

COMMENT ON SUZANNE M. BIANCHI AND NANCY RYTINA'S "THE DECLINE IN OCCUPATIONAL SEX SEGREGATION DURING THE 1970s: CENSUS AND CPS COMPARISONS"

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In their article, Bianchi and Rytina (1986) studied occupational sex segregation using the index of dissimilarity. They also decomposed the difference between the indexes of dissimilarity for two time periods into three components, namely, the effect of change in the occupational structure (called "Mix"), the effect of change in the occupational sex segregation (called "Comp"), and the interaction between these two effects, which they found by subtracting the two main effects from the total effect. Approximately the same results can be obtained from an alternative set of simpler formulas that includes one for the interaction term as well. The basic advantage of this new formulation is that it allows us to avoid the interaction term in a meaningful way along the lines suggested by Kitagawa (1955) and Das Gupta (1978, 1984).

The procedure is described using the occupational data from the 1970 and 1980 censuses (U.S. Bureau of the Census, 1984) as follows:

$$M = \sum_{i=1}^n M_i, \quad F = \sum_{i=1}^n F_i, \quad T_i = M_i + F_i, \quad T = \sum_{i=1}^n T_i,$$

$$P_i = M_i/T_i, \quad Q_i = F_i/T_i = 1 - P_i, \quad P = M/T, \quad Q = F/T = 1 - P,$$

where M_i, F_i = number of males and females in occupation category i in 1970, $i = 1, 2, \dots, n$. The corresponding numbers for the 1980 census are denoted by lower-case letters m, f, t, p , and q .

By definition, the index of occupational dissimilarity for 1970 is

$$I_1 = \frac{1}{2} \sum_{i=1}^n |(M_i \times 100/M) - (F_i \times 100/F)|, \tag{1}$$

which has a possible range from 0 to 100.

Bianchi and Rytina write equation (1) in the form

$$I_1 = 50 \sum_{i=1}^n \left| \frac{P_i T_i}{\sum_{j=1}^n P_j T_j} - \frac{Q_i T_i}{\sum_{j=1}^n Q_j T_j} \right|,$$

$$= G(P_1, \dots, P_n; Q_1, \dots, Q_n; T_1, \dots, T_n) = G(P, Q, T), \text{ say,} \tag{2}$$

where G is a function of the $3n$ quantities $P_1, \dots, P_n; Q_1, \dots, Q_n; T_1, \dots, T_n$.

Their expressions for the three components of the difference $I_2 - I_1$ between the indexes for 1970 and 1980 are

$$\begin{aligned} \text{Mix} &= G(P, Q, t) - G(P, Q, T), \\ \text{Comp} &= G(p, q, T) - G(P, Q, T), \\ \text{Interaction} &= (I_2 - I_1) - \text{Mix} - \text{Comp}. \end{aligned} \quad (3)$$

Since I_1 in equation (2) can be written as

$$I_1 = 50 \sum_{i=1}^n \frac{T_i}{T} \left| \frac{P_i}{P} - \frac{Q_i}{Q} \right|, \quad (4)$$

an alternative representation of the three effects in equations (3) is

$$\begin{aligned} \text{Mix} &= 50 \sum_{i=1}^n \left| \frac{P_i}{P} - \frac{Q_i}{Q} \right| \left(\frac{t_i}{t} - \frac{T_i}{T} \right), \\ \text{Comp} &= 50 \sum_{i=1}^n \frac{T_i}{T} \left(\left| \frac{p_i}{p} - \frac{q_i}{q} \right| - \left| \frac{P_i}{P} - \frac{Q_i}{Q} \right| \right), \\ \text{Interaction} &= 50 \sum_{i=1}^n \left(\frac{t_i}{t} - \frac{T_i}{T} \right) \left(\left| \frac{p_i}{p} - \frac{q_i}{q} \right| - \left| \frac{P_i}{P} - \frac{Q_i}{Q} \right| \right). \end{aligned} \quad (5)$$

Equations (3) are not algebraically identical with equations (5) because in the latter, P and p are treated as independent parameters that are not necessarily consistent with $(P_i$'s, t_i 's) and $(p_i$'s, T_i 's), respectively.

Bianchi and Rytina's table 1 showed the change in sex segregation in an occupational category by comparing the Q_i values over time. It is clear from equation (4) that this change is better reflected by a comparison of the Q_i/Q values. For example, in the two most female-dominated categories, namely, administrative support and private household service, these latter values have consistently moved toward 1 during 1972–1984, suggesting that sex segregation in these two categories has steadily declined, although the Q_i values in their table 1 give an unclear and somewhat opposite picture.

Since it is not easy to interpret the interaction effect, in terms of the proposed formulation in equations (5), it is possible to decompose the difference between two indexes of dissimilarity into Mix and Comp without the interaction term as follows:

Table 1.—Indexes of Dissimilarity and Components of Change for Occupational Sex Segregation

Index/effect	Bianchi-Rytina formulas with interaction	Present formulas	
		With interaction	Without interaction
Index of dissimilarity, 1970	67.68	67.68	67.68
Index of dissimilarity, 1980	59.28	59.28	59.28
Difference (1980 - 1970)	-8.40	-8.40	-8.40
Effect of occupational structure	-1.33	-1.26	-1.59
Effect of sex segregation structure	-6.43	-6.49	-6.81
Interaction effect	-0.64	-0.65	—
Standardized index of dissimilarity, 1970	—	—	67.05
Standardized index of dissimilarity, 1980	—	—	60.24
Difference (1980 - 1970)	—	—	-6.81

$$\begin{aligned}
 I_2 - I_1 = & 50 \sum_{i=1}^n \frac{\left| \frac{P_i}{P} - \frac{Q_i}{Q} \right| + \left| \frac{p_i}{p} - \frac{q_i}{q} \right|}{2} \left(\frac{t_i}{t} - \frac{T_i}{T} \right) \\
 & + 50 \sum_{i=1}^n \frac{\frac{T_i}{T} + \frac{t_i}{t}}{2} \left(\left| \frac{p_i}{p} - \frac{q_i}{q} \right| - \left| \frac{P_i}{P} - \frac{Q_i}{Q} \right| \right). \tag{6}
 \end{aligned}$$

