Occupational Feminization and Pay: Assessing Causal Dynamics Using 1950-2000 U.S. Census Data

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Occupations with a greater share of females pay less than those with a lower share, controlling for education and skill. This association is explained by two dominant views: devaluation and queuing. The former views the pay offered in an occupation to affect its female proportion, due to employers' preference for men– a gendered labor queue. The latter argues that the proportion of females in an occupation affects pay, owing to devaluation of work done by women. Only a few past studies used longitudinal data, which is needed to test the theories. We use fixed-effects models, thus controlling for stable characteristics of occupations, and U.S. Census data from 1950 through 2000. We find substantial evidence for the devaluation view, but only scant evidence for the queuing view.

Occupations with a higher percent female generally pay less than those with lower percentage, even in the presence of controls for education and skill demands (Cohen and Huffman 2003; Cotter et al. 1997; England 1992). Two sociological perspectives provide a possible explanation for this association: devaluation and queuing. Both posit a type of discrimination by employers. The difference between the two mechanisms can be seen as a special case of the broader distinction made by scholars of gender between two ways in which gender inequalities are produced: processes that exclude women from highly rewarded roles historically dominated by men and processes that culturally devalue and lower the rewards associated with roles historically held by women (England 2001). According to the queuing (Reskin and Roos 1990) and relative-attractiveness (Strober 1984; Strober and Arnold 1987; Strober and Catanzarite 1994) view, occupations' wage levels affect their gender composition. These authors claim that both men and women prefer to work in occupations offering higher relative pay, but employers prefer men. In this view, as a result of discrimination in hiring or placement, women cluster in occupations offering lower pay relative to the skills demanded by the positions. In contrast, the devaluation view holds that sex composition affects occupations' pay (England 1992; Sorensen 1994; Steinberg 2001). The devaluation perspective makes no claim about whether the sex segregation of jobs comes from the supply or demand side of labor markets – about whether men and women enter the jobs they do because of employer discrimination in hiring and placement, or because of innate or socially constructed preferences, or differential family responsibilities.

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The devaluation view does, however, posit a type of employer discrimination that occurs after jobs have a particular sex composition. The claim is that decisions of employers about the relative pay of "male" and "female" occupations are affected by gender bias. Employers ascribe a lower value for the work done in occupations with a high share of females and consequently set lower wage levels. While past cross-sectional research shows a fairly robust relationship between occupations' sex composition and wages, determining a causal relationship between these dimensions is best done with longitudinal research.

A limited number of studies explore the relationship between occupation's female share and wage using longitudinal data, and they generally provide support for the devaluation view (Baron and Newman 1989; Catanzarite 2003; England, Allison and Wu 2007; Karlin, England and Ross 2002; Pfeffer and Davis-Blake 1987; Snyder and Hudis 1976). The only quantitative longitudinal study providing evidence to support the queuing perspective was limited to academic administration (Pfeffer and Davis-Blake 1987). Most of these studies have used a cross-lagged panel model with a pair (or several pairs) of years (Catanzarite 2003; Karlin et al. 2002; Snyder and Hudis 1976), or variations of this model that include the lagged-Y as a control but express the independent variable as a change score (Baron and Newman 1989; Pfeffer and Davis-Blake 1987). By contrast, we use a longer period than prior analyses – 50 years – and fixed-effects modeling.

Our model provides three main advantages over past research. First, relative to the lagged-Y regressor models, fixed-effects models do a better job of removing omitted variable bias (Halaby 2004). Fixed-effects models deal with omitted variable bias by using only variation within occupation over time to estimate the parameters. This controls for all stable characteristics of occupations, including those that are not measured. Using fixed-effects models, we will examine whether changes in sex composition around an occupation's long-term average are followed by deviations from an occupation's long-term average wage and vice versa. Only one previous study applied fixed-effects models to the analysis of the association between occupations' pay and percent female (England et al. 2007). Second, we use five decennial censuses, spanning 50 years, whereas a number of earlier studies used only two years (or, in the case of Karlin et al., pairs of years) separated by 5 to 10 years. Using multiple years is superior since particular years may be idiosyncratic. England et al. (2007) used multiple years, but only a 19-year recent period. A longer period is superior for testing theories because it allows for larger changes in the relative sex composition and pay of occupations. Particularly, during the period we study, 1950-2000, most occupations increased their percent female substantially because women's employment increased dramatically, occupational sex segregation declined (Blau and Hendricks 1979; Jacobs 1989; Weeden 2004), and the occupational wage structure underwent drastic changes (Massey and Hirst 1998). Extending the time frame allows us to assess whether the null findings reported in the previous study using fixed effects, particularly with respect to queuing theory, reflect the stability characterizing the period of study in previous research or the actual lack of causal effect. A third advance over prior work is that we use detailed categories obtained from cross-classifying detailed occupation with broad industry categories, and explore the sensitivity of our results to several alternative occupational classifications. The occupation-by-industry categories that we use are more detailed than found in any past national studies except Karlin et al. (2002, who used a much shorter period not extending as recently, and only pairs of years). These three improvements on past literature should provide the best assessment to date of how occupations' wage and sex composition affect each other over time.

Theoretical and Empirical Background

There are two major sociological views regarding the causal dynamics involved in the relationship between occupational sex composition and occupational wage rates: queuing and devaluation. The two views focus on distinct types of employers' discrimination by gender; the queueing view posits what Petersen and Sapporta (2004) call "allocative" discrimination, while the devaluation view entails what they call "valuative" discrimination. These views are not mutually exclusive, as proponents of both views acknowledge; both could be going on simultaneously. The first perspective, associated with Reskin and Roos (1990) and with Catanzarite, Strober and Arnold (Strober 1984; Strober and Arnold 1987; Strober and Catanzarite 1994), claims that deteriorating pay (or increase in other undesirable characteristics) leads to occupational feminization. Strober and Catanzarite (1994) have labeled this the "relative attractiveness" theory of segregation, while Reskin and Roos (1990) refer to it as the "queuing" view. Because the ideas are similar, we will refer to both as queuing. This view assumes that both men and women prefer to work in occupations that offer relatively high levels of reward; that is, it assumes that a single job/occupation queue exists for both men and women. Occupations are arrayed in a queue ordered by the rewards they offer. In addition, the queuing view assumes that employers generally prefer men over women in all jobs, implying that a single labor queue ordered, at least in part, by gender guides hiring decisions. Together, these preferences mean that employers can easily recruit men to high-paying occupations (and/or those occupations high on other rewards). However, recruiting men to occupations characterized by low rewards is problematic because men will be reluctant to work in such occupations and will be able to find work in better occupations. Women, by contrast, will only be able to find work in occupations offering relatively poor rewards because access to high paying occupations will be blocked due to discrimination by employers, except when there aren't enough men to fill these positions. Relatively poor pay, in this view, means lower pay relative to educational requirements. Hence, testing the hypotheses derived from this view requires controlling for occupations' requirement for education. In the queuing view, deteriorating levels of pay and working conditions will motivate men to flee to higher paying occupations, while women will face limited opportunities for upward mobility from such occupations due to employers' preference for male workers. Thus, to provide confirmation for this theory, one should document an effect of occupations' pay rate at one time on the proportion of females or number of males at a later time. The evidence to date in support of the queuing view comes mainly from cross-sectional statistical associations and the collection of case studies of feminization processes occurring in specific occupations presented by Reskin and Roos (1990).

A second perspective, associated with policy proposals for comparable worth, proposes a different causal process, involving an effect of occupational female shares on the level of pay (England 1992; Steinberg 2001). This view assumes that gendered cultural beliefs, which are shared by males and females, portray men as more competent and status-worthy than women (Ridgeway 1997; Ridgeway and England 2007). It also assumes that the value assigned to work in different occupations depends on the characteristics of the occupations' incumbents (Cejka and Eagly 1999). Together, these assumptions imply that work in predominantly female jobs will be devalued by both employers and prospective employees due to the low status of the jobs' incumbents, and that pay in predominantly female jobs is lower *because* women fill the jobs. In this view, a change in the gender composition of an occupation will lead to a change in the valuation of the work being preformed, leading to a change in occupations' relative pay rates. Longitudinal analysis of the effect of changes in sex composition of occupations on changes in wage rates is ideal for testing the implications of this view. However, much of the evidence supporting this view comes from cross-sectional analysis (e.g., Cohen and Huffman 2003; England 1992). Because skill and educational requirement are important aspects in determining pay, the hypothesis derived from this view is tested with controls for education and skills demands.

