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THE DECLINE OF SEX SEGREGATION AND THE WAGE GAP, 1970-80

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Abstract This study examines changes in the distribution of the U.S. workforce by sex across occupations and industries between 1970 and 1980 at a detailed level and assesses their impact on relative female earnings. For this purpose, we make use of 1970 and 1980 Census of Population employment and earnings data at the detailed occupation and industry level. We find that our indices of occupational and industrial segregation declined between 1970 and 1980 for the total workforce, as well as for major occupational groups. Employment growth clearly has an impact on industrial segregation of the workers in an occupation. Overall, the fastest growing occupations showed the largest declines in industry segregation between 1970 and 1980. This suggests that barriers or discrimination against women tend to lower during times when demand is strong and new workers are entering the occupation in large numbers. We also find that the most segregated occupations tend to have lower relative female to male earnings. This pattern is seen among all occupational groups. Moreover, regression results indicate that there is a highly significant negative relation between the change in relative female to male earnings and the change in the degree of industrial segregation within the occupation. The regression results also show that the male-female wage gap closed more rapidly in the faster growing occupations. Employment growth thus acts to reduce the wage gap directly and also indirectly by lowering the degree of industrial segregation. The direct effect may be due to the fact that rapid increases in the demand for workers may lower barriers to women finding jobs at high wage firms.

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I. Introduction

Several studies (Sanborn [1964], Oaxaca [1973], Wolff [1976], and Treiman and Hartmann [1981]) have offered evidence that 35 to 40 percent of the wage differential between full-time male and female workers results from the fact that men and women tend to do different jobs in the market. Female workers are more likely to be found in jobs with lower skills and lower pay--jobs where lengthy training and long tenure are rare or are not rewarded. Studies have shown that women are confined to a smaller number of occupations than men and that female workers are segregated by occupation and industry (Oppenheimer [1970], Oaxaca [1973], Treiman and Terrell [1975], U.S. Commission on Civil Rights [1978], Lloyd and Neimi [1979], Blau and Hendricks [1979], Reubens and Reubens [1979], Rytina and Bianchi [1984], Beller [1984], and Stolzenberg [1986]).

It has been suggested (Polacheck [1976 and 1981] and Landes [1977]) that female tastes for non-market work and the female life-cycle cause the average female worker to have a weaker commitment to her market career and a smaller incentive to acquire the skills and work experience required for many of the jobs typically done by male workers. Also, employers may be likely to view women as less fit candidates than men for jobs where lengthy tenure is required to pay off investments in specific job training of the worker.

The facts cast some doubt on this explanation. During the years from 1960 to 1980--a period when women in the U.S. showed dramatic increases in their labor force participation rates (and presumably their commitment to

market work)--the relative average wage of female to male workers remained unchanged (at about 60%). This was puzzling in the light of evidence from recent studies (Malveaux [1982], Beller [1984], Rytina and Bianchi [1984], and Jacobs [1986]) that there had been significant shifts in the occupational distribution of female workers between 1970 and 1980 and a decline in the segregation of the female workforce both by occupation and industry.

The most commonly used measure of sex segregation is an index developed by Duncan and Duncan [1955]. As the value of this index approaches zero, it indicates that men and women are equally likely to work at each job. As the index approaches a value of 100, males and females are increasingly segregated into different jobs. The index values are generally taken to represent the percent of the workforce that would have to be redistributed in order to eliminate segregation by sex. Studies by Blau and Hendricks [1979], Lloyd and Neimi [1979], Beller [1984], Rytina and Bianchi [1984], Jacobs [1986], and Malveaux [1986]), computed this index for the U.S. and found that it remained constant from 1900 to 1960, showed a modest decline between 1960 and 1970 (from 69.9% to 67.7%) and declined substantially between 1970 and 1980 (from 67.7% to 59.3%).

Two studies, by Jacobs [1986] and Malveaux [1986], have calculated the Duncan and Duncan index from data on employment by industry and occupation. Both produced index values that are higher (meaning more segregation) than those from studies on segregation by occupation alone. Jacobs' index value, for example, was 80.3% for 1970 and 69.6% for 1981. Both Jacobs and Malveaux also found a pattern of decline in the value of the index from 1970 to 1980 similar to what was seen in studies of segregation by occupation only. However, both studies analyzed fairly gross categories of occupation and industry.[1] This is important because the value of the Duncan and Duncan index

depends on the level of detail for which it is calculated. Generally, greater levels of detail in the data produce higher index values.

If female workers earn less because they are segregated then a decline in segregation should improve relative female earnings. At the same time, there are other important factors that influence relative earnings and these may also have changed during this period. One study, Smith and Ward [1984], suggests that although the number of skilled, experienced female workers has risen over the past 20 years, this has been offset by an influx of less skilled women into the workforce as the proportion of women who work has risen.

In addition, if segregation of occupations has declined, then women may now be entering occupations which were previously dominated by males. Since these jobs are more likely than typically "female" occupations to require lengthy training periods when earnings are low (the net investment phase described by Mincer [1962]), this may also explain why the relative earnings of female workers have failed to increase in spite of the decline in segregation.

On the other hand, it is also possible that the trend toward less segregation of occupations was being counteracted by increased worker segregation by industry within occupations. No study had examined segregation within occupations and the studies by Jacobs [1986] and Malveaux [1986], described above, were based on preliminary data for 1980. So if worker segregation by industry had increased, it might also account for the constancy of relative female earnings over this period. Several studies have shown that female workers are more likely to be found in low wage industries (see Blau [1977], for example).

This study examines changes in the distribution of the U.S. workforce by sex across occupations and industries between 1970 and 1980 at a finer level

of detail than has been done before and assesses their impact on relative female earnings. For this purpose, we make use of 1970 and 1980 Census of Population employment and earnings data at the detailed occupation and industry level. The study has three goals.

The first is to determine whether analysis of segregation at a finer level of detail would show the same trend found in the earlier studies. We find that the Duncan & Duncan index of occupational segregation was 0.67 in 1970 and that for occupational and industrial segregation was 0.72. Both indexes declined in 1980, to 0.58 and 0.64, respectively. We also find that with the exceptions of farmers, professional and managerial workers was the occupational group with the lowest level of sex segregation and also the group with the highest educational level and the highest female earnings. The most segregated group was services, which, with the exception of farmers, also had the lowest median educational level and lowest female earnings.

The second goal is to examine industrial segregation of workers within occupation and to investigate the factors that are associated with high or low levels of industrial segregation in an occupation. We divide occupations into three groups (male-dominated, female-dominated, and neutral) according to their proportion of female employees. Each group showed declines in industry segregation. We also find that employment growth clearly has an impact on industrial segregation of the workers in an occupation. Overall, the fastest growing occupations showed the largest declines in industry segregation between 1970 and 1980. The faster the growth rate the greater the decline in segregation. This factor seems to be especially important in the case of jobs that were male-dominated in 1970. This suggests that barriers or discrimination against women tend to lower during times when demand is strong and new workers are entering the occupation in large numbers.

The third goal of this study is to examine the relation between the male-female wage gap and the degree of sex segregation within an occupation as well as other factors. We find on the basis of tabular data that the most segregated occupations tend to have lower relative female to male earnings. This pattern is seen among all occupations and within sex-label groups of occupation. Moreover, regression results indicate that there is a highly significant negative relation between the change in relative female to male earnings and the change in the degree of industrial segregation within the occupation. The evidence suggests that within occupations, female workers tend to be more prevalent in relatively low wage industries than males, so that industry segregation of workers within occupations widens the wage differential between male and female workers. The regression results also show that the male-female wage gap closed more rapidly in the faster growing occupations. Employment growth thus acts to reduce the wage gap directly and also indirectly by lowering the degree of industrial segregation. The direct effect may be due to the fact that rapid increases in the demand for workers may lower barriers to women finding jobs at high wage firms.

The remainder of the paper is organized into five parts. Part 2 introduces the Duncan and Duncan index and discusses the basic data sources. Part 3 reports our findings on worker segregation by detailed occupation and industry over the 1970-80 period. Part 4 examines industrial segregation by sex within occupation. The fifth part reports econometric results of a model which posits changes in relative female earnings as a function of changes in industrial segregation and related factors. Concluding remarks are made in the last part.

II. The Duncan and Duncan Index and Basic Data Sources

Let us first define the basic data framework:

F = matrix of female employment by occupation and industry, where F_{ij} shows the employment of females in occupation i and industry j.

M = matrix of male employment by occupation and industry, where M_{ij} shows the employment of males in occupation i and industry j.

$E = F + M$, matrix of total employment by occupation and industry.

$N_f = \Sigma F_{ij}$, total employment of females.

$N_m = \Sigma M_{ij}$, total employment of males.

$N = \Sigma E_{ij}$, total employment.

Then, we can compute the following employment shares:

$f_i = \Sigma_j F_{ij} / N_f$, the proportion of total female employees working in occupation i.

