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EXPLAINING OCCUPATIONAL SEX SEGREGATION AND WAGES: FINDINGS FROM A MODEL WITH FIXED EFFECTS*

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Does segregation arise because "female" occupations have financial advantages for women planning to spend some time as homemakers, as human-capital theorists claim? Do "male" occupations have more onerous working conditions that explain their higher earnings, as the neoclassical notion of "compensating differentials" suggests? Or do female occupations have low wages that are depressed by the sort of discrimination at issue in "comparable worth," as sociologists have argued? To answer these questions, we use a model with fixed effects to predict the earnings of young men and women from a pooled cross-section time-series of the National Longitudinal Survey. Analyses are undertaken for both blacks and whites. A fixed-effects model is useful for answering these questions because it corrects for the selection bias that results from the tendency of persons who differ on stable characteristics that are unmeasured but affect earnings to select themselves into different occupations. We find little evidence that female occupations provide either low penalties for intermittent employment or high starting wages, the advantages human capital theorists have argued them to have. Rather, there is evidence of pay discrimination against men and women in predominantly female occupations. Implications for economic and sociological theories of labor markets are discussed.

INTRODUCTION

In this paper we use a model with fixed effects to test whether predominantly female occupations have advantages that compensate for their lower average wages. Sociologists and economists disagree about the explanation of both occupational segregation and the low pay of female jobs. In a strict neoclassical view, female jobs possess certain advantages—at least for those who plan interrupted employment or who prefer work typically done by women. These include higher starting wages, lower depreciation of human capital while not employed, and more pleas-

ant working conditions. A sociological view contends that female jobs have uncompensated disadvantages: lower wages than male jobs with an equivalent requirement for education, experience, skill, and working conditions. Discrimination, socialization, institutional practices, and feedback effects among these perpetuate occupational segregation and uncompensated wage differentials. We test these economic and sociological views using methods with several attractive features: longitudinal data spanning more than a decade; a fixed-effects model that nets out effects of all unchanging but unmeasured personal characteristics; a Heckman-style correction for sample selectivity; controls for occupational characteristics from the Dictionary of Occupational Titles; and separate analyses for black women, black men, white women, and white men.

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The Neoclassical Economic View

The neoclassical economic view explains occupational or pay differentials between individuals or groups by differential human-

capital investment, or by differential choices in the tradeoff between pecuniary and nonpecuniary job rewards.

Explaining Segregation. Zellner (1975) and Polachek (1979, 1981, 1984, 1985) pioneered the application of neoclassical theory to explaining occupational segregation. They take the assignment of childrearing to women as given and exogenous to their models. They suggest that women who plan intermittent employment will maximize lifetime earnings if they choose occupations with low rates of appreciation and depreciation of human capital.

Appreciation of human capital refers to formal or informal on-the-job training that makes a worker more productive and leads to wage growth. Other things (such as education) being equal, jobs that provide more on-the-job training will have lower starting salaries, making employees "pay" for their training (Becker 1975). If there is a tradeoff between starting wages and wage growth, women planning a short employment duration will choose jobs with higher starting wages despite their low wage growth (Zellner 1975).

Human-capital theory asserts that those who plan more years of employment will choose jobs with the highest returns to experience. Because on average, men anticipate more job experience than women, women will select occupations with higher starting wages but smaller returns to experience. This would lead occupations with these characteristics to become disproportionately female. Yet, findings have been mixed on the question of whether predominantly female occupations are characterized by lower wage growth than are male occupations (Corcoran, Duncan, and Ponza 1984, p. 183; England 1982, 1984, p. 735 and note 9).¹ *But no*

analysis has found the higher starting wages in female occupations that the theory predicts; to the contrary, starting wages are lower in female than male occupations requiring the same education (Greenberger and Steinberg 1983; England 1984).

Indirect tests of the hypothesis have yielded conflicting results. If segregation results because women who plan less employment choose jobs with higher starting wages and lower appreciation, those who plan more continuous employment should be more likely to choose male occupations. Waite and Berryman (1985) found that high-school girls who planned more years of paid employment were more likely to aspire to a male occupation. On the other hand, disconfirming evidence is reported by Lehrer and Stokes (1985), who found that whether young women plan to be employed or at home at age 35 had no effect on their choosing a male occupation.

The economic approach to segregation has also focused on the *depreciation* of human capital. Polachek (1979, 1981, 1984, 1985) argues that it is advantageous for women who intend spells at home to choose occupations with low rates of such depreciation. Depreciation refers to skill atrophy leading to a reduced real wage upon return to paid employment from homemaking. Since most men plan continuous employment, they have little incentive to choose occupations with low depreciation. Polachek concludes that sex differences in plans for employment continuity lead to sex differences in the job choices that maximize men's and women's lifetime earnings. Past research has not confirmed the most obvious prediction from Polachek's thesis—that predominantly female occupations offer lower depreciation rates during home time than do male occupations (England 1982, 1984; Corcoran et al. 1984).