To put these two views in perspective, we should remember that neither view claims to explain the entirety of the sex gap in pay. While the two views posit distinct types of sex discrimination, neither is inconsistent with a substantial supply side to the sex gap in pay that derives from factors other than employer discrimination, including innate or socialized differences between men and women's skills, preferences and family responsibilities. Moreover, some portion of the sex gap in pay comes from within-occupation differences which are disregarded here.

In contrast to devaluation and queuing, two other perspectives suggest that no causal relation exists between wage rates and female proportion: equalizing differentials theory and institutional theory. Subsuming both compensating differentials theory and human capital theory, equalizing differentials theory claims that employers have to pay more to attract workers to jobs that require substantial investment by prospective workers or that are characterized by unfavorable working conditions (Rosen 1986). The idea is that occupations that require more skill and training, or are unpleasant to perform, will have to pay more to attract workers. Applied to gender inequality, this view claims that occupations that require less specialized training (Tam 1997) attract a greater share of female workers. Specifically, women that expect to spend some time out of the labor force due to childbearing have a lower incentive to invest in acquiring specific human capital, and hence choose to work in occupations and jobs that require less specialized (but possibly more general) training. Another relevant characteristic, identified by this view, is the "mother-friendliness" of the job. Jobs offering childcare, more flexible work hours, or an opportunity to work from home attract women who are willing to forgo the higher wages offered in jobs that do not offer such benefits. The longitudinal implication of this view is that changing skill demands and disamenities of jobs will drive their changing wage levels and sex composition. It also implies that if we control for job characteristics and human capital requirements, we will not find a relationship between occupations' female shares and wages.

Turning attention to organizational practices, institutional and population ecology theories question the flexibility implied in either the queuing or devaluation views of the association between feminization and pay. Both theories emphasize organizational inertia and path dependence as factors that lead to long term effects of original environmental conditions and organizational practices on current structures and practices (Baron et al. 2002; Stinchcombe 1965). Relative wage levels of occupations are expected to change little over time. Findings by institutional economists provide support for this claim (Doeringer and Piore 1971; Levine et al. 2002). Therefore, to the extent that an association between wage rates and female shares exists, institutionalist views predict that it existed when new industries and jobs were created or introduced to new local markets. An original causal effect combined with institutional inertia could have led to the enduring association. Evidence in favor of the view emphasizing inertia is provided by Kim's (1999) study of the California State Civil Service, showing that an occupation's pay in the Civil Service in 1931 continued to affect its pay level in 1993, after controlling for 1993 external market wages in the occupation.

Scarcity of representative, quantitative, longitudinal data has hampered the ability of past studies to adequately evaluate these theories. Much of the support for devaluation or compensating differentials comes from cross-sectional analyses. Some cross-sectional regression analyses find that, consistent with devaluation, occupational percent female is associated with lower pay net of skill demands (England 1992; England, Hermsen and Cotter 2000; Jacobs and Steinberg 1990; Sorensen 1994), while a minority of cross-sectional studies found no relationship (Filer 1985; Tam 1997). By contrast, the queuing and relative attractiveness views were developed largely from longitudinal case studies.

Six quantitative studies have previously used longitudinal data on a range of occupations or jobs in the United States to investigate the causal order between the sex composition of occupations and their wages. A seventh similar analysis used Israeli data. In a study of college administrators, Pfeffer and Davis-Blake (1987) concluded that there was evidence for causality in both directions. They used data for the two academic years ending in 1979 and 1984 from the College and University Personnel Association's Annual Administration Compensation Surveys on administrators' salaries. Baron and Newman (1989) concluded from their study of wage rates in the California Civil Service from 1979 to 1985 that increases in female and minority representation had negative effects on changes in the relative prescribed starting pay of civil service jobs. Using U.S. Census data from 1950, 1960 and 1970 with detailed occupations as cases, Snyder and Hudis (1976) assessed the effect of sex composition on white males' wages and vice versa (they did not consider women's wages). They found that the proportion female had a negative effect on later male median income, while income did not have a significant effect on an occupation's later proportion female. Catanzarite (2003) used Current Population Survey data and a panel model to test for pay deterioration in white males' wages in detailed occupations from 1971 through 1981 and 1982-1992. She found that the earlier proportion of white females and the proportion of black males in an occupation had a negative effect on later male median income in both time periods. Karlin et al. (2002) used Current Population Survey data 1984-1991 to form (for each year) cells by cross-classifying detailed occupation and broad industry as units of analysis. Using pairs of years, they find earlier sex composition to affect later wage, but no support for the reverse. England et al. (2007) use a fixed-effects model with lagged independent variables as we do here, but data for a much shorter period (19 years); they find no support for queuing and some support for devaluation, especially when they use longer lags for the independent variables. Using Israeli data for 1972-83, Semyonov and Lewin-Epstein (1989) find that the percent female of a detailed occupation lowers the wage for nonminority men, but there is no effect of earlier wage on change in sex composition.

Here we use longitudinal data on occupations in the United States during a 50-year period, 1950-2000, to assess whether or not there is a causal effect in either direction between sex composition and pay. We see using a fixed-effects model with lagged independent variables as an advance over the cross-lagged panel (or "lagged-Y-regressor") model used in most previous studies because it provides superior protection against omitted variable bias, controlling for all unmeasured, stable characteristics of occupations. By running alternative models that reverse whether occupations' pay or sex composition is the dependent variable, with fixed-effects in the model in both cases, we attempt to distinguish causal effects in the two directions. In the devaluation view, earlier levels of occupational sex composition should affect later wages. In the queuing view, earlier wages should affect later attractiveness of the job to men, and because employers prefer men for most jobs, a raise in attractiveness will yield a greater increase in the number of men than of women. Thus, early wages should affect later sex composition. Of course, both devaluation and queuing could be going on simultaneously, and our models do not preclude this conclusion. The theory of equalizing differences and the institutional inertia view both predict no causal effect in either direction under controls.

Data and Method

Data

We use the Integrated Public Use Microdata Series, developed by the University of Minnesota Historical Census Project (Ruggles et al. 2003, 2004). IPUMS provides a harmonized collapsed set of occupational categories for all census years. This is important because the U.S. Census Bureau has performed several major overhauls of occupational categories in the past half century. Although IPUMS provides occupational information from 1850 through 2000, data for other variables of interest for this study, particularly earnings and education, are limited to the period starting in 1950, so we start our analysis there. The population covered by the analysis is restricted to the prime working age (i.e., 25-64), salaried, civilian labor force.

Unit of Analysis – Occupation or Occupation by Industry Cell

Occupations are the unit of analysis for this study. We need to follow the same occupation across the decades to see if changes in wages relate to changes in sex composition. We will utilize three different approaches to forming units of analysis, hoping to avoid methodological artifacts by finding robust conclusions across methods.

IPUMS OCC1950

IPUMS reconciled the occupational classification of all available census years from 1950 through 2000. Because the main change was that occupations became more detailed over time, backward-collapsing is the preferred strategy of harmonizing the categories. IPUMS assigned each individual to the OCC1950 code to which they would have been assigned in 1950. The result is a common disaggregate classification scheme containing 287 occupations into which all respondents in any 1950-2000 decennial census sample can be classified. Because 105 of these 287 OCC1950 occupations had no incumbents for some of the decades, we combined them with the occupations to which they are functionally closest. We also excluded occupations that were designated as "Not Elsewhere Classified." This leaves us with 164 occupations for analysis.

OCC1950 is not perfect. The collapsed categories were constructed by recoding occupations in each sample based on where a plurality of persons would have been assigned in each census had the coding system of the previous census still been in effect. So when a more detailed category in, say, the 2000 U.S. Census, wasn't present in the 1990 U.S. Census, all persons in the 2000 category were assigned to the single 1990 category that the largest percent of those in the 2000 category would have been assigned to in 1990. Then they followed the same procedure for 1990 and 1980, then 1980 and 1970, and so on until all respondents in all years were assigned to categories that approximate the less detailed 1950 classification.

This procedure will be less accurate when changes to the occupational classification are dramatic. The most dramatic change in occupational classification occurred with the 2000 U.S. Census. Thus, in sensitivity analyses, we compared models with the 2000 U.S. Census data to those that excluded it to determine if changes in occupational classification altered our findings.

BLS Alternative Classification

To assess the robustness of our findings, we will compare the results to models that use an additional common classification system for the entire period that was developed by the Bureau of Labor Statistics based on the 1990 U.S. Census occupational classification (Meyer and Osborne 2005).[1] After excluding "Not Elsewhere Classified" occupations, this classification contains 165 occupations and provides a better representation of the occupational structure in later decades, but excludes the 1950 sample, so these models include only 1960-2000.