$m_i = \Sigma_j M_{ij} / N_m$, the proportion of total male employees working in occupation i.

$f_{ij} = F_{ij} / N_f$, the proportion of total female employees working in occupation i and industry j.

$m_{ij} = M_{ij} / N_m$, the proportion of total male employees working in occupation i and industry j.

$f^*_{ij} = F_{ij} / \Sigma_j F_{ij}$, the proportion of total female employees in occupation i working in industry j.

$m^*_{ij} = M_{ij} / \Sigma_j M_{ij}$, the proportion of total male employees in occupation i working in industry j.

Three versions of the Duncan and Duncan index are used in this study. The first is:

(1) $$DDO = \Sigma_i \, |m_i - f_i| \, / \, 2,$$

which measures the extent of sex segregation by occupation. DDO can also be calculated for subsets of occupations, where m_i and f_i are defined as the proportion of the total male and female employment, respectively, in the occupational subset accounted for by occupation i. The second is

(2) $$DDIO = \Sigma_{ij} \, |m_{ij} - f_{ij}| \, / \, 2,$$

which measures the degree of sex segregation by industry and occupation. DDIO can also be calculated for subsets of occupations, where m_{ij} and f_{ij} are defined as the proportion of the total male and female employment, respectively, in the occupational subset in occupation i and industry j. The third is

(3) $$DDIND = \Sigma_j \, |m^*_{ij} - f^*_{ij}| \, / \, 2.$$

DDIND is calculated for each of 400 detailed occupations[2] and measures the extent of sex segregation among industries within each occupation.

We use data on civilian employment by detailed occupation and industry based on data from the 1970 and 1980 Censuses of Population. However, the 1980 Census uses a different set of detailed occupation categories than the 1970 Census. There were 441 detailed occupational categories in 1970, while in 1980 there were 447. In order to make data for the two years comparable,1970 employment by sex, detailed occupation, and detailed industry was first translated into 1980 detailed occupation and industry categories. This was accomplished with data from a subsample of the 1970 Census survey in which each occupation was double-coded with both the 1970 and 1980 codes. This permitted us to estimate actual 1970 employment in each of the 1980 occupational categories for all but six of the 443 1980 occupations.[3]

There are problems inherent in comparing the values of these indexes for different detailed occupations and for different groups of occupations, as we do in this study. Admittedly, anyone working with data on occupations is bound by the limitations which are built into the way an occupation is defined. Occupations vary greatly in size and in the range of skills and types of work done by the workers included in an occupation. One factor, which might have mattered quite a lot for our analysis, is the variation in the number of industries over which an occupation is spread. There are 235 detailed industries. Some occupations are restricted to a single industry while others span nearly all of the 235. There is the possibility that segregation of workers by sex, among industries, within occupations might be consistently related to the number of industries in which the occupation is found. The simple correlation between the number of industries with positive employment in an occupation (male or female) and the DDIND index of segregation by sex, among industries, within an occupation was positive (0.4 in 1970 and 0.3 in 1980). However, when we examined this factor in relation to various categories of occupation that are analyzed in this study, it does not appear to explain the differences in segregation of workers between categories in any consistent way.

III. Segregation of the U.S. Workforce [1970-80

The values of the indexes measuring segregation by sex for the U.S. workforce as a whole are shown in Table 1. In both years there was a greater level of segregation of workers among industries and occupations (DDIO) than across occupations alone (DDO). For both years, the difference between the two indexes is about five percentage points. This was expected since earlier studies have shown that the greater the number of cells into which workers are

divided, the higher the value of the index tends to be (see Blau [1983], p. 133, for example). The implication here is that males and females tend to work in different occupations and that within occupations, they tend to work in different industries. The index values also indicate that the level of segregation declined between 1970 and 1980. This is true for both versions of the index, DDO and DDIO, and both declined by about the same amount (roughly eight percentage points).

Several other studies have computed the DDO index for these years (see Table 1). Our values are comparable to theirs.[4] Only one other study computed the DDIO index. It is interesting that Jacobs' index values are higher than our since they are based on data from the Current Population Survey (CPS) for 10,000 occupation and industry cells while our data from the 1970 and 1980 Censuses were for 102,258 cells. Given the larger number of cells, our index values should have been higher than his. However, the Jacobs study was based on different data than ours; it is also possible that our translation of the 1970 data on employment into 1980 occupation and industry categories caused the distributions of male and female workers in 1970 to become more similar (less segregated) than they actually were and that this lowered the value of the index we computed for 1970. However, this would not explain why our 1980 index is also lower than Jacobs', particularly since the data we used for 1980 were considerably more detailed than Jacobs'. The likely reason is that the sample size of the CPS is much smaller than that of the Census of Population, thus introducing more error into the detailed occupational and industry distributions.

The same indexes, DDO and DDIO, were also computed for each of six groups of occupation used by the Census Bureau: (1) management and professional specialties; (2) technical, sales and administrative support positions; (3)

service jobs; (4) farming, forestry and fishery jobs; (5) precision, craft and repair occupations; and (6) operators, fabricators and laborers. The top of Table 2 shows the DDO and DDIO indexes computed for each of these groups for 1970 and 1980.

Service occupations (3), which accounts for about a fifth of total female employment, is the most segregated group by the two indices in both 1970 and 1980. There are three occupational groups which rank in the middle in terms of segregation: technical and sales (2), which accounts for almost half of female employment; precision and craft (5), which includes only about 3 percent of total female employment; and operators and laborers (6), which comprises about a sixth of total females employed. The levels of segregation are very similar among these three groups in the two years. The professional group (1) is markedly less segregated than these three. It accounts for about a fifth of total female employment. There are a large number of occupations in this group, so that its low level of segregation cannot be ascribed to a bias in the indices resulting from a small number of categories. Farmers (4) is the least segregated group, though this may be due to the fact that it comprises only 1 percent of the female work force.[5]

One important result is the consistent rank order of these occupational groups whether they are ranked by segregation by industry and occupation (DDIO), or by occupation alone (DDO). The ranks are also the same in both years. This suggests that patterns of female segregation among these groups are governed by factors that have not changed over time.

A second important result is that the overall level of segregation, as measured by both DDO and DDIO, declined for every group between 1970 and 1980. The two groups that show the largest declines in segregation are services (3), which was the most segregated group in both years, and professionals (1),

which was the least segregated group, except for farmers, in both years. Rytina and Bianchi [1984] also found that the professional occupations became more integrated between 1970 and 1980. They attribute much of this gain to increased female representation in the managerial occupations. Jacobs [1983] likewise found that the professional occupational group had the largest decline in segregation over these years.

The desegregation of service occupations accompanied a decline in its share of the female workforce, while the desegregation of professionals occurred as its share increased. Both of these contributed to the overall decline in segregation of workers by occupation and industry for the U.S. as a whole, because a larger share of the female workforce was now in the second least segregated group and a smaller share was in the most segregated group.

On the other hand, nearly half of employed female workers in both years were found in sales (2), which had the second highest level of worker segregation. In fact, about 60 percent of employed females worked in groups 2, 5 and 6, which had very similar levels of segregation in each year (around 0.68 in 1970 and 0.62 in 1980) and which were substantially more segregated than professionals.

We next compare the two indexes DDO and DDIO for each occupational group. The difference indicates the extent to which workers in the same detailed occupations within each group tend to be further segregated by industry (see Table 2). For each of the three middle ranked groups, sales (2), craft (5) and operatives (6), there is a large difference between its DDO and DDIO index, from .082 points for group 2 to .102 points for group 5. Within these three groups, there are high levels of segregation within detailed occupations as well as further segregation of the sexes among industries within occupations.

The smallest difference between DDO and DDIO on Table 2 is found for professionals (1) and services (3). This is interesting because the Service group has the highest values for both indexes and the Professional group has the lowest values for both. Apparently where segregation is high (services), it is high mainly because of segregation of workers by occupation. Where segregation is low (professionals), it is low because integration of workers by occupation is reinforced by similar distributions of male and female workers among industries within occupations.

Table 2 also lists the average level of a third version of the Duncan & Duncan index, DDIND, among the occupations in each group. DDIND measures industrial segregation of workers within each occupation. This version of the index is discussed in greater detail in Part IV. Mean values of DDIND for each group of occupations support the conclusions drawn above that professional occupations had the least segregation of workers among industries, while groups 2, 5 and 6, had the highest level of industrial segregation.

Differentials between the DDO and DDIO form roughly the same pattern in 1980 as in 1970. Groups 2, 5 and 6 all still had relatively large differentials in 1980, though they were all smaller than they were in 1970. The differential for services (3), the most segregated group, increased substantially, and the differential for professionals (1), the least segregated (large) group, also increased. This implies that although both groups were less segregated in 1980, by either measure, relatively more of the segregation in 1980 came from segregation of workers among industries rather than across occupations. In both groups, the decline in segregation of workers by sex across occupations from 1970 to 1980 was greater than the decline in segregation by occupation and industry.