Explaining Occupational Pay. Neoclassical economic theory predicts that occupations requiring greater human capital will pay better. Thus, if female jobs pay less, this may reflect their lower skill demands. But some-

¹ Using longitudinal data, Corcoran et al. (1984) found higher percentage wage growth in male occupations for white women, but not black women. Using cross-sectional data, England (1984, p. 743) found a higher dollar return per year of experience in male occupations, but not a higher percentage rate of return to experience. Both these analyses hold the sex of individuals constant while estimating how returns to experience vary by the sex composition of occupational categories. Yet much segregation is hidden within the occupational categories used in these analyses (Bielby and Baron 1984). One could take the finding that men have higher overall returns to experience than

women (Corcoran and Duncan 1979) as indirect evidence that, if we used more detailed job categories, we would find that male jobs offer steeper wage growth than female jobs. According to Corcoran (1979), this is because men are in occupations providing greater on-the-job training. It may also be a form of wage discrimination.

times occupations requiring comparable skills differ in pay, even after temporary disequilibrium from shortages or gluts are remedied. Economists explain this with the notion of "compensating differentials." Jobs involving unpleasant working conditions must pay premiums to be filled, whereas jobs that are intrinsically satisfying can be filled for less. However, a wage premium will be unnecessary if sufficient people prefer or are indifferent to the job characteristics in question that the job can be filled without a higher wage to compensate for the nonpecuniary job characteristics. That is, compensating differentials depend on the tastes of the marginal rather than the average worker (Smith 1979). Following this line of argument, Killingsworth (1985) and Filer (1985) have suggested that compensating differentials explain the pay differentials between male and female jobs. Filer (1985) shows that men are more likely to be in jobs involving physical danger.

In short, economists contend that average differences in pay between male and female jobs are all "compensated" for by other advantages of female jobs such as lesser skill demands, more pleasant job requirements or working conditions, higher starting wages, or a lower risk of depreciation. The claim of advocates of "comparable worth" that discrimination creates uncompensated pay differentials between predominantly male and female jobs has two rationales that constitute anomalies for neoclassical theory. First, the hiring discrimination that keeps women out of male jobs leads to excess supply of labor in female jobs, and this crowding lowers their pay (Bergmann 1974, 1986). Alternatively, employers may discriminate against female occupations by paying less than their contribution to the organization (England and Norris 1985a, 1985b). Neoclassical theory predicts that market forces will eventually eliminate both types of discrimination. In the case of hiring discrimination, if some employers won't hire women in male jobs, women who want these jobs will offer to work at a lower wage, thereby providing an incentive for other employers to hire them. In time, higher labor costs should drive hiring discriminators out of business. Wage discrimination against female occupations should erode because employers have an incentive to stop paying men more than is necessary to induce them to work in male occupations and to

encourage women who will accept lower wages to enter the male occupations. Employers who fail to adopt this strategy will face higher labor costs.

Sociological Views

There is no single orthodox sociological view, but we suggest one that accounts for occupational sex segregation and lower pay for female occupations. This view sees the labor market as containing structural niches characterized by uncompensated advantages and disadvantages. It also posits that reciprocal feedback effects between labor markets and household behavior perpetuate the concentration of women in disadvantaged jobs. This view differs from the neoclassical view by insisting that institutional inertia and feedback effects between supply and demand sides of labor markets allow discrimination and its effects to persist indefinitely, despite market forces.

Explaining Segregation. Sociological explanations of segregation emphasize the reciprocal effects of gender-role socialization, discrimination by employers, and institutional arrangements. If the exhortation, reinforcement, and role modeling that make up socialization teach that certain jobs are appropriate for each sex, this will not only affect supply-side training and job "choices," but will also produce anew in each generation employers who hold discriminatory values and beliefs. Thus, socialization affects discrimination. But discrimination also affects socialization by showing individuals the costs of sex-atypical choices; discrimination creates accommodation to limited options that may appear as preferences. Such preferences are always held more ambivalently by disadvantaged groups. While many females do make traditional job choices, more females than males aspire to jobs nontraditional for their sex (Marini and Brinton 1984, p. 200). This sociological view of feedback effects between households and employment contrasts with the tendency of economists to see preferences and the household division of labor as causally prior to outcomes in labor markets (England and Farkas 1986).

Another example of feedback effects between demand and supply-side behavior is the sociological insight that jobs mold incumbents to have characteristics consistent with their jobs (Kanter 1977; Kohn and Schooler

1983). If women are discriminatorily assigned to jobs encouraging traditionally feminine skills and preferences, this amplifies those gender differences that existed prior to such discrimination. It perpetuates segregation without need of further discrimination and also creates a rationale for statistical discrimination, i.e., the tendency of employers to exclude all women from a job if the average woman is less suited than the average man for the job (Bielby and Baron 1986).

Sociologists have also emphasized institutional factors perpetuating segregation even in the absence of overt discrimination in job placement. Paramount among these factors are the structured-mobility ladders of internal labor markets (Althausen and Kalleberg 1981). Female jobs are typically on short mobility ladders leading only to other female jobs. Other such institutional practices include upper age limits for entering apprenticeships, veterans' preferences, limited public advertising of jobs, machinery designed for typical male height and strength, and departmental rather than plantwide seniority being credited toward promotions (Roos and Reskin 1984). The inertia in this view contrasts with the image of smooth, marginal adjustments advanced by neoclassical theory.