Occupation by Industry Classification

We also employ a classification that takes as units of analysis detailed occupation (IPUMS OCC1950) cross-classified by one digit industry.[2] In a similar manner to the construction of OCC1950, IPUMS used the industrial classification of the 1950 Census (IND1950) to create a common classification scheme for the entire period. Using these categories presents a more accurate representation of the sex segregation of jobs because women are often in lower paying industries within occupations (Blau 1977), and segregation is higher when measured with more detailed classification schemes (Bielby and Baron 1986). Using OCC1950*IND1950 also allows us to address the concern that occupations may change over time in their industrial composition. This is important because prior research provides evidence for sex stereotyping of specific industries (Milkman 1987; Semyonov and Scott 1983; Weeden and Sørensen 2004), particularly female-typing in service sector jobs. We attended to this problem by applying the common industrial classification scheme IPMUS designed to all of the samples in our time frame. These advantages motivated us to designate OCC1950*IND1950 as our preferred classification.

Variables

Median Male or Female Wage

IPUMS data provides annual salary from the prior calendar years for each census year, along with the number of weeks the individual worked in the prior year and the usual hours worked per week in the prior week.[3] From these three we constructed an hourly wage variable for each individual in each census year and adjusted it for inflation. Then, separately for men and women, we computed the median hourly wage for each occupation in each census year. This sex-specific median wage measure was computed only across full-time workers (at least 35 hours/week).

Sex Composition

Because effects of, or on, a proportion can be different near the natural limits that the variable can take (0 and 1), our preferred specification is to convert proportion female to the logit of proportion female. If the proportion female of an occupation for each year is P, the logit of P is:

$$\text{Logit of proportion female} = \log\left(\frac{p}{1-p}\right)$$

Control Variables

Control variables include sex-specific averages that measure an occupation's male or female workers' characteristics. To measure human capital from schooling we used a set of variables capturing the proportion of individuals in each cell with different levels of education (i.e., 1-4, 5-8, 9, 10, 11, 12, 1-3 college years, and at least four years of college education). To estimate occupational averages of labor force experience (which the U.S. Census does not measure directly), we used potential experience. From individuals' age we subtracted their years of education plus 6 (the typical age one starts 1st grade). We also controlled for the proportion of male and female incumbents who were black, Native American, Asian and Latino (relative to non-Hispanic white), as well as proportion residing in the Northeast, Midwest and West (relative to the Southeast).

Many prior cross-sectional analyses testing devaluation have entered control variables measuring skill demands from the Dictionary of Occupational Titles. As these variables are not updated yearly (they have only been updated twice, and not all occupations were re-evaluated), we could not use them in our fixed-effects models. The extensive set of education variables, however, provides us with some approximation of skill requirements. Changes in skill demands can pose a problem for our models to the extent that skill demands affect female proportions and wage, making the association between the two spurious. To better deal with this possibility we estimated models with and without lagged dependent variables. For example, when estimating a model for the effects of lagged sex composition on later wage, controlling for lagged wage better controlled for any changes in a previous period of unmeasured skill demands as opposed to simply controlling for average wage across all years via the fixed effects. (Models contain fixed effects as well.)

As a final approximation of varying skill demands we include in our models a measure of returns to experience. This is obtained by extracting the potential experience coefficients from models estimating a human capital wage model for each occupation, by decade, for full-time/full-year male workers. These coefficients are a measure of how much men's wages increase with age, and should provide a rough approximation of rates of return to experience.[4]

Method

We start with *cross-sectional* models estimated separately for each year by ordinary least squares:

$$W_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 X_{it} + \varepsilon_{it} \tag{1}$$

where, W_{it} is the logged median wage (with distinct measures for men and women) for occupation i in year t, P_{it} is the logit of proportion female for occupation i in year t, X_{it} is a vector of control variables, β_1 and β_2 represent the effects of logit of proportion female and control variables on logged median wage (respectively) and ε_{it} is an occupational level random effect. A similar model is estimated with logit of proportion female as dependent variable and logged median hourly wage as a predictor. Both models are estimated separately for men and women,[5] and include education, potential experience, returns to experience, proportion in each racial group, and proportion in each region as controls. The purpose in estimating these models is to get a sense of the magnitude and direction of the relationship between the two key variables, without regard to causal direction or reciprocal effects.

To test these theories, we need to estimate models that allow each of these variables to be affected by the other variable in the same year or in some previous year, while controlling for additional variables represented by the vector X_{it}, which may include lagged variables. Almost all past research on the relationship over time between occupations' sex composition and pay has used cross-lagged panel (or "lagged-Y-regressor") models, where data include two years, and the method of minimizing omitted variable bias is controlling for the dependent variable in the earlier year. Of past quantitative studies, only Karlin et al. (2002) and England et al. (2007) used more than two years of data, and only England et al. (2007) used fixed effects. We believe it advisable to use multiple years of data instead of only two years because particular years may be idiosyncratic. More importantly, we believe that, relative to lagged-Y regressor models, fixed-effects modeling does a superior job of removing omitted variable bias (Halaby 2004). By using only variation within occupations to estimate the parameters, fixed-effects models control for all stable characteristics of occupations, including those that are not measured. Thus, they deal with omitted variable bias for unmeasured characteristics of occupation, provided they are stable characteristics and have only additive effects. We use all years (1950, 1960, 1970, 1980, 1990 and 2000) for most of our analyses, and then, as a check on whether variables have similar effects by period, we present some analyses that divide decades into four groups.

We estimate *fixed-effects* models that incorporate reciprocal, lagged effects of the key variables:

$$\begin{aligned} W_{it} &= \beta_0 + \beta_1 P_{i,t-k} + \beta_2 X_{i,t-k} + \alpha_i + \varepsilon_{it} \\ P_{it} &= \gamma_0 + \gamma_1 W_{i,t-k} + \gamma_2 X_{i,t-k} + \delta_i + \nu_{it} \end{aligned} \tag{2}$$

In these equations, k is the number of years that the variables are lagged. We use a 10-year lag; the structure of our dataset from the decennial census does not permit any shorter lag in our models. The disturbance terms ε_{it} and ν_{it} are random errors, assumed to be independent of each other and the vector of X variables. The variables α_i and δ_i represent the effects of all unmeasured variables that vary across occupations but do not vary across time. In fixed-effects models, these variables are allowed to be correlated with all measured time-varying variables. However, because of reciprocal effects, it is not correct to estimate each equation separately using conventional OLS methods for fixed-effects models (e.g., using dummy variables for occupations or expressing all variables as deviations from occupation means), as ε_{it} and ν_{it} are necessarily correlated with both P_{it} and W_{it} in later years, violating a key assumption of strict exogeneity (Wooldridge 2002).

To deal with this problem we employ an estimation method that corrects for bias arising from the possibly reciprocal relationship between wages and proportion female and from the endogeneity of the lagged dependent variable. Specifically, we estimate each equation separately with lagged independent variables, allowing α (or δ) to correlate with all the measured time-varying predictors in all years, and allowing ε_{it} (or ν_{it}) to correlate only with *future* values of P_{it} (or W_{it}). This last specification is what accommodates the endogeneity in the predictor variables. Each equation is estimated by maximum likelihood under the assumption that the data were drawn from a multivariate normal distribution, using standard software for structural equation modeling. Although it is also possible to estimate the two equations in Equation 2 simultaneously (without allowing for the error terms to be correlated with the endogenous predictors), more flexibility in model specification is obtained by estimating them separately. Because we are using fixed-effects models, with fixed effects for both occupations and time, the estimates produced by this model are based on changes in the relative position of occupations in the wage hierarchy and on change in the relative level of feminization of occupations. Both the dependent and independent variables in these models are, in effect, deviations from each occupation's mean and from the mean over all occupations at each point in time. Therefore, this method is mathematically equivalent to a conventional regression using change scores when used with only three decades.

Results

We start with descriptive evidence on the variation in our main variables of interest and on the cross-sectional association between occupational wage rates and female shares. First, in Figure 1, we present the zero order cross-sectional correlation between the log median wage rates and percent female. The figure shows negative correlations throughout the period of study (ranging from approximately -.15 to -.25), generally higher in the correlation of percent female with male wages than for female wages. Next, in Table 1, we present the correlations of log median wage rates across decades for men using our preferred classification–OCC1950*IND1950. Correlations range from .4 to .8. They were somewhat smaller for women (results not shown). This picture is in line with evidence on recent changes in the occupational wage structure (Massey and Hirst 1998). Tables 2 and 3 present the correlations between percent female across decades and the level of segregation across decades using three different indices (D, Ds and A).[6] The correlations among the female shares across decades (Table 2) are much higher than those for the wage rates, but as Table 3 documents, in line with previous research (Blau and Hendricks 1979; Jacobs 1989; Weeden 2004), the level of segregation decreased substantially across decades. Figure 2 shows the distribution of OCC1950*IND1950 cells across gender typing categories in 1950 and 2000. While the majority of occupations were male-typed both in 1950 and 2000, a substantial portion of cells changed their proportion female category during this period. Overall, this evidence persuades us that the association between percent female and the wage rates is strong enough to warrant scholarly attention and that, while there is considerable inertia as implied by institutional models, it is not so complete that there is no variation over time to analyze.