The bottom of Table 2 shows relative female earnings and the median education level for males and for females in each group. The least segregated (large) group, professionals (1), had the highest level of female earnings, as well as highest median education. It is interesting that average female earnings in this group rose relative to overall average female earnings between 1970 and 1980 but that there was a decline in female earnings relative to male earnings over these years (from 77 to 73 percent). Part of the reason for this may be the decline in the median educational level of female workers in this group.

The most segregated group, services (3), had the lowest average level of female earnings in both years (with the exception of farmers). Services also had a fairly low ratio of female to male earnings in 1970 (lower than that of any group except sales). However, in 1980, the ratio of female to male earnings in services was 0.75, the highest of any group (though that for professionals was quite close). This increase in the ratio of female to male earnings in the most segregated group may have been due to the increase in the relative female educational level for this group; it may also have resulted in part from the very large decline in segregation which this group experienced over the decade. We shall return to this issue in Part IV.

Earnings, Education and Segregation of Workers. We next investigate whether high skill or high wage workers are more or less segregated by sex among industries and occupations than workers at lower wage or skill levels. In order to examine this, we divided the 400 detailed occupations into five quintiles ranked by the average wage levels (for both sexes) for 1970 and 1980. DDO and DDIO were then calculated for each quintile in each year (see Table 3). The results show that employment in the top wage quintile was the least segregated in each year, while employment in the middle wage quintiles

was the most segregated and that of the bottom tended to show less segregation than the middle quintiles. This pattern also emerged with other classification schemes we tried.[6]

We also grouped the 400 detailed occupations into quintiles based on 1970 level of education (see Table 3).[7] The results show that the lowest segregation of workers by sex occurred in the highest education quintile. The other four quintiles show fairly similar values of the segregation indexes.[8]

Why should the high wage and the high education occupations show less segregation of workers by sex? There does not appear to be any consistent relationship between skill level and segregation, because the greatest segregation was at the middle skill levels, not at the bottom. Also, the second quintile does not show markedly lower segregation than other quintiles. It might result from the fact that occupations at very high skill levels tend to be more broadly defined (for example, lawyer or physician), though this would not explain why there is also less segregation by occupation and industry in the top quintile. Another possible explanation is that segregation of workers by sex may result, in part, from workers' choices between jobs requiring continuous market work careers and those which do not. It may be that fewer such choices exist at high skill, high wage levels where nearly all jobs require a heavy commitment to market work. There would then be less of a difference in the job choices made by women and men at high skill levels and the distributions of employment by sex would be more similar than at lower skill levels.

It is also possible that the high levels of segregation seen here in the middle quintile reflect the influence of unions on jobs at this level. To the extent that union membership and seniority (predominantly male) determine access to certain occupations and industries, this may increase segregation by sex at this middle wage level.

IV. Industry Sex Segregation Within Occupations.

DDIND was computed for 400 of the 1980 detailed occupation categories (see Table 1). The DDIND indices are about half those of DDO and DDIO, indicating that the level of industrial segregation within occupations is about half the segregation level among occupations. On average, industrial segregation within occupation declined between 1970 and 1980. However, in both years, there was a large range in index values, from 0.0 to 0.89 in 1970 and from 0.0 to 0.66 in 1980.

The tendency of male and female workers to be employed in different occupations and for the majority of the female workforce to be found in a fairly small number of heavily-female occupations is a topic that has aroused considerable attention. The studies discussed in the Introduction generally found a decline in occupational segregation between 1970 and 1980 with female workers fanning out into a larger number of jobs and the sex ratio of many occupations becoming more neutral. This study looks at changes in worker segregation by industry within sex-dominated occupations over this period to see whether the trend toward integration of occupations has been reinforced or counteracted by changes in the distribution of males and females within occupations among industries.

The studies discussed in the Introduction use different criteria to classify occupations by sex label. Rytina and Bianchi [1984] uses a 20 percentage point spread about the overall proportion of the labor force which is female (40 percent in 1970) to classify occupations. Neutral (non-sex-dominated) ones are in the range of 20 to 60 percentage points; male-dominated jobs are defined as those with 20 percent or less of female workers; female-dominated occupations are defined as those with 60 percent or more of female

workers. Beller [1982] uses a 5 percent point spread about the overall female proportion of the labor force to define neutral occupations and then subdivides the male-dominated and female-dominated categories into two subgroups each.

We use the three-class Rytina and Bianchi scheme (see Table 4). The results indicate that in 1970 workers were somewhat more segregated by sex among industries in neutral occupations than in sex dominated jobs. Female-dominated occupations were the least segregated, though only slightly less so than male-dominated jobs. In 1980, male-dominated jobs were the most segregated and female-dominated jobs were, as in 1970, the least segregated.[9] Moreover, there was a modest decline in segregation for the male-dominated group (whose mean DDIND index fell from 0.34 to 0.31). The neutral category showed the largest decline in segregation (from 0.35 to 0.28). The female-dominated category also showed a large decline in segregation (from 0.31 to 0.26).

The three categories on the top of Table 4 contain different occupations in each year (as the percent of female workers in each occupation changed). Our purpose in looking at the mean values of the indexes for each group in each year was to see if there was a consistent relationship between the sex-composition of an occupation and its level of industrial segregation. It appears that there is not.

The only consistent pattern is that the least segregated jobs are the female-dominated ones in both years. The most segregated category in 1970 (neutral) is next to the least segregated in 1980. A larger number of occupations qualified as neutral in 1980 and there was an increase in the share of employed females in neutral jobs (20 percent in 1970 and 33 percent in 1980). Our findings here suggest then that the trend toward less

occupational segregation (more occupations having a neutral sex composition) has been reinforced by a decline in industrial segregation of the sexes within these occupations.

There were fewer male-dominated jobs in 1980 and there was a smaller share of the female workforce in such jobs. This is also the category with the highest level of industrial segregation in 1980, though segregation in male-dominated jobs was much lower in 1980 than it was in 1970.

The female-dominated category contains the largest share of total employed females in both years, though that share declined over the 10 years. Female-dominated jobs show relatively low industrial segregation in both years and it declined between 1970 and 1980. This is heartening since so large a share of women still remains in these jobs. Furthermore, the movement of female workers out of female-dominated jobs and into neutral jobs has not meant entering a category with appreciably higher levels of industrial segregation within occupations. The mean index value of neutral occupations is not much higher than that for the female-dominated ones in 1980.[10]

Our discussion of sex dominated categories of occupations up to this point has been based on different sets of jobs in 1970 and 1980. Occupations that qualified for one category in 1970 may have switched to a new category in 1980 if the proportion of female workers in it changed. Part of the decline in the mean index value for each category in the top panel of Table 4 may reflect this. In particular, neutral jobs may be less segregated on average in 1980 because less segregated jobs have switched into this category in 1980. Since the mean index value for all categories declined, this cannot be the only explanation. Most jobs must have become less segregated, but this will be made clearer by looking at a constant set of occupations.

These results are shown in the bottom panel of Table 4, where occupations are classified into the three sex label groups based on their 1970 sex

composition. Results are similar to the top panel of Table 4. Occupations that were neutral in 1970 absorbed a larger share of the employed female workforce (from 20 to 23 percent) over the decade and the proportion of females in these occupations increased from 36 to 44 percent. Most of these jobs remained neutral, though three became male-dominated by 1980 and 17 became female-dominated. All groups showed declines in industrial segregation (DDIND), though the largest decline (0.188) occurred in the three neutral jobs that became male-dominated.

The overall trend among these occupations is toward less segregation of workers by sex both by occupation (since most of these jobs remained neutral over the period and the share of the female workforce in these jobs increased) and by industry (since segregation by industry declined for the group as a whole). The fact that some of these jobs became male or female-dominated by the end of the period (therefore less sex neutral) is counteracted by the decline in industrial segregation within the sex dominated job categories. In addition, the loss of 20 jobs that switched out of the neutral category between 1970 and 1980 is outweighed by the gain of 44 jobs (38 of which had been male-dominated in 1970 and 6 of which had been female-dominated).

DDIND declined .056 % points for the occupations classified as female dominated in 1970, this is nearly as large a decline as was seen in the neutral group. The share of the total female employment in female-dominated jobs declined from 70 to 62 percent over the decade, while the proportion of females in these occupations declined slightly. Only six of the 73 occupations classified as female-dominated in 1970 switched to the neutral category in 1980. These six showed a very large decline in industrial segregation of workers. On the other hand, 17 jobs which had been neutral in 1970 switched into the female-dominated category in 1980. Despite this, the overall share of the female workforce in female-dominated jobs declined.