Explaining Occupational Pay. How does the sociological view explain the lower pay in predominantly female occupations? Earlier literature assumed that socialization and discrimination confined women to relatively menial positions (e.g., Chafetz 1974, p. 126; Weitzman 1979) and that their low pay is explained by their low skill level. However, recent evidence suggests that predominantly female jobs pay lower wages even when underlying dimensions of skill demands and working conditions have been controlled (England and McLaughlin 1979; England, Chassie, and McCormack 1982; Treiman, Hartmann, and Roos 1984; for an exception, see Rosenfeld 1983). This is a major complaint of advocates of "comparable worth" or "pay equity" (Treiman and Hartmann 1981; England and Norris 1985a, 1985b; Steinberg and Haignere 1987). This view is compatible with the sociological hypothesis that the sex composition of jobs affects their pay as a consequence of norms that devalue whatever work women do. This effect is reinforced by the exercise of male group power.

But pay discrimination against female jobs

could not persist if most women responded by moving into male jobs. While some have moved into male jobs (Beller 1984; Jacobs 1987), hiring discrimination, socialization, institutional practices, limited job information, and feedback effects among these inhibit such mobility. The realization that their wages are inappropriately low may be impeded by women's inability to compare their effort/reward ratio to that of men, precisely because without holding men's jobs they cannot assess the effort required there (Bielby and Bielby 1988; Crosby 1982). Women who move into male jobs often return to female jobs, a pattern that Jacobs (1987) attributes at least partially to harassment by male coworkers. Such mobility-limiting forces reduce the ability of market forces to erode discriminatorily low wages in female jobs.

Women's socialized preferences for female jobs do not imply that the lower wages of such jobs are fully compensated by their more desirable nonpecuniary characteristics. Thus, we disagree with Killingsworth's (1985) contention that if women choose their jobs, wage discrimination is absent. The economic theory of compensating differentials suggests the need for a higher wage in a job some workers find undesirable only if there are insufficient other workers either indifferent or positively disposed toward the job's characteristics. But because men are socialized much more strongly than women to avoid typically female behavior (Maccoby and Jacklin 1974, p. 328; Chodorow 1978), male jobs can likely be filled without positive compensating differentials (England and Norris 1985b).

DATA, MODEL, VARIABLES, AND HYPOTHESES

Data

We analyze data from the young women's and young men's cohorts of the National Longitudinal Survey (NLS). The female data are from a national probability sample of women aged 14–24 in 1968. The panel of women were surveyed in 1968, 1969, 1970, 1971, 1972, 1973, 1975, 1977, 1978, and 1980. The men are a national probability sample of those aged 14–24 in 1966, surveyed in 1966, 1967, 1968, 1969, 1970, 1971, 1973, 1975, 1976, 1978, 1980, and

1981.² Each panel contains approximately 5,000 individuals. (The data are described in Center for Human Resource Research 1983.) Blacks were oversampled. We undertake separate analyses for blacks and whites within each sex, omitting other racial groups.

We have arranged the longitudinal data into a pooled cross-section time-series in which the unit of analysis is an individual in a particular year. Our tables report means and regression results from analyses that deleted observations in which the individual was not employed or was employed part-time (less than 35 hours/week). As a check on the robustness of our findings, we repeated the analysis for part-time workers. These are discussed below, but the coefficient estimates are not shown.

Model

A key feature of our analysis is the use of a model with fixed effects (Mundlak 1978; Hausman and Taylor 1981; Jasso 1985; Judge, Hill, Griffiths, Lutkepohl, and Lee 1982). The model controls for otherwise unmeasured year-specific (period) and person-specific effects. The model is:

$$Y_{it} = b_0 + \sum b_k X_{kit} + e_{it} \quad (1)$$

where

$$e_{it} = u_i + v_t + w_{it}. \quad (2)$$

In this equation, regression coefficients are denoted as b , k indexes the measured independent variables (X s), i indexes individuals, t indexes time periods, and e = error terms; u = cross-sectional (individual) component of error; v = time-wise component of error; w = purely random error component; and b_0 = intercept. Y , the dependent variable, is the natural logarithm of hourly earnings. The resulting coefficients are those that would be obtained if dummy variables for each year and each person (with appropriate omitted categories) had been included in the regression equations. It is convenient to

obtain these coefficients by fitting the following OLS model:

$$Y^*_{it} = b_0 + \sum b_k X^*_{kit} \quad (3)$$

where

$$Y^*_{it} = Y_{it} - \bar{Y}_i - \bar{Y}_t + \bar{Y} \quad (4)$$

$$X^*_{it} = X_{it} - \bar{X}_i - \bar{X}_t + \bar{X} \quad (5)$$

and other symbols are as defined above. That is, an OLS regression is fit after subtracting from each variable its person mean (across years) and year mean (across persons) and adding the grand mean (from the pooled cross-section time-series).

The t -statistics derived from the OLS model in equation (3) will be inflated because degrees of freedom were not reduced to take account of the implicit variables for persons and periods. To correct for this, standard errors are multiplied by $(\sqrt{NT-K})/\sqrt{(NT-N-T-K+1)}$ (where N is the number of individuals, T the number of time periods, and K the number of independent variables in the model). We report tests of significance that reflect this correction.