Moving to examine cross-sectional association between occupational female proportions and wage rates, Figure 3 presents the coefficients for proportion female by decade from cross-sectional OLS models predicting natural log of male or female median wage (separately for women and men). The figure reveals that a 10 percent increase in proportion female is associated with .5 to 5 percent decrease in hourly wage in each decade. Figure 4 reverses which variable is taken as dependent (which is arbitrary in this preliminary analysis that does not purport to establish causation). Consistent with the queuing view (Reskin and

Figure 1.Correlations between Occupations' Proportion Female and the Natural Log of Male or Female Median Wage

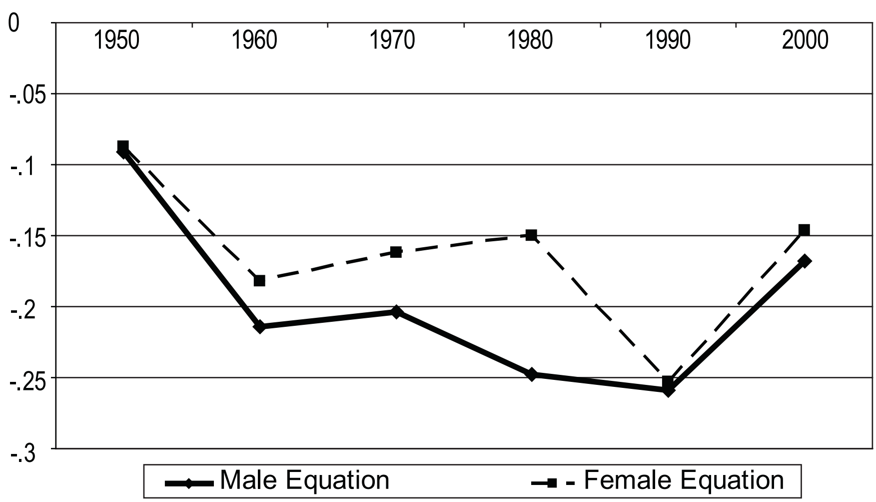


Table 1: Correlations of Occupations' Log of Male Median Hourly Wage

Log of Male Wage:	1950	1960	1970	1980	1990	2000
1950	1.0					
1960	.539	1.0				
1970	.486	.759	1.0			
1980	.432	.693	.798	1.0		
1990	.435	.708	.822	.807	1.0	
2000	.430	.673	.791	.754	.878	1.0

Note: The occupational classification used in this analysis is OCC1950*IND1950. N = 653.
Source: U.S. Census Data 1950-2000.

Table 2: Correlations of Occupations' Logit of Proportion Female

Logit(PF):	1950	1960	1970	1980	1990	2000
1950	1.0					
1960	.882	1.0				
1970	.841	.905	1.0			
1980	.815	.886	.899	1.0		
1990	.808	.872	.857	.915	1.0	
2000	.771	.824	.812	.884	0.91	1.0

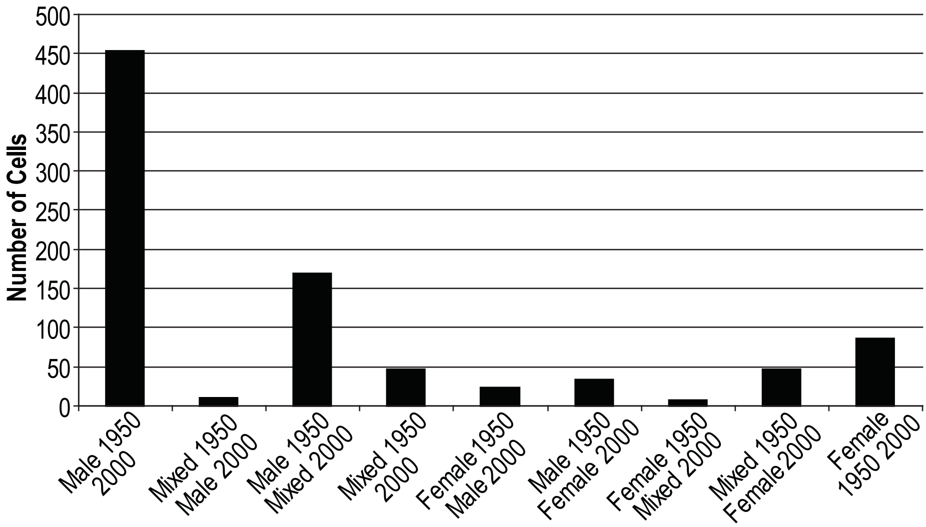
Note: The occupational classification used in this analysis is OCC1950*IND1950. N = 653.
Source: U.S. Census Data 1950-2000.

Table 3: Level of Segregation of Occupations using D, Ds and A

	D	DS	A
OCC1950*IND1950			
1950	68.96	68.43	6.56
1960	77.98	71.12	7.13
1970	74.26	65.62	5.35
1980	68.47	60.25	4.51
1990	62.66	57.96	3.75
2000	60.29	56.94	3.63
OCC1950			
1950	74.88	66.53	10.50
1960	77.26	68.50	14.06
1970	72.03	65.11	8.99
1980	65.99	60.72	7.43
1990	60.01	57.16	6.70
2000	55.08	55.21	6.08
OCCBLS			
1960	74.38	69.44	16.40
1970	71.78	64.37	9.94
1980	66.08	59.70	8.10
1990	59.61	56.39	7.13
2000	57.00	53.45	6.18

Note: OCC1950*IND1950 contains 653 industry-by-occupation cells; OCC1950 classification contains 164 occupations; and OCCBLS 165 occupations.
Source: U.S. Census Data 1950-2000.

Figure 2. Distribution of Occupation-by-Industry Cells Across Gender-Typing Categories in 1950 and 2000

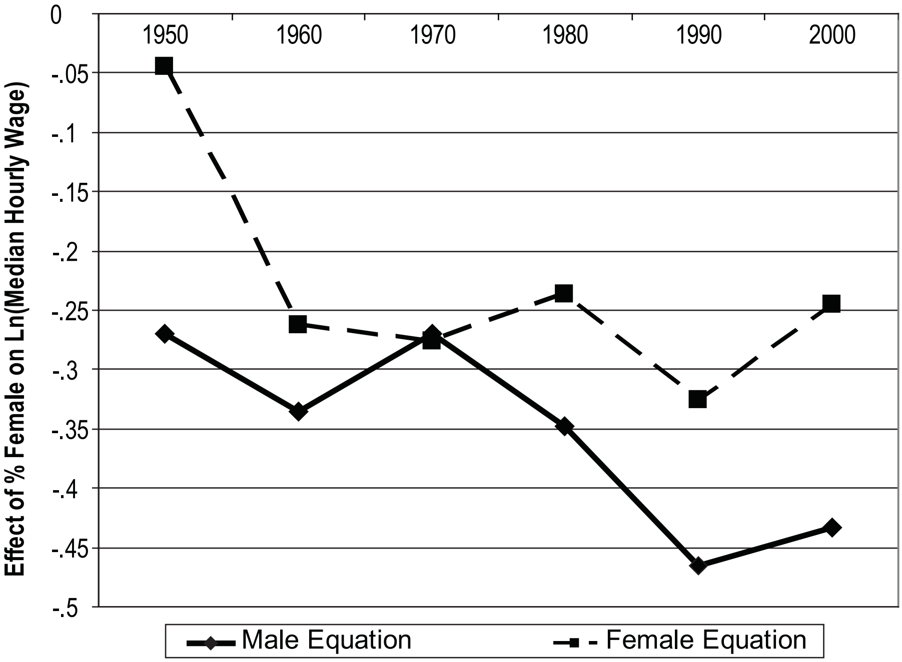


Note: Occupations with 67-100% female are considered as "Female," occupations with 0-33% female are considered as "Male" and all other occupations as "Mixed."
Source: U.S. Census Data 1950-2000.

Roos 1990), we see that wage rates are negatively associated with the proportion of females in each decade.

