996

There are very clear positive relationships, which are highly significant statistically, despite the small number of countries. Instead of the conventional view that segregation works to the disadvantage of women, we find exactly the opposite. The greater the level of segregation, the greater the empowerment and general social advantage of women.

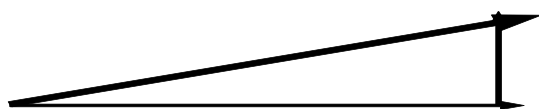
Before we jump to the conclusion that, after all, it is men who are disadvantaged by occupational segregation we need to take account of one further piece of information. In none of the 16 countries, nor indeed in any of the countries covered by the UN Report, do the values of the GDI and GEM reach unity. They are measures of the extent to which the situation in each country approaches equality in the public sphere, with equality represented by the value 1. The approach towards equality may be greater in the more segregated countries, but everywhere inequality and segregation exist.

Nevertheless, there is a puzzle to be explained. How can it be that higher segregation tends to go with less inequality. To answer this we must now turn to the vertical and horizontal dimensions of overall segregation.

3 The Dimensions of Segregation

In order to measure gender inequality in segregation we need to isolate the vertical component. A second component of overall segregation is located on a horizontal dimension. Figure 2 (page 7) shows the mathematical relations of the components of segregation and how they are measured. In the figure the vertical component is shown as positive, which we take to represent the familiar situation of male advantage. However, we shall see that it is possible for the vertical component to entail female advantage, which we represent with a negative value (which would be represented with the vertical arrow pointing down below the horizontal) (Blackburn, Brooks and Jarman 2001, Blackburn, Jarman and Brooks 2000).

Figure 2 The Mathematical Relationships of Segregation Components



In order to measure the components of segregation we can no longer work with a dichotomous measure of overall segregation, as this would entail an important loss of information. Since the vertical dimension requires an external measure of inequality, collapsing it into a dichotomy would suppress most of the information. For the vertical measure we need to order occupations according to their attractiveness/desirability and measure this ordering in relation to gender. For overall segregation we need to order the occupations by the proportion of workers who are women (or alternatively men) and measure the relation with gender. In other words we create 2 x n tables (where n is the number of occupations) and measure the strength of relationship using a statistic of association. It is, of course, essential for comparability to use the same statistics for each measurement. The Gini coefficient has been used for overall segregation by some analysts (e.g. Silber 1989, 1992, Lampard 1994), and this does seem to be a good choice. Fortunately we were able to establish that the Gini coefficient is a limiting case of Somers' D, maximising the value of D for a given set of occupations and the gender distribution across them (Blackburn, Jarman and Siltanen 1994: 415, Blackburn, Brooks and Jarman 2001: Appendix). Thus Somers' D is the appropriate measure for the vertical dimension. The highest possible degree of inequality on the vertical dimension occurs when the ordering is the same as for overall segregation, and the horizontal component is zero; otherwise overall segregation has components as illustrated. We are not aware of a way of directly measuring the horizontal component, but this does not present a problem as it can be deduced using Pythagoras' theorem.

There are a number of possible measures of inequality which might be used for the vertical dimension. However, there are two measures which are particularly appropriate. One is the standard economic measure of income. There is no doubt that income is a key consideration determining the attractiveness and desirability of occupations. It is, nevertheless, only one

aspect of occupational quality. Therefore we also use CAMSIS⁵, the measure of *general* social and economic advantage associated with occupations. Although income inequality provides a ratio scale the use of Somers' D converts it to an ordinal measure. The actual distribution of occupational income is highly skewed, with a few extremely high levels which are almost entirely occupied by men. Thus the conversion to an ordinal scale reduces the gender difference, but is a fair reflection of income differences for the majority of the population. Also, conversion to an ordinal scale makes income directly comparable with CAMSIS. As with MM, it is necessary to standardise the segregation measures, including the dimensions. Thus overall segregation is measured with O_{200} and the vertical and horizontal dimensions with V_{200} and H_{200} ⁶.