Our main purpose in using the fixed-effects model is to derive estimates free from selection bias. The fixed-effect estimators are not contaminated with spurious effects of any stable, unmeasured individual characteristics. Such characteristics include cohort, socioeconomic background and its effects. They also include unchanging aspects of intelligence, preferences resulting from early socialization, life cycle plans, and unmeasured human capital. The effects of these variables are removed by subtracting the person-mean from each observation. The unique effect of the stable but unmeasured characteristics of each individual is the "fixed effect" from which the method takes its name. Removing fixed effects is particularly important for our test of whether there is a net negative effect of occupational percent female on pay because it assures us that all stable pay-relevant but unmeasured individual differences between individuals in predominantly female and male occupations have been controlled.

The method also permits more accurate estimates of effects of experience than is possible in the cross-sectional analyses comprising much of the literature. The effects of experience on earnings are not computed by

² The advantage of using data on a recent cohort is accompanied by a disadvantage: sex discrimination against female occupations in raises or promotions that do not occur until middle age are not captured here. The oldest cohort of female workers was 37 the last year of the survey.

comparing individuals with more and less experience, as in cross-sectional studies. Rather, the longitudinal features of the data are used to assess returns to experience as individuals accumulate it. In the language of “movers” and “stayers,” this method relies entirely on movers, so that the measured effect of experience is the effect of changes in experience on changes in earnings within persons. Likewise, the measured effect of occupational sex composition is based entirely on changes in earnings that occur when individuals change to a job with a different sex composition. Because period effects on earnings are removed by the model, it is not necessary to change earnings to constant dollars.

As a defense against another kind of selection bias, selection into the sample, we use a version of Heckman’s (1979) correction for sample selectivity proposed by Berk (1983). (For examples of this method in use, see Nakamura and Nakamura 1985, and Corcoran, Duncan, and Ponza 1983.) Women who receive low wage offers may reduce their hours or leave employment entirely. Such selection is less common among men. As a result of such selection into employment, samples of employed women may be truncated on earnings in a way that biases coefficient estimates of demand-side effects such as the returns to experience or education or wage offers made to particular occupations. To remove this bias, we have performed logistic-regression analyses for each year (for white and black women separately) to predict our sample-selection requirement of full-time employment (as opposed to nonemployment or part-time employment). The variables used to predict full-time employment are education, experience, marital status, number of children of age six or under in the household, and husband’s annual earnings (coded 0 for unmarried women). We used these equations to compute an instrumental variable that is the predicted probability of full-time employment for each woman in each year.³ This instrument, with deviations for time-, person-, and grand means as in Equation (5) above, was added as a predictor to each of the earnings equations for females.

³ The formula for the predicted probability from a logistic regression is $1 / (1 + e^{-bx})$ (where the first b is the constant and subsequent b s are the coefficients attached to independent variables).

Controlling for this variable helps remove any sample-selectivity bias that may be present (Berk 1983). We present only results with this correction, but note that it exerted only trivial effects on the magnitudes of coefficients, and no effect on conclusions.

Variables

All regressions take the natural logarithm of current hourly earnings as the dependent variable. The independent variables include years of education, marital status (presently married or not), hours usually worked per week on current job, the percent female (in 1970) in one’s detailed Census occupation,⁴ weeks of employment experience, and, for women, the instrumental variable that is the predicted probability of full-time employment based on personal and family characteristics. Although we refer to effects of being in “female” occupations as a shorthand throughout, we actually assess such effects along a continuum of sex composition rather than choose an arbitrary cutting point to define female and male occupations. Experience is the total number of weeks of employment (whether full- or part-time) beginning one year prior to the first survey wave.⁵ Interaction and quadratic terms constructed from

⁴ NLS data code respondents’ occupation in 1960 Census categories. We merged the percent female in 1970 occupational categories onto the file from documentation provided with the codebook for the NLS Mature Women survey. We chose 1970 data on sex composition because it was closer to most of the years of data than 1960.

⁵ The NLS data do not provide measures of years of experience prior to one year before the survey. However, given our fixed-effects specification, unmeasured differences between individuals in experience prior to the survey are automatically controlled. In each year of the survey, respondents were asked the number of weeks they had been employed in the prior year. We added these entries to compute work experience accumulated by any given year, beginning with the year prior to the survey. This procedure presented a problem for the surveys following those few years in which no survey was conducted (1974 and 1979 for women and 1972, 1974, 1977, and 1979 for men). Our procedure was to assume that, if respondents were employed at the prior survey date, they were also fully employed during the missing year, while if they were not employed at the prior survey date, they were also not employed during the missing year.

these variables are entered where appropriate to test hypotheses. Variables constructed from the NLS data are listed in Table 1.

Two of the hypotheses from human-capital theory (see below) call for measures of home time, net of experience. "Home time" refers to time spent out of the labor force in homemaking. In cross-sectional data, when individuals differ in age, home time and experience can be separately measured. However, since our measure of experience is only available from the beginning of the NLS survey, home time is a linear and negative function of experience; it provides no distinct information. Thus, we include experience in our models and take it to be indicative of either experience or lack of home time. Due to this data limitation, we cannot estimate the effects of home time or experience while holding the other constant.

Finally, a set of occupational characteristics from the Dictionary of Occupational Titles is added to the model to test hypotheses requiring controls for the skill demands and working conditions of occupations (U.S. Department of Labor 1965, 1977; Daymont and D'Amico 1979).⁶ These variables, listed in Table 2, were merged onto each case according to the 1960 occupational codes on the NLS file.