The first expression on the right side of equation (6) is the Mix effect, that is, the amount of change in the index of dissimilarity in 1970–1980 that would result from the change in the occupational structure, if the sex segregation structure remained the same (and equal to the average of the 1970 and 1980 structures). The second expression is a “pure” measure of change in occupational sex segregation, that is, the amount of change in the index of dissimilarity that would occur from the change in the sex segregation structure, if the occupational structure remained the same (and equal to the average of the 1970 and 1980 structures). We can also interpret this latter expression as the difference between two standardized indexes of occupational dissimilarity, that is,

$$\begin{aligned}
 \text{Standardized } I_1 &= 50 \sum_{i=1}^n \frac{\frac{T_i}{T} + \frac{t_i}{t}}{2} \left| \frac{P_i}{P} - \frac{Q_i}{Q} \right|, \\
 \text{Standardized } I_2 &= 50 \sum_{i=1}^n \frac{\frac{T_i}{T} + \frac{t_i}{t}}{2} \left| \frac{p_i}{p} - \frac{q_i}{q} \right|. \tag{7}
 \end{aligned}$$

Excluding the experienced unemployed not classified by occupation and the seven occupational categories with no individuals in them in 1970, we are left with 480 categories of the experienced civilian labor force, 16 years and over, for the 1970 and 1980 censuses (U.S. Bureau of the Census, 1984) from which we obtain the results given in table 1. As we see from the results with interaction, the three effects obtained from the Bianchi-Rytina formulas in equations (3) and from the proposed formulas in equations (5) are fairly close. Moreover, this new formulation enables us to do away with the interaction term and make a more precise statement as follows:

The *crude* index of occupational dissimilarity in sex declined from 67.68 in 1970 to 59.28 in 1980, which is a reduction of 8.40 points (i.e., 12.4 percent). When the effect of the change in the occupational structure during 1970–1980 is eliminated, the *standardized* indexes of dissimilarity in 1970 and 1980 become 67.05 and 60.24, respectively, which is a reduction of 6.81 points (i.e., 10.2 percent). In other words, of the total reduction of 8.40 points in crude indexes, 6.81 points (i.e., 81.1 percent) are the reduction due to change in the sex segregation structure and the remaining 1.59 points (i.e., 18.9 percent) are the reduction due to change in the occupational structure.

Another similar article is by Lichter (1985), in which he expressed concern that in the 1970s, there was an increase in the spatial segregation of blacks and whites across counties in the United States and in the four major census regions. His conclusion is based on the values of the indexes of dissimilarity between the percent distributions of blacks and nonblacks in the counties in 1970 and 1980. As a matter of fact, if we eliminate the effect of the change in the county population structure in the decade, the increase in black–nonblack segregation becomes even more significant. To show this, in the foregoing formulas, we replace the employed males and females in the 480 occupational categories by black and nonblack populations in the 3,109 counties (excluding those in Alaska and Hawaii) in the 1970 and 1980 censuses. Using equations (4) and (7), we obtain the crude and standardized indexes of dissimilarity for black–nonblack segregation across counties in the United States and in four regions, as shown in table 2. The numbers reveal not only that the indexes increased in the decade in all regions, as already shown by Lichter in table 2 of his article, but also that the increases in all of them would have been even higher if the overall percent distributions of the populations by counties remained unchanged in the decade at the 1970–1980 average level. In other words, the growth differentials in

Table 2.—Crude and Standardized Indexes of Dissimilarity for Black–Nonblack Segregation Across Counties

Nation/region	Index of dissimilarity			Standardized index of dissimilarity		
	1970	1980	% increase	1970	1980	% increase
United States	47.15	47.43	0.6	46.68	48.22	3.3
Northeast	45.48	46.80	2.9	44.81	47.68	6.4
North Central	51.49	53.28	3.5	50.70	54.32	7.1
South	38.72	39.09	1.0	37.86	40.11	5.9
West	40.58	41.31	1.8	39.98	42.11	5.3

county populations in the decade diluted to some extent the actual increase in racial segregation.

REFERENCES

- Bianchi, S. M., and N. Rytina. 1986. The decline in occupational sex segregation during the 1970s: Census and CPS comparisons. *Demography* 23:79–86.
- Das Gupta, P. 1978. A general method of decomposing a difference between two rates into several components. *Demography* 15:99–112.
- . 1984. Contributions of other socio-economic factors to the fertility differentials of women by education: A multivariate approach. *Genus* 40:117–127.
- Kitagawa, E. M. 1955. Components of a difference between two rates. *Journal of the American Statistical Association* 50:1168–1194.
- Lichter, D. T. 1985. Racial concentration and segregation across U.S. counties, 1950–1980. *Demography* 22:603–609.
- U.S. Bureau of the Census. 1984. *1980 Census of Population. Supplementary Report. Detailed Occupation of the Experienced Civilian Labor Force by Sex for the United States and Regions: 1980 and 1970*. PC80-S1-15. Washington, D.C.: Government Printing Office.