It is important to recognise that the name 'horizontal segregation' has often been used with a meaning quite different from that employed here. The name has been applied to what we term 'overall segregation'. It appears that Hakim (1979) introduced this usage to distinguish overall segregation from vertical segregation, without any further assumptions. However, this use of 'horizontal' has been quite widely adopted (e.g. Moore 1985, Crompton and Sanderson 1990, Cousins 1999, ETAN Expert Working Group 2000, Palomba 2002) with confusing results. Not only does this 'horizontal' include a true vertical component (being the resultant of the orthogonal vertical and horizontal components in our conventional mathematical sense) but it is treated as a measure of inequality.

4 Vertical and Horizontal Segregation

We can now return to our puzzle, where higher levels of overall segregation tend to be associated with greater gender equality. In general we would expect the components of segregation to vary with the level of overall segregation: the higher the level of overall segregation, the higher its vertical and horizontal components, and vice versa. Indeed this is more or less logically necessary. We have seen that in all countries there is a degree of gender inequality in the public sphere. However, there is little scope for a vertical dimension in those countries where gender segregation is very low (e.g. MM_{200} for Ethiopia = 0.113, Rwanda = 0.118)⁷. We would certainly expect a higher vertical component in the more highly segregated countries. In so far as the vertical component varies with overall segregation this does not explain our puzzle.

⁵ The measure was originally developed for the British occupational structure and known as the Cambridge Scale, but there are now versions of CAMSIS for many countries. It is a better measure of social or economic inequality than conventional measures of class or status.

⁶ The formulae are: $O_{200} = O_{200E} \times O_n / O_{nE}$ where O_n is the observed value for n occupations and O_{nE} is the corresponding expected value, given by

$$O_{nE} = 1 - 1/[1 + 2(\log_{10}n)^{0.73}]; \text{ thus } O_{200E} = 0.78609.$$

$V_{200} = V_n[1 - V_n(O_n - O_{200})/O_n^2]$ where n is again the observed number of occupations.

$$H_{200} = (O_{200}^2 - V_{200}^2)^{-1/2}$$

⁷ Data from United Nations (1996), but as it is based on only 7 occupations there is considerable scope for error. However, the basic point remains valid.

However, there is another possible pattern. Vertical segregation may vary inversely with horizontal segregation, and so with overall segregation to some extent. In so far as this is the dominant pattern we will get the result we deduced from the analysis of women's empowerment and gender related development. Among the economically developed countries we considered, the level of overall segregation is consistently high enough for this to type of relationship to dominate. The same two trends may be expected to operate within countries over time. On the one hand, moves to a more egalitarian, gender neutral society may be expected to reduce all forms of segregation. At the same time, changes in themselves may be expected to affect vertical and horizontal segregation in opposite directions.

The question remains, why should high horizontal segregation, and so high overall segregation, be accompanied by less gender inequality? The answer lies in the effect of segregation in an unequal society. If men gain the senior positions where men and women compete together, then women will get senior positions more often where there is no competition. In so far as a career structure is dominated by one sex, then that sex will tend to fill the senior positions. Where women do not have to compete with men there can be no discrimination on the basis of gender; women can occupy the top positions. Furthermore, if the most advantaged men in terms of career prospects (by class background, education and social connections) are concentrated in male dominated occupations, the competition from men in other occupations is less strong. Looking at it in another way, in a more gender-equal society it may appear to both sexes that their prospects are better in occupations dominated by their own sex. Indeed, in so far as those making appointments exercise any gender bias in favour of their own sex, prospects are better for those who follow conventionally gendered occupations. High horizontal segregation seriously limits occupational choice for both women and men but also tends to restrict vertical segregation.

A consideration of some actual data will help to clarify the position further. We do not have measures for a sufficient number of countries to present an actual test of our argument. Nevertheless the available measures allow an encouraging exploratory analysis. We have income data for Britain, Canada and the USA, and CAMSIS for Britain and the USA. Table 3 presents the comparison of the three countries when vertical segregation is measured by income. For Britain and Canada the data compares 1991 and 1996 while for the US the data are for census years 1990 and 2000.