To test the longitudinal implications of the devaluation and queuing views, we turn to fixed-effects models, estimated as a system of simultaneous equations. Because the devaluation view claims that female proportion negatively affects later pay rates, it is tested in Table 4 with coefficients for lagged logit of proportion female from models predicting log of later (male or female) median hourly wage. Results reveal that female proportion has a negative effect on the levels of reward, generally a 1-3 percent decrease in wages per a 1 percent decrease in the odds, even after controlling for lagged log of median hourly wage, occupational levels of educational requirements, potential experience, returns to experience, proportion in each racial group and proportion in each region. To give the reader a better sense of the magnitude of this effect, when we allowed the effect of female proportion on wage to be nonlinear via dummy variables, female-typed occupations had lower later levels of reward, generally by 6-10 percent, than mixed (integrated) occupations (results not shown), consistent with the prediction of the devaluation view.[7] To test the robustness of these results we estimated models that omitted lagged dependent variables and models that excluded the 2000 data, as the change in occupational categories between 1990 and 2000 makes the 2000 census the least comparable to

Figure 3. Coefficients for Occupations' Proportion Female from Cross-Sectional OLS Models Predicting Natural Log of Male or Female Median Wage



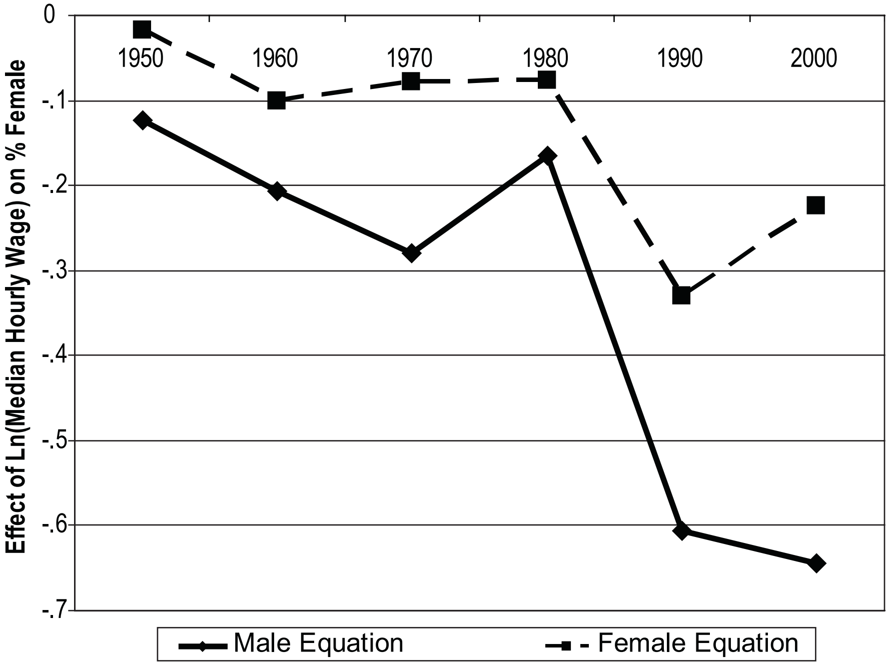
Notes: All coefficients are significant at $p < .05$. All models control for proportion (male or female) in each education level, mean (male or female) potential experience, returns to experience, proportion black, proportion Native American, proportion Asian, proportion Latino, proportion Northeast, proportion Midwest and proportion West.
Source: U.S. Census Data 1950-2000.

all the other available datasets (IPUMS 2006).[8] Results (not shown but available upon request) were generally in line with the results presented in Table 4.

Queuing theorists propose a reverse causal order, with pay rates affecting later female proportion. To test this we estimated fixed-effect models with wage rates predicting later female proportion. Results from these models are presented in Table 5. None of the coefficients in Table 5 are significant with the predicted sign. We obtained similar null findings with a negative binomial model (not shown) predicting later number of males or females. Our results corroborate those of previous longitudinal studies revealing no effect of pay rates on female proportion (England et al. 2007; Karlin et al. 2002; Semyonov and Lewin-Epstein 1989).

So far, our models have used data from all years, and are specified to assume that effects of variables are the same across the entire period. One way we can relax this assumption is to divide the data into four groups of decades, constrain-

Figure 4.Coefficients for Occupations' Natural Log of Male or Female Median Wage from Cross-Sectional OLS Models Predicting Proportion Female



Notes: All coefficients are significant at p < .05. All models control for proportion (male or female) in each education level, mean (male or female) potential experience, returns to experience, proportion black, proportion Native American, proportion Asian, proportion Latino, proportion Northeast, proportion Midwest and proportion West.
Source: U.S. Census Data 1950-2000.

ing only two adjacent decades to have equal coefficients.[9] We do this in tables 6 and 7, where we constrain the parameters of the 1970 and 1980 equations to be equal and allow all others to vary. We obtained similar results to those reported in tables 6 and 7 when we changed the decades we constrained to be equal (i.e., constraining 1960 and 1970, 1980-1990, or 1990-2000 to be equal) and when we divided into three time periods. Because OCC1950 and IND1950 are based on the 1950 respective classifications and OCCBLS is based on the 1990 occupational classification, OCC1950*IND1950 and OCC1950 more accurately capture the patterns in the early part of the study period, while OCCBLS more accurately represents the patterns in the later part of the study period. Table 6 retests the devaluation thesis, presenting the effects of lagged logit of proportion female on occupations' wage for each decade. We see that the wage decrement associated with increased female proportion appears consistently (with the exception of female models using OCC1950*IND1950) for the entire period. Table 6

Table 4: Coefficients for Lagged Logit of Proportion Female from Fixed-Effects Models Predicting Log of Later (Male or Female) Median Hourly Wage, Using Pooled Longitudinal Data and a One-Decade Lag

Effect of Logit of Proportion Female on Later Log Median Hourly Wage	Female Models	Male Models
OCC1950*IND1950	-.015**	-.009***
	(-2.97)	(-4.99)
OCC1950	-.025***	-.022***
	(-4.38)	(-5.0)
OCCBLS	-.022***	-.028***
	(-3.93)	(-5.7)

Notes: **p < .01 ***p < .001 (two-tailed test; t statistic in parentheses).
All models control for lagged log of median hourly wage(male or female), proportion (male or female) in each education level, mean (male or female) potential experience, returns to experience, proportion black, proportion Native American, proportion Asian, proportion Latino, proportion Northeast, proportion Midwest, and proportion West. Predicted sign from devaluation hypothesis is negative.
Source: U.S. Census Data 1950-2000.

Table 5: Coefficients for Lagged Log Median (Female or Male) Hourly Wage from Fixed-Effects Models Predicting Logit of Proportion Female, Using Pooled Longitudinal Data

Effect of Log Median Hourly Wage on Later Logit of Proportion Female	Female Models	Male Models
OCC1950*IND1950	-.093	.047
	(-1.8)	(.94)
OCC1950	-.079	-.09
	(-1.09)	(-1.15)
OCCBLS	-.079	.012
	(-.97)	(.1)

Notes: *p < .05 (two-tailed test; t statistic in parentheses).
All models control for lagged logit of proportion female, proportion (male or female) in each education level, mean (male or female) potential experience, returns to experience, proportion black, proportion Native American, proportion Asian, proportion Latino, proportion Northeast, proportion Midwest, and proportion West. Predicted sign from queuing or relative attractiveness hypothesis is negative. None of the effects are significant.
Source: U.S. Census Data 1950-2000.

Table 6: Decade Specific Coefficients for Lagged Logit of Proportion Female from Fixed-Effects Models Predicting Log of Later (Male or Female) Median Hourly Wage, Using Pooled Longitudinal Data and a One-Decade Lag

Effect of Lagged Logit of Proportion Female on Later Log Median Hourly Wage	Year	Female Models	Male Models
OCC1950*IND1950	2000	-.009	-.007*
		(-1.33)	(-2.2)
	1990	-.017***	-.013***
		(-2.88)	(-4.37)
	1980	-.012	-.009***
		(-1.8)	(-3.7)
	1970	-.012	-.009***
		(-1.8)	(-3.7)
	1960	-.029**	-.01**
		(-2.67)	(-2.66)
OCC1950	2000	-.024**	-.025***
		(-3.35)	(-4.21)
	1990	-.036***	-.029***
		(-4.86)	(-5.48)
	1980	-.015*	-.017***
		(-2.19)	(-3.68)
	1970	-.015*	-.017***
		(-2.19)	(-3.68)
	1960	-.036**	-.047**
		(-2.65)	(-3.03)
OCCBLS	2000	-.019*	-.034***
		(-2.62)	(-5.16)
	1990	-.032***	-.039***
		(-4.52)	(-6.6)
	1980	-.017**	-.026***
		(-2.66)	(-5.38)
	1970	-.017**	-.026***
		(-2.66)	(-5.38)

Notes: *p < .05 **p < .01 ***p < .001 (two-tailed test; t statistic in parentheses).
All models control for lagged log of median hourly wage (male or female), proportion (male or female) in each education level, mean (male or female) potential experience, returns to experience, proportion black, proportion Native American, proportion Asian, proportion Latino, proportion Northeast, proportion Midwest, and proportion West.
Predicted sign from devaluation hypothesis is negative.
Decades are labeled by the year in which they end.
Source: U.S. Census Data 1950-2000.

does reveal one notable temporal change in devaluation: stronger effects of female proportion on wage rates in the 1990 equation.

