Chapter Title: Wages in the Federal and Private Sectors

Chapter Author: Steven F. Venti

7   Wages in the Federal and Private Sectors

Steven F. Venti

The legal principle of comparability has formally guided federal white-collar wage policy for the last twenty years. The legislation requires that "federal pay rates be comparable with private enterprise pay rates for the same levels of work."[1] The principle has been interpreted and enforced to equalize wages between the federal and private sectors. Recent evidence suggests this objective has not been attained. Seminal work by Smith (1976, 1977, 1981) and Quinn (1979) indicates federal workers may be "overpaid" relative to their private sector counterparts by as much as 15 percent to 20 percent.

This chapter makes two additional contributions to the comparability debate. The first is another attempt to determine if federal and private sector wages are "equal" as mandated by current federal wage guidelines. Since individual productivity differences are valid reasons for pay differences between sectors, we extend the approach of Smith and Quinn to control for the effects of both observed *and* unobserved worker quality in order to isolate residual wage inequality between sectors.

The second contribution is an attempt to motivate a more choice-theoretic treatment of public-private wage differences. This approach is based on a simple supply interpretation of wage "comparability": as a cost-minimizing employer, the public sector would set wages just high enough to attract the required work force. This interpretation appears to be the original motivation for comparability legislation. The approach suggests that if there exist equalizing differences in pay for nonpecuniary job attributes of each sector, a policy of equal wages is inappropriate. To resolve the issue of a "comparable" wage, we de-

Steven F. Venti is assistant professor of economics at Dartmouth College.

velop and estimate a model of sectoral job attachment to identify the wage differential consistent with this interpretation of comparability.

7.1   Introduction and Overview

Pay comparability between the public and private sectors is supported by both equity and efficiency arguments. Equity considerations dictate a worker do no better or worse in the public sector than in the private sector. Efficiency considerations imply that the federal sector pays no more than is necessary to attract an adequate supply of employees. Equal pay, it is presumed, will lead to "fair" competition for workers between the public and private sectors.

Several previous studies have attempted to determine if equal pay in the public sector has been attained. They have employed wage regressions to adjust observed differentials for observed quality and productivity differences among workers. Inability to "explain" pay differences by measured characteristics is taken as evidence that equal pay is not the rule. Unexplained or residual differences in pay are interpreted as quasi rents to employment in the higher-paying sector.

The present analysis addresses two alternative interpretations of the "unexplained" difference between public and private wages. The first is unobserved differences in the productivity of workers in each sector. Despite the availability of large samples and detailed information in recent microdata files, we can never fully capture all worker-specific differences. If workers are sorted between sectors on the basis of these unobserved factors, the unexplained component of wage regressions may be more properly interpreted as individual differences rather than quasi rents. One goal of the present analysis is to extend the wage regression approach to adjust for the effects of observed and unobserved productivity-related personal characteristics.

The second interpretation of the unexplained difference between public and private sector wages is equalizing (or compensating) wage differences for nonpecuniary job attributes. Workers may perceive fundamental differences between the public and private sectors. Distinguishing features of each sector, which may be viewed either favorably or unfavorably by workers, include stability of employment, opportunity for internal promotion, unique nature of public service, pace of work, the bureaucratic work environment, and so forth. If the "return" from a job is viewed as a package containing both wage and nonwage components, then part of any public-private wage difference may be an equalizing difference for the nonwage job attributes. If workers trade off wages for these job attributes, a policy of "equal wages" between sectors may lead to a federal wage scale that neither equalizes overall "returns" to workers in each sector nor elicits the appropriate supply response.

If wage differences between sectors are, in part, equalizing differences, how can one determine if the federal sector "overpays"? Unlike the problem of unobserved productivity, the effects of equalizing differences cannot easily be dealt with in a wage regression framework. In particular, the conventional approach of standardizing wages for the effects of nonwage job attributes cannot be applied because some of the fundamental differences between the federal and private sectors (e.g., serving the public) cannot be easily measured.[2] The alternative approach adopted here is to judge whether the government "overpays" based on implicit queues for public sector jobs. If the difference between public and private wage offers exceeds the equalizing difference in pay necessary to offset the difference between nonwage job aspects, then more individuals will desire government employment than there are public sector jobs. The wage differential that "just" eliminates the queue is, in a simple supply sense, the "comparable" wage differential.