Table 3 Dimensions of Segregation Canada, Britain and the USA
Vertical Dimension measured by Pay

Segregation	Canada		Britain		USA	
	<u>1991</u>	<u>1996</u>	<u>1991</u>	<u>1996</u>	<u>1990</u>	<u>2000</u>
Overall (O_{200})	.689	.692	.771	.761	.686	.668
Vertical (V_{200})	.309	.268	.276	.289	.309	.253
Horizontal (H_{200})	.616	.638	.720	.704	.612	.618
N of Occupations	512	514	371	371	504	509

Source Data: Canadian Census, supplied by Statistics Canada; British Labour Force Survey and New Earnings Survey; and IPUMS US Census data. For the USA and Canada income estimates are based on the pay of men and women; for Britain estimates are based on the more detailed male earnings.

The first thing to note is that the changes over time all follow the predicted pattern. In Canada and the USA horizontal segregation increased while vertical segregation declined. In Britain the pattern was reversed; as the horizontal component declined while vertical segregation increased. In Canada and Britain overall segregation changed in the same direction as horizontal segregation, while in the USA the decline in vertical segregation was accompanied by a decline in overall segregation. The changes are all quite small but this is not surprising in view of the short time period. When we look at earlier periods we see the same sort of pattern. In Canada the contrast between vertical and horizontal components is greater if we go back to 1981. While horizontal segregation increased 6.2% from 0.601 in 1981 the vertical component saw a massive 41% decline from 0.454, and this large decline caused a decline on overall segregation from 1981 to 1991 (Brooks, Jarman and Blackburn 2003:205). In Britain the changes from 1991 to 1996 reverse an earlier trend. Although comparison with the earlier data is less reliable, it appears that from 1971 to 1991 the vertical component decreased substantially, by about 42%, while the horizontal component increased about 10%, with a combined effect of reducing overall segregation by roughly 4%. Generally there have been moves towards equality which have slightly reduced overall segregation at the expense of increased horizontal segregation.

When we make comparisons between countries the results are not so clear cut. In 1990/91 Britain has higher horizontal and overall segregation and lower vertical segregation than the other two countries, while there is virtually no difference between Canada and the USA. This is consistent with expectations. However, in 1996/200 there is no such pattern, though if we were to interpolate an estimate for the USA in 1996 the comparison with Canada would fit the pattern.

An important point to note about these measures is that the horizontal component is appreciably greater than the vertical one. This makes clear the danger of assuming that overall segregation can serve as a measure of gender inequality, and helps to explain why so doing can give contradictory results. When we turn to the vertical dimension measured by CAMSIS the point becomes even clearer.

**Table 4 Segregation in Britain, 1971 -1996, and USA 1990
Vertical Dimension Measured by CAMSIS**

Segregation	<u>Britain</u>				<u>USA</u>
	1971	1981	1991	1996	1990
Overall (G_{200})	-.809	-.801	-.778	-.768	-.686
Vertical (V_{200})	-.123	-.082	-.124	-.118	-.140
Horizontal (H_{200})	.800	.798	.768	.759	.671
N of occupations	223	547	371	371	504

Source: British census except 1996 which is adjusted from the Labour Force Survey to maintain the ratio with the 1991 Labour Force Survey; IPUMS for US census data, and CAMSIS website at Cardiff University. Overall segregation is shown as negative as it lies below the horizontal in Figure 1 like the vertical segregation which is negative. Horizontal segregation is a scalar quantity, showing no advantage to either sex, and so can only be positive.

Table 4 shows the pattern of segregation using CAMSIS, the general measure of occupational inequality, for the USA in 1990 and for Britain from 1971 to 1996. The most comparable years for Britain are 1991 and 1996 as they use the same occupational classification scheme.

The scheme used for the 1981 census was very different so values for this year should be treated with considerable caution.

The most striking thing to note is the complete set of negative values, indicating that occupational advantage lies with women. Fox and Suschnigg (1989) and England (1979) found similar results using prestige scales for Canada and the USA. Reluctance to accept such a result led Fox (1989: 358) to say of prestige scales, 'We believe (with England, 1979) ... that the concept should be removed from its central role in research on stratification'. Our findings indicate that this pattern of inequality is real and needs to be taken seriously⁸.

The vertical components are all quite small, but even if we ignore the sign and regard them as estimates of a zero dimension, they are still considerably lower than the vertical component based on income. In the British data CAMSIS and income are correlated about 0.7, indicating roughly half their variance is common. If this relation with income were controlled, the non-income occupational advantages included in CAMSIS would show a clear advantage for women. To understand this we must note that men may dominate the best jobs but also are more likely to be in the unattractive manual jobs. Women tend to be concentrated towards the middle of the range in lower level non-manual work, while a substantial proportion occupy professional positions which pay less than the male dominated business jobs but compare well on status and general attractiveness. It is worth adding that neither income nor CAMSIS are direct measures of power, which would be hard to operationalize but very probably tends to be held more by men (Wright, Baxter and Birkelund 1995).