Occupations classified as male-dominated in 1970 had the smallest average decline in DDIND (0.038). The share of total female employment in these jobs increased substantially, from 9 to 15 percent, and the proportion of females in male-dominated occupations nearly doubled between 1970 and 1980. Most of the occupations that began the decade as male-dominated remained male-dominated by 1980 (175 out of 214). These jobs recorded the smallest decline in DDIND (0.029). On the other hand, this group experienced the largest percentage increase in its share of the female workforce over this period: from 9 to 15 percentage points, a 66 percent increase in its share. As with female-dominated jobs that became neutral over the decade, male-dominated jobs that became neutral showed larger average declines in industrial segregation than jobs that remained sex dominated. DDIND declined 0.081 in the 38 male-dominated jobs that became neutral.

Employment Growth and Segregation Changes Overall, faster growing occupations showed large declines in segregation of workers by industry between 1970 and 1980; (the simple correlation between the growth rate of an occupation and the decline in its DDIND value was -0.14). We divided the 400 occupations into 7 groups based on their growth rate of employment over the decade (Table 5). Except for the first group, there is almost a direct correspondence between occupational growth and the decline in industrial segregation (DDIND). The second and third slowest growing occupational groups ((2) and (3)) experienced a modest decline in DDIND whereas the fastest growing group had a 0.19 decline.

This pattern is again evident when we examine the relation between growth and declines in segregation by industry within sex dominated groups of occupations (Table 6). For each sex-label category, the fast growth group of occupations shows the largest declines in industry segregation, the moderate

growth group shows the second largest declines and the shrinking group shows the smallest declines. The range is greatest for the male-dominated occupations. Overall these jobs showed a smaller decline in worker segregation by industry than neutral and female-dominated jobs and they also tended to have a lower average growth rate. However, it seems that growth has its greatest impact on worker segregation in the male-dominated category. These results suggest that growth lowers barriers which otherwise prevent female workers from finding jobs in the same industries with male workers in male-dominated occupations. Since there is a greater demand for new workers in fast growing occupations, it may be more difficult for firms to discriminate against females. It is interesting to note that Reubens and Reubens [1974] concluded that just the opposite occurred during the period from 1960 to 1970. They found that most of the gains made by women entering male-dominated occupations during the 1960's occurred in jobs where male employment was static or shrinking.

To examine this further, we subdivided the group of male-dominated occupations by the same three growth categories and further by the change in the proportion of female workers between 1970 and 1980. The results are shown in the bottom panel of Table 6, and they again indicate that growth plays a critical role in the desegregation of occupations. Among shrinking male-dominated jobs, declines in segregation by industry were slight and they occurred only in those jobs where the overall sex-ratio was constant or becoming more male-dominated. Among moderate growth and fast growth occupations there is a clear pattern. The more the proportion of females increased, the more worker segregation by industry declined. Apparently when female workers enter fast growing, male-dominated occupations, they tend to find jobs in the same industries where male workers predominated. Again,

growth may lower the barriers which formerly kept women out of these industries.

However, the causality is not clear, because the converse is also true. The column on the right shows that in fast growing occupations where the proportion of females declined, the segregation of workers by industry tended to increase. So these two factors apparently act together. In male-dominated occupations, declines in worker segregation by industry occur primarily when the female proportion of the occupation is increasing and when the occupation is growing overall. If the female proportion declines with growth (which means that males are entering at a greater rate than females), segregation by industry tends to increase.

Segregation of Workers by Industry and Relative Female Earnings There is some evidence, though it is not decisive, that the relative earnings of female workers are lower in occupations where they are more segregated by industry. The simple correlation between relative female earnings and industrial segregation in an occupation was -0.14 in 1970 and -0.21 in 1980.

The data in Table 7 show the unweighted average of relative hourly earnings of female to male workers for six groups of occupations categorized by level of worker segregation by industry (DDIND index value).[11] There is a rough pattern of decline in relative female earnings as the level of worker segregation increases (this is stronger in 1980 than in 1970).[12] This same pattern of lower average relative female earnings at higher levels of segregation within occupations occurs within each of the sex-dominated categories.

The data in Table 8 for 1970 show that within each group of occupations classified by sex label, relative female earnings decline as industry segregation increases. The range in relative earnings is greatest in the

neutral category: from 0.68 in the most segregated jobs to 0.75 in the least segregated. The data for 1980 show a similar pattern. Within each sex-label group of occupations, relative female earnings decline as segregation by industry increases. However, in 1980, among neutral and female-dominated occupations, there are relatively more jobs in the least segregated and moderately segregated categories and fewer jobs in the most segregated category.

Over the 1970-80 period, occupations became less segregated by industry on average. However, the most segregated occupations still show comparatively lower levels of relative female earnings in 1980. The one exception to this is the group of neutral occupations in 1980 in which average (unweighted) relative female earnings remained the same for each segregation group. This might imply that although male and female workers tended to work in different industries among neutral occupations, women were no more likely than men to be found in low wage industries.

The mean relative female earnings figures for 1980 in Table 7 cannot be compared with those for 1970, because these figures are averages over different groups of occupations in each year. The purpose here is simply to determine whether there is a distinct pattern in average female earnings by segregation grouping. The data in Table 8 indicate that this is so only for sex-dominated jobs in 1980.

V. Determinants of Changes in Relative Female Earnings

We next develop an econometric model to examine the relation between worker segregation by industry and the change in relative female earnings within occupations. The basic equation is:

(4) $CHRFE_i = a + b_1\ CHDDIND_i + b_2\ CHEDUC_i + b_3\ CHEXP_i + b_4\ GROWTH_i + b_5\ FDOM_i + b_6\ MDOM_i + b_7\ RELFW_i$

where:

$CHRFE_i$ = the percent change in relative female to male earnings in occupation i between 1970 and 1980.

$CHDDIND_i$ = the change in the DDIND index in occupation i between 1970 and 1980.

$CHEDUC_i$ = the change in the ratio of median female education to median male education in occupation i between 1970 and 1980.

$CHEXP_i$ = percent change in female employment minus percent change in male employment in occupation i between 1970 and 1980.

$GROWTH_i$ = percent change in total employment in occupation i between 1970 and 1980.

$FDOM_i$ = a dummy variable set equal to 1 for the 73 female-dominated occupations (60 percent or more female workers in 1970) and equal to 0 for all other occupations.

$MDOM_i$ = a dummy variable set equal to 1 for the 213 male-dominated occupations (20 percent or less female workers in 1970) and equal to 0 for all other occupations.

$RELFW_i$ = average female earnings in occupation i as a percent of average female earnings in all occupations in 1970.

One additional variable which was used in place of RELFW is:

$MEANED_i$ = average educational level in occupation i in 1970.

Exact definitions of each variable, data sources, means of all variables, and simple correlation coefficients among variables are available in the Appendix.

If wages paid to workers in occupation i did not vary among industries, then changes in industry segregation of workers by sex would have no impact on

relative female (to male) earnings. Even if wages varied among industries, segregation of workers might still have no effect on relative female earnings if women were as likely as men to be found in both high wage and low wage industries. Changes in DDIND will have a significant effect on the dependent variable only if women are consistently more likely than men to be found in industries that pay below average (or above average) wages for a given occupation. Since earlier research suggests that women are more prevalent in low wage industries, we expect that declines in the index (CHDDIND) will be associated with a rise in relative female earnings.

The other variables in the model control for other factors which are likely to alter relative female earnings in an occupation. CHEDUC measures the change in the relative education of female to male workers in each job.[13] Since the established relation between earnings and education is positive, we would expect b_2 to be positive.

CHEXP measures the relative increase in female to male employment within an occupation over the 10 years. If a larger proportion of females than males are newcomers to an occupation, then we should expect a decline in the job tenure and work experience of the average female worker in such a job relative to that of the average male worker. Since job tenure is positively related to earnings, we would predict b_3 to be negative.[14]

The model also contains a variable measuring the overall employment growth rate of the occupation (GROWTH) between 1970 and 1980. Our hypothesis is that in fast growing occupations, rapid increases in the demand for workers may lower barriers to women entering high wage industries. This effect will be reflected mainly through changes in the segregation index, CHDDIND, but growth should also increase opportunities for women to enter high wage firms as well, (which the segregation index does not capture). Our prediction is that b_4 will be positive.

The two dummy variables FDOM and MDOM are included in the model on the basis of the results reported in Section IV, which shows clear, though not fully explained, evidence that the pattern of change in relative female earnings between 1970 and 1980, has been quite different in occupations with different sex composition. The decline in relative female earnings in male-dominated occupations may have occurred because the inflow of new female workers to these jobs lowered the level of work experience and job tenure of the average female worker. Just the reverse may be the case for female-dominated jobs in which male employment grew faster than female and relative female earnings rose. The variable CHEXP should capture part of the change in relative earnings that resulted from these factors. However, earlier research (see Treiman and Hartmann [1981], for example) indicates that there may be other factors which influence the wage structure in occupations of different sex composition and the dummy variables were included in this model to control for this possibility. Since relative female earnings rose in female-dominated and fell in male-dominated occupations, b_5 is expected to be positive and b_6, negative.