Table 7, testing queuing separately for the four periods, shows some evidence of queuing in the 1960 equation (using the OCC1950*IND1950 classification) and some evidence for queuing in the 2000 equation (using the OCCBLS classification), but no queuing in other decades, consistent with our results for all periods combined, which showed virtually no evidence of queuing. For both devaluation and queuing the results reported in this article for the 1980-2000 period are generally consistent with the subset of those results reported by England et al. (2007) that included the lagged dependent variable and had the longest lags (up to nine years). They reported significant coefficients for devaluation models with lags that are equivalent to our one-decade lag, though not from the shorter lags they also tested. They found no support for queuing models using any lag length. In contrast to England et al. we allowed the relationship between occupational feminization and pay in the 1980s to differ from their relationship in the 1990s.

What might explain the changes across decades in causal effects of sex composition and wage reported in tables 6 and 7? We know from prior work that, as occupations desegregated, women integrated into male occupations mostly at high professional levels than blue collar occupations (Cotter, Hermsen and Vanneman 2004; Weeden 2004). This disproportionate movement of women into high status and paying occupations (even relative to their education) is the opposite of what queuing predicts. Therefore, the insignificant effect of wage in later decades suggests that any substantial movement by women into relatively more attractive occupations was counterbalanced by increases in less desirable occupations. Our models do show some queuing of the sort described by Reskin and Roos (1990) in the 1950s, where women's entry to a field often followed its declining relative rewards. In subsequent decades, however, the data do not show this. In some of our models, queuing reappears in the 1990s (i.e., the 2000 equation). This finding is in line with the recent concern about the stalling of the gender revolution (Blau, Brinton and Grusky 2006). The increase in the wage penalty for feminization in the 1980s (shown in our models) may relate to the increasing overall wage inequality after 1970 that was documented by many authors (Autor et al. 2006; Gottschalk 1997; Katz and Autor 1999; Morris and Western 1999). As recent research has shown, the bulk of this increase was concentrated in the 1980s (Card and DiNardo 2002). This growing inequality, in part, reflected men in the bottom half of the wage distribution moving from male-intensive blue collar jobs well paid for their education levels to more integrated or female service-sector jobs which paid less well for their education. At the top, however, it was in predominantly male high status jobs that the right-hand tail of the earnings distributions moved out ever more (Autor et al. 2006), increasing the advantage of being in such jobs over even the highest paying predominantly female jobs. This later development is consistent with the increased coefficients reflecting devaluation for the 1980s.

Discussion

We have presented the first long-term assessment of whether changes in an occupation's sex composition are followed by changes in its median wage and whether changes in relative wages affect feminization. Only one previous study has applied a fixed-effects model to longitudinal data to sort out the causal order between occupations' pay and percent female (England et al. 2007). We improve on that

Table 7: Decade Specific Coefficients for Lagged Log of (Male or Female) Median Hourly Wage from Fixed-Effects Models Predicting Later Logit of Proportion Female, Using Pooled Longitudinal Data and a One-Decade Lag

Effect of Log Median Hourly Wage on Later Logit of Proportion Female	Year	Female Models	Male Models
OCC1950*IND1950	2000	-.077	-.192
		(-.64)	(-1.29)
	1990	.003	.17
		(.03)	(1.42)
	1980	-.073	.031
		(-1.07)	(.24)
	1970	-.073	.031
		(-1.07)	(.24)
	1960	-.222*	-.43**
		(-2.27)	(-2.88)
OCC1950	2000	-.245	-.586**
		(-1.73)	(-3.23)
	1990	.156	-.001
		(1.33)	(-.01)
	1980	-.077	-.07
		(-.81)	(-.67)
	1970	-.077	-.07
		(-.81)	(-.67)
	1960	-.2	-.391
		(-1.4)	(-1.74)
OCCBLS	2000	-.118	-.705***
		(-1.19)	(-4.09)
	1990	.029	.017
		(.248)	(.12)
	1980	-.118	-.05
		(-1.19)	(-.41)
	1970	-.118	-.05
		(-1.19)	(-.41)

Note: *p < .05 **p < .01 ***p < .001 (two-tailed test; t statistic in parentheses).
All models control for lagged logit of proportion female, proportion (male or female) in each education level, mean (male or female) potential experience, returns to experience, proportion black, proportion Native American, proportion Asian, proportion Latino, proportion Northeast, proportion Midwest, and proportion West. Predicted sign from queuing hypothesis is negative.
Decades are labeled by the year in which they end.
Source: U.S. Census Data 1950-2000.

study by studying a much longer time frame, by using cells created by cross-classifying industry and occupations as our unit of analysis, and by providing additional controls. Extending the time frame allowed us to asses whether the null effects reported in previous studies, particularly with respect to queuing theory, reflect the stability characterizing the period of study in previous research or a lack of causal effect of pay on feminization or its reverse.

These are the contributions of our study, but we also note its limitations. First, the time frame still excludes the first half of the 20th century. Therefore, this research can deal with the tenets of institutional theory only in a limited manner because data on the founding conditions of every industry or occupation do not exist. Second, our study covers a period of time when major changes to the occupational classification system were introduced by the U.S. Census Bureau. We dealt with this problem by employing a variety of classifications and by running models with and without the 2000 U.S. Census. While results are not always consistent, they often are. Third, our study focuses on only two mechanisms responsible for the association between occupational feminization and occupational pay, while ignoring other factors that affect the relative level of wages or the proportion female in each occupation. Other factors, such as changing skill demands, might account for a greater share of variance in changes in occupational pay and occupational feminization, but are beyond the scope of our research.

A final limitation of our analysis is that our fixed-effects models adjust for unchanging, but not changing, characteristics of occupations. Unfortunately, we could not include variables that directly measure changes in occupational skill demands because time-varying measures of occupational skill levels are not available. We dealt with this, albeit imperfectly, by including controls for average education, average potential experience and male returns to potential experience, all of which are available by year, and by including models that allow strength or direction of association to differ over time. Our inability to measure changes in skill demands directly means that we were not able to assess hypotheses about de-skilling, so it is worth considering whether these processes, if occurring, might render the conclusions we reach here biased. If de-skilling lowers wages, and low wages lead to feminization, as argued by queuing theorists, our models should pick up this process on the coefficients for effects of wage on sex composition; we did not find these effects. If the way that de-skilling enters the process is that employers see women as less competent and de-skill work in response to feminization, which in turn lowers salaries, then our models will pick this up as part of the devaluation effect. Thus, it is possible that what we interpret as devaluation is employers responding to feminization by first de-skilling and then lowering wages, or simply by lowering wages directly in response to feminization without de-skilling. We can't distinguish between these here.

We found some evidence for the devaluation view – an effect of earlier female proportion on occupations' later wage rates, even in the presence of controls for experience and educational requirements. When we divided our data into four periods, we saw no diminution of the devaluation effect over time; if anything, it increased (in the 1980s). This argues against the neoclassical equalizing differences view, which predicts no net effect of sex composition with adequate controls. Our introduction of fixed effects to remove bias resulting from omitted variables describing stable non-pecuniary advantages of occupations makes this a stronger conclusion than available from past cross-sectional studies of devaluation.

We find little evidence of queueing, except in the first decade. The thesis states that, because employers prefer men in most occupations, it is only when wages fall that occupations will feminize; thus, wages affect later sex composition. When we pool all years, we find almost no evidence of a negative effect of early wage on later percent female, consistent with most past longitudinal studies of queuing. However, when we divide the data into four periods, there is some evidence of queuing in the 1950s.