Hypotheses

We test two kinds of hypotheses—those that explain segregation and those that explain wage differences between female and male occupations. Our analysis directly tests explanations of segregation offered by human-capital theory. Rejecting these would lend support to the sociological view of the causes of segregation, although it is not directly tested. Our analysis does directly test the

⁶ We are grateful to Mark Hayward of Battelle for providing machine-readable DOT data for 1960 codes. The data were assembled by Thomas Daymont and Ronald D'Amico of Ohio State University, Center for Human Resource Research. All variables are from the most recent Fourth Edition of the Dictionary of Occupational Titles (U.S. Department of Labor 1977), except for five variables from the Third Edition (U.S. Department of Labor 1965). These are (1) direction, control, and planning; (2) one of the two measures of stress; (3) strength (heavy work); (4) other physical requirements; and (5) bad working conditions.

Table 1. NLS Variables Used in Wage Regressions

Name	Description
LNWAGE	Natural logarithm of hourly wage on current job
ED	Years of education completed
MAR	Marital Status: 1 = currently married; 0 = other
HRS	Hours per week usually worked at current job
PF	Percent female in 1960 detailed Census occupation
EXP	Weeks of employment experience since 1 year before beginning of survey

Source: Documentation for National Longitudinal Surveys, young men's and women's cohort (Center for Human Resource Research, 1983).

sociological view that female occupations suffer discriminatorily low wages against the economic view that occupational wage differentials are explained by compensating differentials. Although we address two distinct sets of questions, those regarding segregation and those regarding wage differentials, the issue of whether female occupations have advantages that compensate for their disadvantages is central to both.

HYPOTHESIS 1. *Appreciation and Depreciation.* Human-capital theory predicts that female occupations offer higher starting wages but lower rates of human-capital appreciation than male jobs. If female occupations have flatter wage increases with experience, the interaction term of experience times occupational percent female should have a significantly negative effect on earnings. Human-capital theory also predicts that female occupations offer lower depreciation during home time. Because in these data, experience and home time are linearly and negatively related, the notion that jobs become predominantly female because they offer low depreciation also leads us to predict a negative interaction effect of percent female and experience.⁷

HYPOTHESIS 2. *Indirect Tests of Appreciation and Depreciation.* Polachek (1985) has criticized England's (1982, 1984) use of

⁷ Careful readers may be confused by England's (1985, p. 442) claim that Polachek's thesis implies a negative sign on the interaction effect of percent female times home time. This claim is a misprint; it should read that the thesis implies a positive sign on the interaction of percent female and home time. This implies a positive interaction of percent female and experience in these data.

Table 2. Control Variables From Dictionary of Occupational Titles

<i>Skill Demands</i>	<i>Skill Demands (continued)</i>
Direction, control, and planning	Influencing
Strength (heavy work)	Use of sensory or judgmental criteria
Other physical requirements	Use of measurable or verifiable criteria
Complexity with data	Dealing with people
Complexity with people	Need to set limits, tolerances, or standards
Complexity with things	Need to climb or balance
General educational requirement for reasoning	Need to stoop, kneel, crouch, or crawl
General educational requirement for mathematics	Need to reach, handle, finger, or feel
General educational requirement for use of language	Need to talk and hear
Years of vocational or on-the-job training required	Need to see well
Requirement for intelligence	
Requirement for verbal aptitude	<i>Working Conditions</i>
Requirement for numerical aptitude	Stress (2 measures)
Requirement for spatial aptitude	Repetitive, continuous work
Requirement for form perception	Task variety and change
Requirement for clerical perception	Exposed to cold temperatures
Requirement for motor coordination	Exposed to hot temperatures
Requirement for finger dexterity	Exposed to wet working conditions
Requirement for manual dexterity	Exposed to noise
Requirement for eye-hand-foot coordination	Exposed to hazards
Use of feelings, ideas, or facts	Exposed to fumes

Source: Daymont and D'Amico 1979.

interaction terms involving percent female to test human-capital predictions, arguing that measurement error in the variable biases coefficients toward zero. Because even the Census detailed occupational categories are broader than the job titles used by firms, and much segregation exists within the Census categories (Bielby and Baron 1984), the sex composition of one's Census occupation measures the sex composition of one's job imperfectly. Accordingly, Polachek (1985) suggests testing predictions about occupational choice from human-capital theory in a way that does not rely on measures of occupational categories. A positive effect of the square of home time would indicate that those experiencing more home time have chosen jobs in which the negative effect of home time is relatively small. This follows from the fact that a positive sign on a squared term can be interpreted to mean that those who score higher on the variable are subject to a higher positive or lower negative effect of that variable on the dependent variable. In our data, home time is a negative linear function of experience. Mathematically, a positive net effect of the square of home time implies a positive net effect of the square of experience. (The intuitive explanation of this is that to change to a prediction involving experience, the sign needs to be reversed once for each of the two home time terms in the squared term, and thus the sign remains the same.) If the

square of experience has a positive effect, this is indirect evidence that the segregation we observe within detailed job categories results from rational choices of women trying to minimize the penalties of time at home. A positive effect of this same quadratic term is also indirect evidence that those planning more experience select jobs with the greatest returns to experience, another prediction of human-capital theory.