Unfortunately, there are no direct measures for the skill level of each of these detailed occupations. As a result, we used two proxies. The first is RELFW, which measures the ratio of average female earnings in each occupation in 1970 to overall average female earnings. The second is MEANED, the average education level of all workers in each occupation in 1970. In high skill occupations, we expect that the relative human capital of female workers may be a more important determinant of relative female earnings than in low skill occupations (where changes in relative female earnings may be more influenced by falling barriers to sex discrimination). If this is so, b_7 will be negative.

Results are shown in Table 9. Overall the results support the predictions of our model. The R^2 with all seven variables in the model is 0.39, which is in the range produced by most empirical tests of earnings functions. The most important result is that the variable CHDDIND is consistently negative and significant at the one percent level. In fact, the t-ratios are all about 7.0. The negative sign on b_1 is evidence that within occupations, female workers tend to be more prevalent in relatively low wage industries than males, so that industry segregation of workers within occupations widens the wage differential between male and female workers. The magnitude of the estimated coefficients (-0.4 to -0.5) implies that a one percent decline in DDIND is associated with a 0.5 percent increase in relative female earnings in an occupation. The beta coefficients average about a 0.3 and indicate that this variable is the most important explanatory variable of the seven.

The second important finding is that the coefficient of GROWTH is positive and highly significant in all specifications. The t-ratios are approximately 4.0 and the beta coefficient indicates that it is the second most important explanatory variable. The results confirm our hypothesis that in fast growing occupations, relative female earnings rise because rapid increases in the demand for such workers may lower barriers to women finding jobs at high wage firms. This is an important finding for it highlights the extent to which segregation of females into low wage firms has a clear impact on relative female earnings. In this model segregation of workers by industry is controlled for by CHDDIND, so the effect of GROWTH is separate from the effect of changes in segregation by industry. In fact, the coefficient of CHDDIND becomes slightly smaller and its t-value declines somewhat when GROWTH is added to the equation.

CHEDUC has a positive coefficient, though it is not usually significant.[15] Another version of the education variable was tried but was no more successful.[16] The coefficient of CHEXP is significant and has the expected negative sign. Our first proxy for the skill level of the occupation, RELFW, has highly significant and negative coefficients. The second proxy, MEANED, also has a significant negative coefficent, though the beta coefficient was considerably smaller that of RELWF. The results confirm our hypothesis that the male-female wage gap closed more rapidly in low skill occupations, once other factors are controlled for.

FDOM (equal to 1 for female-dominated jobs) and MDOM (equal to 1 for male-dominated jobs) also produced significant regression coefficients. The percent change in relative female earnings was about 4 percent greater in female-dominated jobs than in neutral ones (the reference category)and about 5 percent less in male-dominated than in neutral jobs. It is interesting that these dummy variables are significant even though the model controls for so many of the factors we might expect to influence the growth or decline in relative female earnings in an occupation (such as changes in women's relative education and experience and the growth rate of the occupation). These reults suggest that there are other characteristics of occupations which vary with sex composition and which influence the wage structure.

To explore this last point further, the same model was tested in regressions on three sex-label occupational subsets (see Table 10). The results indicate that this model is more successful in explaining the variation in the change in relative female earnings among female-dominated and male-dominated occupations than among neutral ones. The R^2 statistic is considerably higher for the two sex dominated samples than for the neutral sample. This is primarily the result of the higher t-ratios and beta

coefficients of the CHDDIND, GROWTH and RELFW variables in these two samples than in the neutral sample.

The coefficient of CHDDIND is negative and significant for all three samples. However, the estimated coefficient of b_1 as well as its beta value are substantially larger for the female-dominated sample of occupations than for the neutral and male-dominated samples. This suggests that variations in industry segregation cause larger variations in relative female earnings among female-dominated jobs. The coefficient of GROWTH is significant only in the two sex-dominated samples. This may suggest that there were originally lower barriers to female workers finding jobs at high wage firms in the neutral occupations than in the sex-dominated ones or that these barriers do not tend to decline in periods when there is strong demand for workers in the neutral jobs. The coefficient of the skill proxy, RELFW, has a much larger beta value and much higher t-value in the male-dominated sample than in the other two. The results suggest that particularly in male-dominated occupations, human capital factors are more crucial in closing the wage gap in high skill occupations, whereas falling discrimination barriers are more important in low skill jobs.

Overall, the evidence from the regressions in Table 10 suggests that there are intrinsic and unidentified factors governing the structure of wages in sex dominated occupations which are not captured by this model. It is also clear that declines in the industry segregation of workers by sex within these occupations had an important impact on the growth of relative female to male earnings over the decade of the 1970s even within sex dominated categories of occupation.

VI. **Conclusion**

All indices of sex segregation showed a decline between 1970 and 1980. DDO fell from 0.67 to 0.58; DDIO declined from 0.72 to 0.64; and the average value of DDIND decreased from 0.34 to 0.28. With the exception of farmers, professional and managerial workers was the occupational group with the lowest level of sex segregation and also the group with the highest educational level and the highest female earnings. The most segregated group was services, which, with the exception of farmers, also had the lowest median educational level and lowest female earnings.

All six of the occupational groups we investigated showed declines in segregation over the period from 1970 to 1980. The largest declines occurred for the most segregated and least segregated groups. All six groups showed more segregation by occupation and industry (DDIO) than by occupation alone (DDO). The differential between these two was smallest in the most segregated group (services) and, with the exception of farmers, the least segregated group (professionals). An examination of segregation at different wage and educational levels indicates that the lowest level of segregation was at the highest wage and educational levels, whereas the highest levels of segregation were seen at middle wage levels.

When jobs are classified by their sex-composition in each year, the only consistent relationship to emerge between sex composition and industry segregation of workers is that female-dominated jobs had the lowest average level of industrial segregation in both 1970 and 1980. In 1970, neutral jobs were the most segregated by industry, while in 1980, male-dominated jobs were the most segregated. Occupations in each of the three categories showed a substantial decline in industry segregation between 1970 and 1980. Average DDIND in the most segregated group in 1980 (male-dominated) was the same as that in the least segregated category in 1970 (female-dominated).

Most jobs did not change sex-label between 1970 and 1980. Each group showed declines in industry segregation on average. Substantial declines in segregation by industry occurred in the 38 formerly male-dominated and 6 formerly female-dominated jobs that became neutral in 1980. Sex dominated jobs that remained sex dominated showed only modest declines in segregation of workers by industry over these 10 years. This was especially true for male-dominated jobs. Overall it then appears that decreases in occupational segregation have been reinforced by declines in industry segregation of workers within these sex-label occupational groups and shifts of occupations from the sex dominated category to the neutral category.

Growth clearly has an impact on industrial segregation of the workers in an occupation. Overall, the fastest growing occupations showed the largest declines in industry segregation between 1970 and 1980. Shrinking occupations showed the smallest declines in segregation. Our data show a decisive and consistent pattern in each of the 3 sex-label groups of occupation: the faster the growth rate, the greater the decline in segregation. This factor seems to be especially important in the case of jobs that were male-dominated in 1970. For these, there were very large declines in industry segregation for the occupations with a high growth rate and for those in which female workers entered the occupation in greater numbers than males. This result contrasts sharply with that of Reubens and Reubens [1974] who found that during the 1960s female gains were greater in male-dominate occupations whose employment was static or shrinking. Our results suggest that barriers or discrimination against women tend to lower during times when demand is strong and new workers are entering the occupation in large numbers.

The tabular evidence indicates that the most segregated occupations tend to have lower relative female to male earnings. This pattern is seen among

all occupations and within sex-label groups of occupation. The econometric results indicate that changes in industrial segregation of workers by sex within an occupation do have a significant impact on the change in relative female earnings. As segregation declines, relative female earnings rise. This result is particularly strong in sex dominated occupations. Employment growth within an occupation was found to have a very significant direct effect in raising relative female earnings within the occupation. This effect was also stronger within the sex dominated occupations. Presumably this occurs because growth lowers barriers to females entering high wage firms. Employment growth also helps to close the wage gap indirectly by lowering the level of industrial segregation within occupations. Moreover, changes in relative schooling and experience levels between females and males were found to be significant in explaining the increase in relative female earnings.

Another finding of some interest is that the male-female wage gap in low skill occupations, particularly male-dominated ones, fell more rapidly than in high skill occupations, once other factors are controlled for. We do not have a definitive explanation for this. However, one possibility is that human capital factors are more crucial in closing the wage gap in high skill occupations, whereas falling discrimination barriers are more important in low skill jobs.