A previous analysis by England et al. (2007) of a shorter (19-year) and more recent period used the statistical approach we adopt here. It found no effects of wage rates on later female proportion. In addition, it documented an effect of female proportion on occupational wage rates mostly in models with lags that are similar to our one decade lag (i.e., eight and nine years lags), but failed to find an effect of percent female in models with shorter lags. The authors concluded that institutional inertia in wage structures must explain the lack of effect in models with a shorter lags.[10] That is, they argued that perhaps both devaluation and queuing operated at the birth of occupations, but after a wage was set, further feminization made little difference in later wage, and rises or declines in wages had little to do with later feminization. In their view, female occupations are still underpaid relative to their educational requirements, but this is a residual effect of devaluation taking place decades previous. Our analysis, using a much longer period, casts doubt on this previous conclusion. To be sure, there is substantial inertia in both wage rates and sex composition as seen by the strong inter-period correlations (tables 1-3). Yet, using a longer time frame and decade-long lag, we have found substantial support for the view that increased feminization of occupations diminishes their relative pay.[11] Moreover, while this evidence is more equivocal, we have some evidence that in the first decade of the study period when occupations lost relative pay, they were more likely to feminize, consistent with the queuing view, but we found no evidence for queuing later. The reduction of queuing over time is consistent with the notion that hiring discrimination against women seeking admission into male occupations reduced, or that supply-side change in women's interests was greatest at the upper reaches of the occupational structure. It is also important to realize that lack of support for queuing in the later periods does not mean that hiring and placement discrimination was not occurring. Lack of statistical support for the queuing model is not inconsistent with a situation in which extensive hiring discrimination by sex occurs, with women preferred for traditionally female occupations while men are preferred for historically male occupations that offer similar levels of compensation. This, combined with segregation-producing supply-side forces, produces enough segregation to give employers the opportunity to engage in devaluing whatever work is done by women. While we make no claims that the devaluation of predominantly female jobs explains most of the sex gap in pay, we believe this study shows that it is an ongoing important contributor to gender inequality.

Notes

1. OCCBLS has recently been integrated into the IPUMS database.
2. We did not use a more detailed industry classification because this would have resulted in a large share of cells with missing data for some of the decades, forcing us to exclude these cells or to use arbitrary aggregation rules.
3. Weeks worked are measured in these intervals: 1-13, 14-26, 27-39, 40-47, 48-49, 50-52. Hours worked per week in current job are measured in these intervals: 1-14, 15-29, 30-34, 35-39, 40, 41-48, 49-59, 60+. To create continuous variables, we used midpoints with Pareto distribution imputation for the highest categories. To check if the use of categorical responses (with midpoints) for the weeks and hours measured pose a problem in the measurement of the median occupational hourly wage, we measured the correlation between a median hourly wage variable constructed using continuous measures and a median hourly wage variable constructed using categorical variable. The correlations for 1990 (where both categorical and continuous measurement of weeks and hours of work exist) using the OCCIND, OCC1950 and OCCBLS are .957, .998 and .997 (respectively).
4. We estimate these returns on male data because women's lack of wage increase with age may indicate intermittent labor force participation.
5. We run separate models to predict median occupational hourly wage for males and females. If the devaluation view is correct, we should find that either men or women suffer from working in an occupation with a higher percent female. If we used a single measure that captures the median hourly wage of all workers, the coefficient for percent female would have been affected by the extent of within-occupation gender differences in pay. Suppose, for example, that occupations differ in their proportion of females, that the male median wage is $15/hour in every occupation, and that the female median wage is $10 in every occupation. In this hypothetical situation, the entire sex gap in pay would come from within-occupation sex differences in pay. Yet, if we pooled men and women and ran a model predicting median pay from percent female, we would find a large negative effect. Such an artifact is not present when separate models are run for men and women.
6. For a discussion of the qualities of the three indices see Charles and Grusky (1995). A is defined as follows:

$$A = \exp\left(1/J \times \sum_{j=1}^{J} \left\{\ln(F_{jk}/M_{jk}) - \left[1/J \times \sum_{j=1}^{J} \ln(F_{jk}/M_{jk})\right]\right\}^2\right)^{1/2}$$

7. Occupations from 67-100% female were defined as "female;" those from 0-33% male as "male;" others were in the reference category, "mixed." Male occupations were significantly different than mixed only in some models, generally providing wages that are 4-7% higher than the wages in mixed occupations. Although the non-consistent finding about male occupations might suggest non-linearity, when we tried specifications with proportion female to its second, third and higher powers (following the findings of Cotter et al. 2004) they did not show significant effects.
8. We also consider the possibility that the size of the occupation might affect the results due to greater measurement error in small occupations. Therefore, we estimated these models and the queuing models while weighting by the size of the occupation. We found that models weighted by the size produced similar results to un-weighted models (results not shown).

9. Imposing only one equality constraint allows us to retain our methodological framework while providing as much detail as possible on the dynamics of the relationship between occupational feminization and pay. It also allows for evaluating whether changes in the occupational classification schemes across decades are associated with changes in the magnitude of the coefficients.
10. Of course, modern institutional theory does not deal only with inertia, but also discusses the conditions under which institutional change occurs (e.g., DiMaggio and Powell 1983; Scott 2001; Sutton et al. 1994; Zucker 1988).
11. England et al. (2007) presented results from models with varied lengths of lags for the independent variables. They also presented results for models with or without lagged values of the dependent variable. The different models, especially for models evaluating devaluation theory, produced different results. Specifically, they produced significant effects of proportion female on wage mostly for models with longer lags, particularly those with eight- and nine-year lags. In this article, we are forced to use a one-decade lag, and we chose to use models with lagged values of the dependent variable. Using decade-long lags and lagged values of the dependent variable we find similar evidence for devaluation as found in the 8- and 9-year lags used by England et al. (2007). These authors' global conclusion that there is little evidence for devaluation came from the fact that they also tried shorter lags and models without the lagged dependent variable, and they did not find significant effects in those models. We think controlling for the lagged dependent variable is appropriate, and that it probably takes a lag of some years to change the median wage in an occupation, given that it is unlikely that pay will be lowered on existing employees, so the effect may have to occur glacially through lower wages for new workers.

References

Allison, Paul D. 1990. "Change Scores as Dependent Variables in Regression Analysis." Pp. 93-114. *Sociological Methodology 1990 Volume 20.* Clifford C. Clogg, editor. John Wiley & Sons.

Autor, David H., Lawrence F. Katz and Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review* 96(2):189-94.

Baron, James, and Andrew Newman. 1989. "Pay the Man: Effects of Demographic Composition on Prescribed Wage Rates in the California Civil Service." Pp. 107-30. *Pay Equity: Empirical Inquiries.* Robert Michael, Heidi Hartmann and Brigid O'Farrell, editors. National Academy Press.

Baron, James N., Michael T. Hannan, Greta Hsu and Ozgecan Kocak. 2002. "Gender and the Organization-Building Process in Young, High-Tech Firms." Pp. 245-73. *The New Economic Sociology: Developments in an Emerging Field*. Mauro Guillen, Randall Collins, Paula England and Marshall Meyer, editors. Russell Sage Foundation.

Bielby, William T., and James N. Baron. 1986. "Men and Women at Work: Sex Segregation and Statistical Discrimination." *American Journal of Sociology* 91(4):759-99.

Blau, Francine D. 1977. *Equal Pay in the Office*. Lexington Books.

Blau, Francine D., Mary C. Brinton and David B. Grusky. 2006. *The Declining Significance of Gender?* Russell Sage Foundation.

Blau, Francine D., and E. Hendricks Wallace. 1979. "Occupational Segregation by Sex: Trends and Prospects." *Journal of Human Recourses* 14(2):197-210.

Card, David, and John E. DiNardo. 2002. "Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles." *Journal of Labor Economics* 20(4):733-83.

Catanzarite, Lisa. 2003. "Race-Gender Composition and Occupational Pay Degradation." *Social Problems* 50(1):14-37.

Cejka, Mary A., and Alice H. Eagly. 1999. "Gender-Stereotypic Images of Occupations Correspond to the Sex Segregation of Employment." *Personality and Social Psychology Bulletin* 25(4):413-23.

Charles, Maria, and David B. Grusky. 1995. "Models for Describing the Underlying Structure of Sex Segregation." *American Journal of Sociology* 100(4):931-71.

Cohen, Philip N., and Matt L. Huffman. 2003. "Individuals Jobs and Labor Markets: The Devaluation of Women's Work." *American Sociological Review* 68(3):443-63.

Cotter, David A., JoAnn DeFiore, Joan M. Hermsen, Brenda Marsteller Kowalewski and Reeve Vanneman. 1997. "All Women Benefit: The Macro-Level Effect of Occupational Integration on Gender Earnings Equality." *American Sociological Review* 62(5):714-34.