What are we to make of the relation between the vertical and horizontal dimensions? With negative values the interpretation is ambiguous. We might interpret the relation as before except that the advantage lies with women, so that essentially we ignore the sign and concentrate on the numerical value. This would give us the predicted pattern comparing the US with any of the British years; the USA has numerically lower horizontal and overall segregation coupled with numerically greater vertical segregation. On the other hand, since we know that in general the advantage lies with men, as seen in the UN data, we might expect opposite trends in horizontal and vertical segregation to mean that higher horizontal segregation is accompanied by more negative vertical segregation, that is vertical segregation takes account of sign so that larger negative values are taken as lower values. This is roughly what we see in the British trend, where the horizontal component declines steadily while the vertical component increases slightly. The only firm conclusion from the CAMSIS data is that overall segregation is not a measure of gender inequality and differences in vertical segregation do not necessarily follow the same pattern as differences in overall segregation.

5 Conclusion

One thing that emerges clearly from this discussion is the importance of precise and clear conceptualisation of segregation. Without a firm distinction between concentration and segregation none of the analysis presented here would have been possible. Then it became essential to recognise that overall segregation is not a measure of gender inequality, or even an approximation to inequality. Only vertical segregation measures inequality. In keeping

⁸ It should be noted that England and Fox and Suschnigg were not actually measuring a vertical dimension of segregation; like several other commentators they were simply comparing gender scores on a prestige scale.

with mathematics and common sense, the horizontal dimension of segregation must be at right angles to the vertical, thus representing difference without inequality. Any other conception of a horizontal dimension is a sure recipe for confusion. While women are disadvantaged in the public sphere in all countries, the horizontal differences are greater than the vertical inequality, even in respect of pay. With respect to the social advantages of occupations, women are not disadvantaged and may even be slightly advantaged, at least in some industrially developed countries. The relation between overall segregation and its vertical component is complex. On the one hand there is an obvious positive association - as vertical segregation increases it must tend to increase the resultant overall segregation and vice versa; or looking at it the other way round, as overall segregation changes it will tend to change vertical and horizontal segregation in the same direction. At the same time there is an inverse relation between horizontal and vertical segregation, so that as vertical segregation increases or decreases, then horizontal segregation - and sometimes overall segregation - changes in the opposite direction. We suggest this is because higher horizontal segregation increases the tendency for men and women to have distinct but equal career prospects. Further research is needed to determine how and why the balance between these opposing tendencies in the relation between overall and vertical segregation is determined.

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Bibliography

Anker R. (1998) *Gender and Jobs, Sex Segregation of Occupations in the World*, Geneva, International Labour Office.

Armstrong P. and Armstrong H. (1978) *The Double Ghetto: Canadian women and their segregated work*, Toronto, The Canadian Publishers.

Blackburn R. M., Brooks B. and Jarman J. (2001) 'The Vertical Dimension of Occupational Segregation', *Work, Employment and Society*, 15, 3, 311-338.

Blackburn R. M. and Jarman J. (1997) 'Occupational Gender Segregation', *Social Research Update*, 16, Spring. Also available at <http://www.soc.surrey.ac.uk/sru/SRU16/SRU16.html>.

Blackburn R. M., Jarman J. and Brooks B. (2000) 'The Puzzle Of Gender Segregation and Inequality; a Cross-National Analysis', *European Sociological Review*, 16, 2, 119-35.

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, Employment and Society*, 7, 3: 335-362.