Footnotes

[1] Malveaux used data on employment by 1 digity industry and 1 digit occupation; Jacobs used Current Population Survey data on 10,000 categories of occupation and industry.

[2] This index was calculated for only 400 of the 437 detailed occupations used in this study, because estimates of either male or female employment for 1970 in 37 of the 1980 occupational categories are unreliable due to the small size of the subsample.

[3] The concordance scheme is from U.S. Department of Commerce (1986). This is based on a subsample of 120,000 records from the 1970 Census. Because this sample is so much smaller than the full Census, six of the 1980 occupation codes did not appear at all, though, fortunately, these were occupations which had relatively small employment. It was therefore impossible to estimate actual 1970 employment in these, so they were dropped from the set of occupations used for this study. In order to make the 1980 data compatible, these six occupations were also eliminated from the 1980 data. Both DDO and DDIO indexes were computed for 1980 based on total employment with the six occupations included and with the six occupations excluded. There was virtually no difference in the value of the indexes (probably because the employment in these six occupations was so small).

[4] As Beller points out, indexes computed from different data sources are not directly comparable. The Beller index shown here is based on the Annual Dempgraphic File of the Census Current Population Survey for 1981 and is based on 262 occupations. Our index for 1980 is based on the 1980 Census data for 437 occupations.

[5] We tested for the possibility that the variation in the degree of segregation among occupational groups is due, in part, to the variation in the

number of industries over which the employment in the occupations in each group was spread. We found that this was not the case here. Employment in the most segregated group (3) was spread among fewer industries, on average, than two other groups in 1970 and four other groups in 1980. On the other hand, employment among professional workers (1) was spread among more industries than services (3) in 1980 but showed much less segregation.

[6] Five different classification schemes were tried for ranking occupations by wage level. Some schemes used eight categories, while others used quintiles. Some schemes were based on simple averages of the mean male and female wages in each occupation, while others used weighted averages, with percent male and female used as weights. One other scheme was based on only the mean male wage in each occupation. The general pattern of results is consistent with those reported above.

There is also the possibility that this pattern resulted from our having grouped occupations based on an average of both male and female wages in the occupation. In order for the overall average to be very high, both mean male and mean female wages must be high. As we will discuss in Part IV, female wages tend to be low in occupations where there is a high level of industrial segregation. Therefore, a high mean wage for both sexes can occur only in jobs with low industry segregation. However, we found the same rank order of segregation levels when occupations were grouped by quintiles based only on mean hourly male wages, with the only exception that in 1970 the bottom quintile had the highest level of segregation.

[7] There was insufficient variation in our education data for 1980 to delineate five quintiles, because more than 200 of the 400 occupations had a median education level of 12 years. This resulted from the fact that our data on median education level for each detailed occupation in 1980 was based on data of the distribution of workers among six educational classes for each

occupation. These were the only data available on education by sex and by detailed occupation available for 1980.

[8] We again checked for the possibility that differences in the estimates of DDIO could be biased from variation in the number of industries over which employment in these occupations were spread. There was almost no correlation between DDIO and the number of industries over the wage quintiles.

[9] The results were not markedly different when the five-class Beller scheme was tried. The average values of DDIND for very sex dominated and moderately sex dominated categories were quite similar. A three-class version of the Beller categories was also tried. The same pattern emerges with either the Beller or Rytina and Bianchi categories: in neutral occupations workers tended to be more segregated by sex among industries than in sex dominated jobs, and the difference between them is greater when the neutral job category is more narrowly defined, as in the Beller scheme.

[10] Again, we examined the possibility that differences in the value of the segregation indices among the three sex label groups resulted from variation in the number of industries over which employment in each group was spread. In 1970, employment in the least segregated group (female-dominated) was spread over the least number of industries,while employment in the most segregated group (male-dominated) was spread over the most industries. However, in 1980, employment in the most segregated group (male-dominated) was spread over the fewest industries.

[11] The 1970 hourly wage data presented here are estimated from Census data on mean annual earnings by sex and by detailed occupation for persons in the experienced civilian labor force who had worked 50 or more weeks in 1969, and on Census data on mean hours worked in the reference week by sex and detailed occupation. Unfortunately, the hours data are based on all workers (part year and full year), while the earnings data are based on full year workers only.

If full year workers have higher mean hourly wages than part year workers (within each sex and detailed occupation category), then our estimates of the 1970 hourly wages may be biased upward. A weighted mean of the 1970 hourly male wage over all occupations ($4.54) and of the female wage ($2.80) for 1970, based on our estimates for each occupation, was virtually the same as the mean hourly wage in published Census data for all males and all females for 1970. However, there may still have been overestimates for some detailed occupations and underestimates for others. The 1980 wage data were taken directly from published Census data on mean hourly wages by sex and detailed occupation for all workers in the experienced civilian labor force. Both part year and full year workers are included. There were no data available on hourly wages by sex and detailed occupation for part year workers in 1970 which could be used to make the two wage series completely comparable. For this reason, we used the annual earnings data (rather than hourly wages) in the regressions in Part 5.

[12] Another point of interest is that for four of the categories, relative female earnings are lower in 1980, on average, than in 1970. This may reflect the fact that the means are unwieghted averages over each group of occupations and that there are different jobs in each of the six groups in each year.

[13] As noted above, median education levels in 1980 for each sex and detailed occupation had to be estimated from data on the distribution of workers among six education classes. From this we computed median education for each sex and detailed occupation. The computed median however, was severely limited by the narrow width of the median class for nearly 200 occupations. This led to an estimate of median education at 12 years for these 200 occupations. This resulted in less measured variation in median education among the 400 occupations in 1980 than was likely the case, and, as a result, our variable CHRELED may not be as sensitive a measure as we would have liked.

[14] Unfortunately, no data were available on the age distribution of employment by sex and detailed occupation to estimate experience or job tenure directly.

[15] This results may be due to our crude estimate of median education. See footnote 13.

[16] The other version of the education variable was EDIFF = (EM80 - EF80) - (EM70 - EF70), where EM80 = median male education in occupation i in 1980, EF80 = median female education in occupation i in 1980, EM70 = median male education in i in 1970, and EF70 = median female education in i in 1970.

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Table 1

Duncan and Duncan Indices for the Full Work Force, 1970 and 1980

	1970	1980	Change
This Study:			
DDO	0.668	0.585	- 0.083
DDIO	0.717	0.633	- 0.081
DDIND[a]	0.335	0.282	- 0.047
Other Measures of Segregation by Occupation Only:			
Reskin & Hartman[b]	0.677	0.593	-0.084
Beller[c]	0.659	0.617	-0.042
Other Measures of Segregation by Occupation and Industry:			
Jacobs[d]	0.803	0.696	-0.107

a. Unweighted average of 400 occupations. See footnote 3.
b. The source is Reskin and Hartmann, 1986, Table 2-4, p. 25.
c. The source is Beller, 1984, Table 2-1, p. 14..
d. The source is Jacobs, 1983, from Reskin and Hartmann, 1986, p. 24.

Table 2

Duncan and Duncan Indices, Relative Female Wages, and Median Education
By Major Occupational Group, 1970 and 1980

Occup. Group[a]	Number of Occups.	Segregation Indices: DDO 1970	DDO 1980	DDIO 1970	DDIO 1980	DDIND[b] 1970	DDIND[b] 1980	Difference Between DDIO and DDO 1970	Difference Between DDIO and DDO 1980
(1)	95	0.56	0.43	0.60	0.49	0.24	0.21	.046	.057
(2)	94	0.60	0.55	0.68	0.62	0.32	0.27	.083	.068
(3)	40	0.68	0.55	0.73	0.63	0.25	0.23	.047	.078
(4)	12	0.35	0.30	0.37	0.31	0.07	0.14	.013	.018
(5)	95	0.58	0.54	0.68	0.62	0.35	0.32	.102	.082
(6)	101	0.57	0.52	0.67	0.60	0.33	0.32	.097	.084
All	437	0.67	0.59	0.72	0.63	0.34	0.28	.049	.048

Occup Group[a]	Percent of Total Female Employment 1970	1980	Ratio of Mean Hourly Female Wage to Overall Mean Fem. Wage 1970	1980	Ratio of Mean Hourly Female Wage to Mean Hourly Male Wage 1970	1980	Median Years Of Schooling In Occup. Group 1970 male	1970 fem.	1980 male	1980 fem.
(1)	17.1	21.5	1.20	1.25	0.77	0.73	15.0	15.0	15.0	14.3
(2)	45.3	45.6	0.87	0.88	0.64	0.68	12.9	12.5	12.7	12.1
(3)	19.8	17.9	0.60	0.67	0.66	0.75	11.0	10.9	11.7	11.7
(4)	0.9	1.0	0.49	0.60	0.74	0.74	10.0	10.4	11.6	11.8
(5)	2.6	2.3	0.84	0.91	0.69	0.66	11.6	11.4	12.0	12.0
(6)	14.2	11.7	0.73	0.80	0.70	0.71	11.0	10.7	11.9	11.7

a. The six occupational groups (with 1980 Census codes) are as follows:
(1) Managerial and professional specialty occupations (003-203).
(2) Technical, sales and administrative support positions (203-389).
(3) Service jobs (403-469).
(4) Farming, forestry and fishery jobs(473-499).
(5) Precision, craft and repair occupations (503-699).
(6) Operators, fabricators and laborers (703-889).

b. Unweighed mean value among all occupations in group.