HYPOTHESIS 3. *Starting Wages.* Even if female occupations have the low appreciation specified by Hypotheses 1 and 2, this does not make them advantageous for women planning home time. Rather, it is the higher starting wages presumed to accompany flat appreciation that would make such jobs advantageous to those with intermittent employment. If this is the explanation of segregation, then female jobs should show higher starting wages, other things equal. To test this, we use the regression results to see how predicted wages differ by sex composition when experience is 0. When experience is 0, a positive sign on the coefficient of percent female in an equation also including the interaction term for percent female times experience would indicate higher starting wages in predominantly female occupations.

HYPOTHESIS 4. *The Effect of Occupational Sex Composition on Pay.* Turning to explanations of the relatively low pay in female occupations, we use the DOT mea-

tures of occupational skill demands and working conditions as controls. We test whether less onerous demands and conditions fully compensate for the relatively low pay of female occupations, or whether there is a net effect of occupational sex composition on wages. The sociological hypothesis is that, after controlling for human-capital and occupational characteristics, the percent female of one's occupation has a negative effect on wages. Such an effect would be evidence of crowding in, or wage discrimination against, female occupations, leading to uncompensated wage differentials. The absence of such an effect would be evidence in favor of the economists' view of compensating differentials.

FINDINGS

Table 3 presents the means for full-time workers on all NLS variables, (prior to the subtractions in equations (4) and (5), required for the fixed-effects model). We note that both black and white women were in occupations that averaged over 65 percent female, whereas men of both races were in occupations that averaged less than 23 percent female.

Equations for black and white women in Table 4 show coefficients when the instrumental variable that is the predicted probability of employment is added to the model as a control. All coefficients reflect the fixed-effect modeling described in equations (1)–(5). In Table 4, specification 1 is a basic human-capital model with occupational sex

composition added. For all groups, those in occupations with a higher percent female earn less. Hypotheses 1–4 are tested in specifications 2–4 by adding one or more variables to this basic model.

Hypothesis 1, derived from human-capital theory, states that occupations with a higher percent female will offer lower returns to experience and penalize home time less, either of which would lead to a negative interaction effect of experience times occupational percent female. Specification 2 in Table 4 tests this hypothesis; the results are equivocal. White women show the expected negative effect; those in occupations with more females receive lower returns to experience or less depreciation during home time. Given our inability to distinguish unique effects of home time and experience with these data (because the variables are linearly related), we cannot be sure which is operative or whether both are present. This is unfortunate, because while both are predicted by economic theory, only lower depreciation would constitute an advantage for female occupations. Low appreciation is in itself a disadvantage; indeed, it could be seen as evidence of wage discrimination against female occupation that grows with seniority. Low appreciation in female occupations is consistent with the neoclassical view only if the low appreciation is accompanied by the advantage of relatively high starting wages, an effect that we test for directly (and fail to find) in Hypothesis 3, discussed below. Thus, if the interaction of percent female and experience for white women merely indicates lower appreciation in female occupations (rather than lower depreciation or higher starting wages), it is more consistent with a sociological notion of wage discrimination against female occupations than with economic theory. It is only if it is indicative of lower depreciation in female occupations that this finding for white women supports the explanation of segregation from human-capital theory.

The interaction of percent female and experience is in the predicted direction but not significant for black women. Contrary to prediction, the interaction effect has a significant positive effect for both black and white men. In results not shown, the hypothesis also fails to receive support for three of the four groups of part-time workers (though here it is black men who show the predicted negative

Table 3. Means For Race/Sex Groups

Variable	White Women	Black Women	White Men	Black Men
WAGE (\$/hour)	3.26	3.01	5.50	3.83
LNWAGE (LN\$/hour)	5.66	5.58	6.12	5.76
ED (years)	12.83	12.00	12.85	11.11
MAR (1 = married)	.55	.42	.66	.49
HRS	40.92	40.50	45.06	43.13
PF	68.28	65.51	19.81	22.56
EXP (weeks)	210.62	202.26	343.78	288.86

Note: These means apply only to full-time workers (defined as working at least 35 hours/week). Male and female means cannot be rigorously compared since men were surveyed in 1966, 1967, 1968, 1969, 1970, 1971, 1973, 1975, 1976, 1978, 1980 and 1981, while women were surveyed in 1968, 1969, 1970, 1971, 1972, 1973, 1975, 1977, 1978, and 1980.

Table 4. Regression Coefficients^a from Fixed-Effect Models for Women and Men Employed Full-Time

	Women ^b							
	Whites				Blacks			
	Specification				Specification			
	1	2	3	4 ^c	1	2	3	4 ^c
Education (years)	.1175* (22.8)	.1173* (22.8)	.1162* (22.3)	.1190* (21.5)	.1273* (16.8)	.1278* (16.9)	.1277* (16.8)	.1288* (15.8)
Experience (weeks)	.0006* (8.5)	.0008* (8.5)	.0007* (5.9)	.0006* (8.7)	.0005* (4.7)	.0006* (4.2)	.0008* (4.4)	.0005* (5.0)
Experience ²			-.9E-7 (-0.8)				-.3E-6 (-1.7)	
Hours worked	.0126* (19.4)	.0127* (19.4)	.0130* (19.9)	.0136* (20.7)	.0153* (13.9)	.0153* (13.9)	.0156* (14.1)	.0156* (14.0)
Marital status	-.0448* (-3.7)	-.0434* (-3.6)	-.0517* (-4.3)	-.0469* (-3.9)	-.0407* (-2.2)	-.0405* (-2.2)	-.0420* (-2.2)	-.0472* (-2.6)
EXP X PF ^d		-.3E-5* (-3.2)				-.2E-5 (-1.2)		
% Female in occupation	-.0013* (-6.7)	-.0006* (-2.3)		-.0008* (-2.6)	-.0016* (-5.5)	-.0013* (-2.9)		-.0011* (-2.3)
Adjusted R ²	.128*	.129*	.123*	.146*	.153*	.153*	.149*	.179*
N	10089	10089	10070	10089	4248	4248	4218	4248