Cotter, David A., Joan M. Hermsen and Reeve Vanneman. 2004. *Gender Inequality at Work*. Russell Sage Foundation.

Doeringer, Peter B., and Michael J. Piore. 1971. *Internal Labor Markets and Manpower Analysis.* Heath Lexington.

DiMaggio, Paul J., and Walter W. Powell. 1983. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review* 48(2):147-60.

England, Paula. 1992. *Comparable Worth: Theories and Evidence.* Aldine de Gruyter.

______. 2001. "Gender and Feminist Studies." Pp. 5910-15. *International Encyclopedia of the Social and Behavioral Sciences Volume 4.* Neil J. Smelser and Paul B. Baltes, editors. Elsevier.

England, Paula, Paul Allison and Yuxiao Wu. 2007. "Does Bad Pay Cause Occupations to Feminize, Does Feminization Reduce Pay, and How Can We Tell With Longitudinal Data?" *Social Science Research* 36(3):1237-56.

England, Paula, Joan Hermsen and David Cotter. 2000. "The Devaluation of Women's Work: A Comment on Tam." *American Journal of Sociology* 105(6):1741-51.

Filer, Randall. 1985. "Male-Female Wage Differences: The Importance of Compensating Differentials." *Industrial and Labor Relations Review* 38(3):426-37.

Gottschalk, Peter. 1997. "Inequality, Income Growth, and Mobility: The Basic Facts." *Journal of Economic Perspective* 11(2):21-40.

Halaby, Charles N. 2004. "Panel Models in Sociological Research: Theory into Practice." *Annual Review of Sociology* 30:507-44.

IPUMS. 2006. "Chapter 4: Occupation and Income Scores." Minnesota, MN: Minnesota Population Center. Available at: http://usa.ipums.org/usa/chapter4/chapter4.shtml.

Jacobs, Jerry A. 1989. *Revolving Doors: Sex Segregation and Women's Careers*. Stanford University Press.

Jacobs, Jerry A., and Ronnie J. Steinberg. 1990. "Compensating Differentials and the Male-Female Wage Gap: Evidence from the New York State Comparable Worth Study." *Social Forces* 69(2):439-68.

Karlin, Carolyn A., Paula England and Mary Ross. 2002. "Why Do 'Women's Jobs' Have Low Pay For Their Educational Level?" *Gender Issues* 20(4):3-22.

Katz, Lawrence F., and David H. Autor. 1999. "Changes in the Wage Structure and Earnings Inequality." Pp. 1463-1555. *Handbook of Labor Economics Volume III*. Orley C. Ashenfelter and David Card, editors. Elsevier.

Kim, Marlene. 1999. "Inertia and Discrimination in the California State Civil Service." *Industrial Relations* 38(1):46-68.

Levine, David I., Dale Belman, Gary Charness, Erica L. Groshen and K.C. O'Shaughnessy. 2002. *How New is the "New Employment Contract"? Evidence from North American Pay Practices*. Kalamazoo, MI: Upjohn Institute.

Massey, Douglas S., and Deborah, S. Hirst. 1998. "From Escalators to Hourglass: Changes in the U.S. Occupational Wage Structure 1949-1989." *Social Science Research* 27(1):51-71.

Meyer, Peter B., and Anastasia M. Osborne. 2005. "Proposed Category System for 1960-2000 Census Occupations." *Bureau of Labor Statistics Working Paper # 383*. Available at: http://stat.bls.gov/ore/pdf/ec050090.pdf.

Milkman, Ruth. 1987. *Gender at Work: The Dynamics of Job Segregation by Sex During World War II.* University of Illinois Press.

Morris, Martina, and Bruce Western 1999. "Inequality in Earnings at the close of the Twentieth Century." *Annual Review of Sociology* 25:623-57.

Petersen, Trond, and Ishak Saporta. 2004. "The Opportunity Structure for Discrimination." *American Journal of Sociology* 109(4):852-901.

Pfeffer, Jeffrey, and Alison Davis-Blake. 1987. "The Effect of the Proportion of Women on Salaries: The Case of College Administrators." *Administrative Science Quarterly* 32(1):1-24.

Reskin, Barbara F., and Patricia Roos. 1990. *Job Queues, Gender Queues: Explaining Women's Inroads into Male Occupations.* Temple University Press.

Ridgeway, Cecilia. 1997. "Interaction and the Conservation of Gender Inequality: Considering Employment." *American Sociological Review* 62(2):218-35.

Ridgeway, Cecilia, and Paula England. 2007. "Sociological Approaches to Sex Discrimination in Employment." Pp. 189-212. *Sex Discrimination in the Workplace*. Faye J. Crosby, Margaret S. Stockdale and S. Ann Ropp, editors. Blackwell.

Rosen, Sherwin. 1986. "The Theory of Equalizing Differences." *Handbook of Labor Economics* 1(1):641-92.

Ruggles, Steven, Matthew Sobek, Miriam L. King, Caroline Liebler and Catherine A. Fitch. 2003. "IPUMS Redesign." *Historical Methods* 36(1):9-19.

Ruggles, Steven, Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King and Chad Ronnander. 2004. *Integrated Public Use Microdata Series: Version 3.0* [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor]. Available at: http://usa.ipums.org/usa/.

Scott, W. Richard. 2001. *Institutions and Organizations.* Sage Publications.

Semyonov, Moshe, and Noah Lewin-Epstein. 1989. "Segregation and Competition in Occupational Labor Markets." *Social Forces* 68(2):379-96.

Semyonov, Moshe, and Richard I. Scott. 1983. "Industrial Shifts, Female Employment, and Occupational Differentiation: A Dynamic Model for American Cities, 1960-1970." *Demography* 20(2):163-76.

Snyder, David, and Paula M. Hudis. 1976. "Occupational Income and the Effects of Minority Competition and Segregation: A Reanalysis and Some New Evidence." *American Sociological Review* 41(2):209-34.

Sorensen, Elaine. 1994. *Comparable Worth: Is It a Worthy Policy?* Princeton University Press.

Steinberg, Ronnie J. 2001. "Comparable Worth in Gender Studies." Pp. 2393-97. *International Encyclopedia of the Social & Behavioral Sciences*, *Volume 4.* Neil J. Smelser and Paul B. Baltes, editors. Elsevier.

Stinchcombe, Arthur L. 1965. "Social Structure and Organizations." Pp. 142-93. *Handbook of Organizations*. James March, editor. Rand-McNally.

Strober, Myra H. 1984. "Toward a General Theory of Occupational Sex Segregation: The Case of Public School Teaching." Pp. 144-56. *Sex Segregation in the Workplace: Trends, Explanations, Remedies.* Barbara F. Reskin, editor. National Academy Press.

Strober, Myra H., and Carolyn L. Arnold. 1987. "The Dynamics of Occupational Segregation Among Bank Tellers." Pp. 107-48. *Gender in the Workplace.* Clair Brown and Joseph A. Pechman, editors. Washington, DC: Brookings Institution.

Strober, Myra H., and Lisa M. Catanzarite, 1994. "The Relative Attractiveness Theory of Occupational Segregation by Gender." Pp. 116-39. *Beiträge zur Arbeitsmarkt- und Berufsforschung* [*Labor Market and Occupational Research.*] Petra Beckmann and Gerhard Engelbrech, editors. Nuremberg, Germany: Institute for Employment Research.

Sutton John R., Frank Dobbin, John W. Meyer and W. Richard Scott. 1994. "The Legalization of the Workplace." *American Journal of Sociology* 99(4):944-71.

Tam, Tony. 1997. "Sex Segregation and Occupational Gender Inequality in the United States: Devaluation or Specialized Training?" *American Journal of Sociology* 102(6):1652-92.

Weeden, Kim A. 2004. "Profiles of Change: Sex Segregation in the United States, 1910-2000." Pp. 131-78. *Occupational Ghettos: The Worldwide Segregation of Women and Men.* Maria Charles and David B. Grusky, editors. Stanford University Press.

Weeden, Kim A., and Jesper B. Sørensen. 2004. "A Framework for Analyzing Industrial and Occupational Sex Segregation in the U.S." Pp. 245-96. *Occupational Ghettos: The Worldwide Segregation of Women and Men.* Maria Charles and David B. Grusky Stanford, editors. Stanford University Press.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. MIT Press.

Zucker, Lynne G. 1988. "Where Do Institutional Patterns Come From? Organizations as Actors in Social Systems." Pp. 23-49. *Institutional Patterns and Organizations: Culture and Environment.* Lynne G. Zucker, editor. Ballinger.