Table 3

Duncan and Duncan Indices by Wage and Educational Quintiles[a]

Quintile	DDO	DDIO	Mean Hourly Wage Index[b]	Percent of Total Employed Males	Females
I. 1970 Wage Quintiles					
Top	0.41	0.49	148.2	13%	5%
2nd	0.72	0.74	107.1	24	26
3rd	0.73	0.76	92.7	17	14
4th	0.60	0.71	82.4	22	25
Bottom	0.68	0.72	69.7	23	30
II. 1980 Wage Quintiles					
Top	0.38	0.45	143.8	24	16
2nd	0.57	0.63	109.8	19	12
3rd	0.74	0.78	94.4	18	21
4th	0.55	0.63	83.3	19	16
Bottom	0.52	0.62	68.5	19	36
III. 1970 Education Quintiles					
Quintile	DDO	DDIO	Mean Education[c]	Percent of Total Employed Males	Females
Top	0.55	0.58	15.8	14	12
2nd	0.71	0.74	12.8	20	36
3rd	0.66	0.74	12.2	19	21
4th	0.57	0.67	11.4	19	11
Bottom	0.71	0.74	10.3	27	19

a. Each quintile contains 80 of the 400 detailed occupations.

b. Unweighted average of the ratio of the quintile mean hourly wage to the overall mean hourly wage for males and the ratio of the quintile mean hourly wage to the overall mean hourly wage for females.

c. Weighted average of median male education in the quintile and median female education in that quintile, with male and female employment shares as weights.

Table 4

Duncan and Duncan Indices by Sex Label Occupational Groups

I. Classification Based on Sex Labels in Each Year

Sex Label	Percent of Occupations		Percent of Total Female Employment		Mean Value of DDIND[b]		Change in Mean Value of DDIND
	1970	1980	1970	1980	1970	1980	
Male-Dominated	53%	44%	10%	6%	0.34	0.31	-0.038
Neutral	28	34	20	33	0.35	0.28	-0.058
Female-Dominated	18	21	70	61	0.31	0.26	-0.056

II. Classification Based on 1970 Sex Labels

1970 Sex Label	Percent of Total Female Employment		Average Percent Of Females in Occupation[b]		1980 Sex Label	Number of Occupations	Change in Mean Value of DDIND
	1970	1980	1970	1980			
Male-Dominated	10%	15%	6%	11%	Male-Dom.	175	-0.029
					Neutral	38	-0.081
					Fem.-Dom.	0	--
					Total	213	-0.038
Neutral	20	23	36	44	Male-Dom.	3	-0.187
					Neutral	94	-0.054
					Fem.-Dom.	17	-0.059
					Total	114	-0.058
Female-Dominated	70	62	80	79	Male-Dom.	0	--
					Neutral	6	-0.137
					Fem.-Dom.	67	-0.049
					Total	73	-0.056

a. Male-dominated occupations are defined as those with 20 percent or less female employment. Female-dominated occupation are defined as those with 60 percent or more female. Neutral occupations are defined as those with more than 20 percent but less than 60 percent female.

b. Unweighted mean among occupations within the occupational group.

Table 5

Duncan and Duncan Indices for Occupations Grouped by Employment Growth Rate

Group	1970 - 1980 Occupational Employment Growth	1970 - 1980 Change in Mean Value of DDIND[a]
(1)	-30% or lower	-0.052
(2)	-30% to 0	-0.014
(3)	0 to 30%	-0.033
(4)	30 to 90%	-0.061
(5)	90 to 150%	-0.085
(6)	150 to 300%	-0.084
(7)	300% or greater	-0.194

a. Unweighted mean among occupations within the occupational group.

Table 6

Change in Mean Value of DDIND over the 1970-80 Period For Occupations Grouped by Employment Growth Rate, Sex Label, and Female Representation

I. All Occupations

	Employment Growth, 1970-80		
Sex Label[a]	Shrinking (negative)	Moderate Growth (0 to 149%)	Fast Growth (150% or greater)
Male-dominated:	-0.01	-0.05	-0.16
Neutral:	-0.03	-0.07	-0.09
Female-dominated:	-0.05	-0.05	-0.10

II. Occupations Classified Male-Dominated in 1970

Change in Proportion of Females in Occupation	Shrinking	Moderate Growth	Fast Growth
Negative	-0.02	-0.02	0.07
0 to 5%	-0.02	-0.04	-0.02
5 to 10%	-0.01	-0.04	-0.24
10% or Greater	0.00	-0.09	-0.24

a. Male-dominated occupations are defined as those with 20 percent or less female employment. Female-dominated occupation are defined as those with 60 percent or more female. Neutral occupations are defined as those with more than than 20 percent but less than 60 percent female.

Table 7

Unweighted Average of the Ratio of Female to Male Hourly Wages
For Occupations Grouped by the Level of Industrial Segregation

Value of DDIND Index:	Number of Occupations in Group		Mean Ratio of Female to Male Hourly Wages	
	1970	1980	1970	1980
(1) Less than 0.100	33	36	0.76	0.76
(2) 0.101 to 0.200	51	69	0.74	0.68
(3) 0.201 to 0.300	76	117	0.76	0.72
(4) 0.301 to 0.400	95	86	0.75	0.69
(5) 0.401 to 0.500	100	64	0.70	0.70
(6) 0.501 or Greater	45	28	0.71	0.64

Table 8

Unweighted Average of the Ratio of Female to Male Hourly Wages
For Occupations Grouped by the Level of Industrial Segregation and Sex Label

Sex Label[a]	Value of DDIND Index: Least Segregated (0 to 0.119)	Moderately Segregated (0.20 to 0.399)	Most Segregated (0.40 or Greater)
I. 1970			
Male-Dominated	0.76 (47 Occup.)	0.80 (94 Occup.)	0.73 (72 Occup.)
Neutral	0.75 (20 Occup.)	0.72 (40 Occup.)	0.68 (54 Occup.)
Female-dominated	0.73 (17 Occup.)	0.70 (37 Occup.)	0.67 (19 Occup.)
II. 1980			
Male-Dominated	0.70 (39 Occup.)	0.71 (93 Occup.)	0.69 (46 Occup.)
Neutral	0.69 (42 Occup.)	0.69 (61 Occup.)	0.69 (35 Occup.)
Female-dominated	0.77 (24 Occup.)	0.72 (49 Occup.)	0.64 (11 Occup.)

a. Male-dominated occupations are defined as those with 20 percent or less female employment. Female-dominated occupation are defined as those with 60 percent or more female. Neutral occupations are defined as those with more than than 20 percent but less than 60 percent female.

Table 9

Regression Results of the Percentage Change
In Relative Female Earnings (CHRFE) on CHDDIND, GROWTH, and Other Variables[a]

Independent Variables	Regression Form (1)	(2)	(3)	(4)	(5)	(6)
Constant	-6.55	-7.33	-4.82	13.82	14.48	7.83
(t-ratio)	(6.65)	(7.49)	(3.13)	(5.49)	(6.18)	(1.48)
CHDDIND	-0.48**	-0.43**	-0.42**	-0.43**	-0.44**	-0.45**
(t-ratio)	(7.24)	(6.69)	(6.83)	(7.56)	(7.52)	(7.03)
beta coeff.	-0.33	-0.31	-0.30	-0.30	-0.31	-0.32
CHEDUC	9.47	18.38	21.47#	9.26	5.66	18.20
(t-ratio)	(0.68)	(1.33)	(1.62)	(0.76)	(0.46)	(1.33)
beta coeff.	0.03	0.06	0.07	0.03	0.02	0.06
CHEXP	-0.02**	-0.02**	-0.01**	-0.01*	-0.02**	-0.02**
(t-ratio)	(4.17)	(4.88)	(2.43)	(2.15)	(3.93)	(4.42)
beta coeff.	-0.19	-0.22	-0.11	-0.09	-0.16	-0.20
GROWTH		0.03**	0.02**	0.02**	0.03**	0.03**
(t-ratio)		(4.40)	(3.05)	(4.23)	(5.41)	(4.85)
beta coeff.		0.20	0.14	0.18	0.23	0.23
FDOM			5.84**	4.16*		
(t-ratio)			(2.46)	(1.92)		
beta coeff.			0.13	0.09		
MDOM			-7.64**	-5.30**		
(t-ratio)			(4.21)	(3.16)		
beta coeff.			-0.21	-0.15		
RELFW				-0.20**	-0.23**	
(t-ratio)				(8.92)	(10.03)	
beta coeff.				-0.37	-0.41	
MEANED						-1.25**
(t-ratio)						(2.92)
beta coeff.						-0.14
R^2	0.16	0.20	0.27	0.39	0.36	0.21

a. The sample size is 400 detailed occupations. See the text and Appendix for definitions of variables and for sources of data.