	Men							
	Whites				Blacks			
	Specification				Specification			
	1	2	3	4 ^c	1	2	3	4 ^c
Education (years)	.1570* (35.7)	.1530* (34.5)	.1547* (35.2)	.1547* (34.0)	.1531* (20.3)	.1497* (19.7)	.1512* (20.1)	.1543* (19.7)
Experience (weeks)	.0008* (7.4)	.0014* (9.8)	.0010* (7.4)	.0007* (6.9)	-.0001 (-0.7)	.0006* (2.7)	.0003 (1.2)	-.0001 (-0.7)
Experience ²			-.3E-6* (-2.5)				-.5E-6* (-2.3)	
Hours worked	.0133* (24.8)	.0132* (24.7)	.0135* (25.5)	.0141* (26.4)	.0154* (15.9)	.0154* (16.0)	.0154* (16.1)	.0163* (16.8)
Marital status	.0649* (4.7)	.0645* (4.7)	.0597* (4.4)	.0551* (4.1)	.0739* (3.2)	.0725* (3.2)	.0700* (3.1)	.0686* (3.0)
EXP X PF ^d		.8E-5* (6.4)				.9E-5* (4.6)		
% Female in occupation	-.0007* (-2.5)	-.0025* (-6.4)		-.0010* (-2.5)	-.0003 (-0.6)	-.0022* (-3.7)		-.0002 (-0.2)
Adjusted R ²	.180*	.182*	.182*	.204*	.198*	.202*	.200*	.222*
N	13874	13874	14102	13874	4569	4569	4601	4569

Note: Dependent variable is Ln hourly wage. All models include fixed effects. See equations 1–5 in text.

^a The *t*-statistic is in parentheses under coefficient.

^b Female regressions include the instrumental variable from the equation predicting full-time employment. See text.

^c Specification 4 includes all DOT variables listed in Table 2.

^d Interaction term of Experience times % Female in Occupation.

* $p < .05$, 2-tailed test.

interaction of percent female and experience). In short, because the findings are inconsistent with Hypothesis 1 for three of the four full-time race-sex groups, as well as for three of the four part-time race-sex groups, we consider it not supported.

Hypothesis 2 is an indirect test of the explanation of segregation offered by human-capital theory. The prediction is that the square of experience will have a positive sign, indicating that those who plan the most home

time choose jobs with less negative depreciation rates and/or that those with the most experience choose jobs with high returns to experience. Specification 3 in Table 4 shows that, contrary to the prediction of a positive effect, the squared term for experience is negative and significant for men of both races and negative and nonsignificant for women of both races. For part-time workers, the prediction is upheld for only one of the four race-sex groups, white men (findings not

shown). In sum, Hypothesis 2 is not upheld for any of the four race-sex groups among full-time workers and for only one of the four groups of part-time workers.

Hypothesis 3 concerns starting wages. If segregation arises because more women than men choose jobs with high starting wages and flat appreciation, starting wages predicted from specification 2 in Table 4 should be higher in occupations with a higher percent female. When experience is 0, the effect of the interaction term (experience times percent female) is 0, so the effect of occupational sex composition on starting wages is given by the coefficient for the additive effect of percent female. Table 4 shows that this has a significant negative effect for each of the four race-sex groups of full-time workers. Among part-time workers, analyses not shown here find the effect to have a negative sign for all four race-groups and to be significant for black and white women. Thus, female occupations do not offer the higher starting wages that human-capital theorists posit to be their advantage. On the contrary, net of human capital, starting wages are lower in female occupations. This means that if those few coefficients consistent with the economic explanation of segregation (discussed above) indicate low appreciation in female occupations (rather than low depreciation), then they are, nonetheless, not evidence in favor of the economic view, because the low appreciation is not accompanied by higher starting wages. Overall, the results provide very little support for economic explanations of occupational segregation.

Hypothesis 4 states the sociological view that female occupations pay less than male occupations, net of human capital, skill demands, and working conditions. It can be juxtaposed to the economic view of compensating differentials, which predicts no net effect of sex composition on wages. This hypothesis is tested by specification 4 in Table 4, which controls for human capital and the skill demands and working conditions of one's occupation. It shows that the effect of percent female is negative and significant for all groups except black men, for whom the effect is not significant. Because wages are in logarithmic form, the coefficients times 100 indicate the percentage decrease in earnings for each 1 percent female in one's occupation. Thus, white women's wages decrease .08 percent for each one point in occupational

percent female. The figure for black women is .11 percent and for white men is .10 percent.⁸ In results not shown on part-time workers, all four race-sex groups show a negative effect of percent female that is statistically significant for the two female groups. Overall, these findings support the contention that uncompensated pay differentials between male and female occupations are caused by wage discrimination against female occupations, as sociologists have suggested. Insofar as the DOT control variables provide adequate measures of non-pecuniary disamenities, our findings fail to support the economic view that compensating differentials for unpleasant working conditions explain all pay differences between male and female occupations.