- Blackburn R. M., Jarman J. and Siltanen J. (1994) 'Measuring Occupational Gender Segregation: A Reply to Lampard', *Work, Employment and Society*, 8, 3: 413-419.
- Blackburn R. M., Siltanen J and Jarman J. (1990) 'Measuring Occupational Gender Segregation', *Working Paper 3*, Cambridge: Sociological Research Group, 1990.
- Blackburn R. M., Siltanen J. and Jarman J.(1995) 'The Measurement of Occupational Gender Segregation: Current Problems and a New Approach', *Journal of the Royal Statistical Society*, 158, Part 2: 319-331.
- Boyd M., Mulvihill M. A. and Myles J. (1991) 'Gender, power and postindustrialism', *Canadian Review of Sociology and Anthropology*, 28, 4, 407-433.
- Bradley H. (1989) *Men's Work, Women's Work*, Cambridge, Polity.
- Brooks B., Jarman J. and Blackburn R. M. (2003) 'Occupational Gender Segregation in Canada, 1981-1996: Overall, Vertical and Horizontal Segregation.' *Canadian Review of Sociology and Anthropology*, 42, 2, 197-213.
- Cousins C. (1999) *Society, Work and Welfare in Europe*, London, Macmillan.
- Crompton R. and Sanderson K. (1990) *Gendered Jobs and Social Change*, London, Unwin Hyman.
- Crompton, R. and Harris F. (1998a) 'Explaining women's employment patterns: 'orientations to work' revisited', *British Journal of Sociology*, 49, 1, 118- 136.
- Crompton, R. and Harris F. (1998c) 'Gender Relations and Employment: The Impact of Occupation', *Work, Employment and Society*, 12, 2, 297-315.
- England P. (1979) 'Women and Occupational Prestige; a Case of Vacuous Sex Equality', *Signs*, 5, 252 - 65.
- ETAN (2000) *Science Policies in the European Union: Promoting Excellence Through Mainstreaming Gender Equality*, Brussels, European Commission.
- Fox J. And Suschnigg C. (1989) 'A Note on Gender and the Prestige of Occupations', *Canadian Journal of Sociology*, 14, 3, 353-360.
- 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', Research Paper No. 9, London, Department of Employment.
- James D. R. and Taueber K. E. (1985) 'Measures of Segregation', In N.B. Tuma (ed), *Sociological Methodology*, San Francisco, Jossey-Bass, pp. 1-31.
- Jarman J., Blackburn R. M., Brooks B. and Dermott E. (1999) 'Gender Differences at Work: International Variations in Overall Occupational Gender Segregation', *Sociological Research Online*, Vol. 4, No. 1, March; <http://www.socresonline.org.uk>.

Labour Force Survey (Britain) (1991 & 1996)

Lampard R. (1994) 'Comment On Blackburn, Jarman and Siltanen: Marginal Matching and the Gini Coefficient', *Work, Employment and Society*, 8, 3, 407-411.

Lewis D. E. (1985) 'The Sources of Changes in the Occupational Segregation of Australian Women', *The Economic Record*, December, 719-736.

Moore G. (1985) 'Horizontal and Vertical: The Dimensions of Occupational Segregation by Gender in Canada', *The CRIAW Papers* No. 12: Canadian Research Institute for the Advancement of Women.

Palomba R. (2002) 'Dossier III - Women in Science: What Do the Indicators Reveal?' *European Report on Science and Technology Indicators*. 257-270, Brussels, European Commission.

Reskin B.F. and Roos P.A. (1990) *Job Queues, Gender Queues*, Philadelphia, Temple University Press.

Silber J. (1989) 'On the Measurement Of Employment Segregation', *Economics Letters*, 30: 237-243.

Silber J. (1992) 'Occupational Segregation Indices in the Multidimensional Case: A Note', *The Economic Record*, 68, 202, 276-7.

Siltanen J., Jarman J. and R. M. Blackburn R. M. (1995) *Gender Inequality in the Labour Market: Occupational Concentration and Segregation*, Geneva, International Labour Office.

United Nations (1996) *Human Development Report 1996*, Oxford, New York, Oxford University Press for the United Nations Development Programme.

Walby S. (1997) *Gender Transformations*, London, Routledge.

Wright E. O., Baxter J. and Birkelund G. E. (1995) 'The gender gap in workplace authority: a cross-national study', *American Sociological Review*, 60, 407-435.

Yamagata H., Yeh K.S., Stewman S. and Dodge H. (1997) 'Sex Segregation and Glass Ceilings: A Comparative Model of Women's Career Opportunities in the Federal Government over a Quarter Century', *American Journal of Sociology*, 103, 3, 566-632.