** = significant at 0.01 level.
* = significant at 0.05 level
# = significant at 0.10 level.

Table 10

Regression Results of the Percentage Change
In Relative Female Earnings (CHRFE) Within Sex Label Occupational Groups[b]

Independent variables:	Occupational Group[a]		
Independent	Male-dominated occupations	Neutral occupations	Female-dominated occupations
Constant	13.41	3.51	15.13
(t-ratio)	4.65	0.82	1.86
CHDDIND	-0.30**	-0.31**	-0.83**
(t-ratio)	(4.10)	(2.81)	(5.31)
beta coeff.	-0.23	-0.27	-0.58
CHEDUC	14.49	26.42	21.74
(t-ratio)	(0.98)	(1.18)	(0.55)
beta coeff.	0.05	0.11	0.06
CHEXP	-0.007	-0.002	-0.001
(t-ratio)	(1.32)	(0.17)	(0.11)
beta coeff.	-0.08	-0.02	-0.01
GROWTH	0.06**	-0.005	0.02**
(t-ratio)	(3.53)	(0.28)	(2.84)
beta coeff.	0.21	-0.03	0.29
RELFW	-0.25**	-0.07#	-0.19*
(t-ratio)	(9.78)	(1.72)	(2.01)
beta coeff.	-0.55	-0.16	-0.20
R^2	0.39	0.14	0.39
sample size	213	114	73

a. See the text and Appendix for definitions of variables and for sources of data.

b. Male-dominated occupations are defined as those with 20 percent or less female employment. Female-dominated occupation are defined as those with 60 percent or more female. Neutral occupations are defined as those with more than than 20 percent but less than 60 percent female.

** = significant at 0.01 level.
* = significant at 0.05 level
# = significant at 0.10 level.

Appendix

Definitions of Regression Variables, Sources of Data,
Means of Variables, and Simple Correlations Among Variables

I. Variable Definitions

1. $CHRFE_i = [(EF80_i/EM80_i) - (EF70_i/EM70_i)] / (EF70_i/EM70_i)$

where $EF70_i$ = 1969 annual earnings of year-round female workers in occupation i;
$EM70_i$ = 1969 annual earnings of year-round male workers in occupation i;
$EF80_i$ = 1979 annual earnings of year-round female workers in occupation i;
$EM70_i$ = 1979 annual earnings of year-round male workers in occupation i.

2. $CHDDIND_i = DDIND80_i - DDIND70_i$

3. $CHEDUC_i = EDF80_i/EDM80_i - EDF70_i/EDM70_i$

where $EDF70_i$ = 1970 median education of female workers in occupation i;
$EDM70_i$ = 1970 median education of male workers in occupation i;
$EDF80_i$ = 1980 median education of female workers in occupation i;
$EDM80_i$ = 1980 median education of male workers in occupation i.

4. $CHEX_i = [(F80_i - F70_i) / F70_i] - [(M80_i - M70_i) / M70_i]$

where $F70_i$ = 1970 female employment in occupation i;
$M70_i$ = 1970 male employment in occupation i;
$F80_i$ = 1980 female employment in occupation i;
$M80_i$ = 1980 male employment in occupation i.

5. $GROWTH_i = (EMP80_i - EMP70_i) / EMP70_i$

where $EMP70_i$ = 1970 total employment in occupation i; and
$EMP80_i$ = 1980 total employment in occupation i.

$RELFW_i = WF70_i / WF70ALL$

where $WF70_i$ = 1970 mean hourly wage for female workers in occupation i; and
WF70ALL = 1970 overall mean hourly wage for female workers ($3.27).

II. Data Sources.

1. EF70 and EM70: U.S. Bureau of the Census, Census of the Population, 1970, Subject Reports, Occupational Characteristics, PC-2-7A, (Washington, D.C.: U.S. Government Printing Office), 1973, Table 19. This table shows mean annual earnings by sex and detailed occupation for all workers in the experienced civilian labor force, aged 16 and above, who worked 50-52 weeks in 1969.

2. EF80 and EM80: U.S. Bureau of the Census,, Earnings by Occupat Census of the Population, 1970, ion and Education, PC-2-8B, (Washington, D.C.: U.S.

Government Printing Office), 1973, Table 1. This table shows mean annual earnings by sex and detailed occupation for all persons in the recent experienced civilian labor force who worked at all in 1979, aged 18 and over.

3. EDF70 and EDM70: U.S. Bureau of the Census, Census of the Population, 1970, Special Report ,PC-2-7A, (Washington, D.C.: U.S. Government Printing Office), 1973, Table 1. this table shows median education by sex and detailed occupation for workers in the experienced civilian labor force in 1969.

4. EDF80 EDM80: from computer tape: 1980 Census, 1980 Special Tabulation, Occupation By Race and Sex Classified Separately By Industry, Earnings and Education EEO Related: U.S. Summary. This shows the frequency distribution of workers in the experienced civilian labor force by sex and detailed occupation for 6 education categories in 1980 from which median education was estimated.

5. F70 and M70: from computer tape, 1970 Census, Census of Population, 1970, Special Report: Employment by Industry and Occupation. These data show employment by 1970 3-digit occupation and industry categories. To convert to 1980 occupation and industry codes, we used tabulations from: Bureau of the Census, "1970-1980 Census Comparability, Detailed Industry Sorted By 1970 Codes; Detailed Industry Sorted By 1980 Codes; Detailed Occupation Sorted by 1970 Codes, Detailed Occupation Sorted by 1980 Codes," February, 1986. The data from this special survey are based on a sample of respondents in the 1970 Census survey whose occupation and industry were double coded (for both 1970 and 1980 classifications). This then yielded estimates of the proportion of 1970 employment in each 1970 category which would be included in each 1980 category. Because data were not available from the comparability study for the very smallest occupations, 47 of the 1980 categories were eliminated from the data used in the regressions.

6. F80 and M80: from computer tape, 1980 Census: Census of Population, 1980: Occupation By Industry, Table Matrix number 4-1. This shows employment by sex for 447 occupations and 234 industries.

7. WF70 and WF70ALL: U.S. Bureau of the Census, 1970 Census: Special Report, PC-2-7A, (Washington, D.C.: U.S. Government Printing Office), 1973, Table 19, which shows annual earnings for all workers aged 16 and over in the experienced civilian labor force who worked 50-52 weeks in 1969 by sex and detailed occupation. Data on mean hours worked in the reference week by sex and detailed occupation are from the same report, Table 15. The hours data are for all workers in the experienced civilian labor force (including those working part year). These data are thus not directly comparable with the annual earnings data. This may have lead to an overestimate of the hourly wage for all workers, because the average hours worked per week by year round workers are probably greater than that for all workers.

Table A.1

Mean Values of Regression Variables

	Full Sample (400 occs.)		Male-dominated (213 occs.)		Neutral (114 occs.)		Female-dominated (73 occs.)	
Variable	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
CHRFE	- 6.2	286	- 12.0	137	- 2.3	568	4.9	425
CHDDIND	- 4.7	264	- 3.8	326	- 5.8	190	- 5.6	254
CHEDUC	- .01	587	- .009	652	- .004	1388	- .02	270
CHEXP	94.0	191	140.0	124	83.0	188	-24.0	740
GROWTH	47.0	272	28.0	218	58.0	162	85.0	294
RELFW	100.0	32.4	107.0	33	95.4	29	87.6	26

c.v. = coefficient of variation

Table A.2

Correlation Coefficients among Regression Variables

	CHRFE	CHDDIND	CHEDUC	CHEXP	GROWTH	FDOM	MDOM	RELFW
CHRFE	1.0	-0.34	0.37	-0.21	0.20	0.29	-0.35	-0.42
CHDDIND	-0.34	1.0	0.01	0.03	-0.14	-0.04	0.08	0.005
CHEDUC	0.04	0.01	1.0	-0.06	-0.1	-0.09	0.01	-0.12
CHEXP	-0.21	0.03	-0.06	1.0	0.15	-0.31	0.27	0.16
GROWTH	0.20	-0.14	-0.15	0.15	1.0	0.14	-0.16	0.09
FDOM	0.29	-0.04	-0.09	-0.31	0.14	1.0	-0.50	-0.18
MDOM	-0.35	0.08	0.01	0.27	-0.16	-0.50	1.0	0.23
RELFW	0.42	0.005	-0.12	0.16	0.09	-0.18	0.23	1.0