DISCUSSION

These regression results provide little support for the explanation of segregation offered by human-capital theory. Research attention might better shift toward sociological explanations of segregation in terms of multiple feedbacks between gender-role socialization, discrimination, and institutional practices; we only indirectly tested this sociological model of segregation. Yet, we *have* provided a direct test of the sociological claim of uncompensated and discriminatory pay differences between male and female occupations. Net of human capital, skill demands, and working conditions, those who work in occupations with more females earn less. This is evidence of the type of discrimination at issue in comparable worth or pay equity. Our conclusions on these points are more credible than those from past cross-sectional studies because our fixed-effects model controls for any unmeasured differences in human capital or preferences between those in male and female occupations. Our confidence in the findings is further strengthened by the presence of detailed controls for occupational characteristics and the use of a correction for sample selectivity. Finally, it is important to remember that this evidence of wage discrimination

⁸ However, we cannot simply multiply these figures times 100 to predict the percentage change in wages that would occur if one moved from an all male occupation to an all female occupation. The change would be larger than this, because the logarithmic functional form is nonlinear.

comes from data on young cohorts of men and women.

Our findings do not imply that neoclassical theory entirely lacks explanatory power. To be sure, human capital affects earnings, and sex differences in experience are the proximate cause of between a quarter and a half of the sex gap in pay (Mincer and Polachek 1974; Sandell and Shapiro 1978; Corcoran 1979; Corcoran and Duncan 1979). But human-capital theory has not successfully explained occupational sex segregation, and the neoclassical notion of compensating differentials has not explained the interoccupational wage gap between predominantly male and female occupations.

Two qualifications to our interpretations of the effects of occupational sex composition on wages should be noted. First, to the extent that our measures of occupational skill demands and working conditions fail to fully tap dimensions the marginal worker perceives as disamenities, compensating differentials may explain a portion of the pay differences between male and female jobs. Yet, our confidence in the present findings stems from the broad range of such variables we have controlled. Second, it is possible that the net effect of percent female results in part from crowding in female occupations, as Bergmann (1974, 1986) has suggested, rather than solely from pay discrimination against occupations based on their gender composition. Although we agree that crowding may explain part of this effect, we doubt that it is the sole explanation, because it is likely that sexism affects wages, not only via discriminatory hiring, but also via discrimination in occupational wage setting after jobs have achieved their sex composition.

The findings are consistent with the sociological view that sex discrimination in hiring and wages, its feedback effects onto socialization and tastes, and other institutional practices combine to limit the interoccupational mobility that provides the neoclassical mechanism for eroding segregation and uncompensated pay differences between male and female occupations. But is the neoclassical mainstream impervious to such views?

Recent developments within mainstream economics may be hospitable to an integration with sociological views. One of these is implicit-contract theory (Okun 1981, pp. 26–133; Azariadis and Stiglitz 1983; Farkas and England 1985; Rosen 1985; England and

Farkas 1986). After on-the-job training that is specific to a job ladder in one particular firm, both employers and workers have incentives to avoid turnover. This is because workers are less productive (and can earn less) in jobs for which they are untrained, while employers wish to avoid incurring training costs for new employees. Accordingly, employers develop strategies to reduce turnover. One such strategy is to pay a wage lower than the workers' productivity in the early years of employment, while offering seniority raises that take workers' wages above their estimated productivity in the later years.

Although this implication of implicit-contract theory is often ignored, these strategies both discourage the replacement of men with women and make it more costly for women to move. Further, such compensation strategies mean that most of the competitive forces that might sort workers by their human capital and/or erode uncompensated interjob wage differentials are reduced to operating at the single time-point of entry to the firm. It is at this point that employers offering greater lifetime earnings will be motivated to choose the cheapest available workers with the greatest productive potential without discrimination or other irrational criteria. Because this "precontract" point is affected by competitive forces, economists often write as if the usual conclusions about erosion of uncompensated wage differentials and other discrimination still hold in a model including implicit contracts. Indeed, one can derive from implicit-contract theory an explanation of segregation that has the same predictions as human-capital theory. In this view, women planning intermittent employment are well advised to avoid jobs with back-loaded compensation (the "implicit contract") in favor of those with higher starting wages.

Despite the fact that many of the new developments in labor economics can be given this conservative reading consistent with human-capital theory, they also contain implications consistent with a notion of demand-side segmentation of labor markets (Dickens and Lang 1985; Lang and Dickens 1988). When the competitive forces of labor markets impinge primarily on a few discrete moments in individuals' careers, as is implied by implicit-contract theory, their effects are much less swift and powerful than the orthodox economic view suggests (Farkas, England, and Barton 1988). Although many

economists still resist these implications, they provide an opening for integration with the sociological perspective. In this view, market forces are present, but they may amplify sex differentials through the feedback effects emphasized by sociologists as often as they erode discrimination and uncompensated wage differentials between structural locations. This view helps us understand the imperfect sorting of workers, limited mobility, and uncompensated wage differentials posited by structural sociologists and suggested by our results.

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