The present analysis formulates and estimates a model of sectoral attachment at the individual level that permits rough calculation of the length of implicit queues for federal sector jobs. We identify determinants of worker preferences for federal sector employment and determinants of federal sector hiring choices. The separate decisions of employee and employer together determine whether the worker will be employed in the government sector. More important, identification of the separate decisions permits a test for the existence of queues for federal jobs by revealing excess desired demand for government jobs at a given relative public-private wage. A related advantage of directly specifying the sectoral attachment mechanism is that it can be incorporated into the wage regression method to adjust observed differentials for both observed and unobserved productivity characteristics.

Before proceeding, one shortcoming of the model deserves mention. This study focuses only on the wage component of pecuniary compensation. The principle of comparability has only recently been applied to nonwage compensation (Carow 1981). Although the model deals with nonwage job attributes, the analysis is geared to those attributes, unlike fringe benefits, that cannot be manipulated by employers. Of course the existence of positive public-private wage differentials would be of less consequence if offset by other forms of pecuniary compensation such as fringe benefits. However, there is ample evidence this is not the case (Quinn 1979, 1982a, 1982b; Bellante and Long 1981). These studies suggest that federal-private wage differentials may understate total compensation differentials.

The results suggest that wage equality between similar workers in the federal and private sectors was not achieved in 1982. After adjusting for both observed and unobserved productivity characteristics, we find that the federal wage structure exceeds the private sector wage structure by about 4 percent for males and 22 percent for females. We also

attempt to estimate the wage differential that eliminates implicit queues for federal sector jobs. For the marginal worker this is the wage differential that equalizes the attractiveness of total compensation (wage and nonwage) packages offered by each sector. The estimates suggest that elimination of queues would be achieved by reducing federal wages for males about 16 percent and federal wages for females by about 42 percent.

Section 7.2 briefly outlines the objectives of comparability legislation and the pay-setting mechanism in the federal government. Section 7.3 briefly reviews the wage regression approach and provides the motivation for the empirical work that follows. Section 7.4 lays out the employer-employee matching model that is central to our approach, and section 7.5 discusses econometric issues. The description of data sources and presentation of results are contained in sections 7.6 and 7.7 respectively. The findings are summarized in the final section.

7.2   Setting Pay in the Federal Sector

The federal government employs several different systems to determine pay. Slightly under one-half of all federal civilian employees (mostly white collar) are classified under the General Schedule (GS) pay system. Another fifth (mostly blue collar) fall under the Federal Wage System (FWS). Remaining workers are covered by the Postal Service Schedule or one of several smaller pay plans for other agencies.

Each of the major federal pay systems is linked to private sector rates of pay. Reasons for doing so are set forth in the Federal Salary Reform Act of 1962 which established the comparability principle for workers covered by the GS:

> Adoption of the principle of comparability will insure equity for the federal employee with his equals throughout the national economy—enable the government to compete fairly with private firms for qualified personnel—and provide at least a logical and factual standard for setting Federal Salaries. (Reprinted in President's Panel on Federal Compensation 1976, 8)

Having set this objective, an elaborate mechanism was established to annually adjust federal pay to private pay rates. In March of each year the Bureau of Labor Statistics undertakes a national white-collar salary survey. This information is used to assign rates of pay to jobs in the public sector such that federal pay rates are comparable to "private enterprise pay rates for the same levels of work."[3] A number of factors interfere with pursuit of this objective. First, it is often difficult to compare jobs in the public sector with jobs in the private sector (air traffic controllers, judges, etc.). Second, a number of tech-

nical problems with the BLS survey may make the private sector comparison group a biased sample of all private sector workers.[4] Finally, in nine of the past thirteen years, and not since 1976, have the pay raises suggested by the technical analyses been fully accepted by the executive and legislative branches. As a consequence there is good reason to suspect that the comparability process may have strayed from its objective.

Although in principle federal wage schedules assign rates of pay to jobs not to individuals, in application the system provides some flexibility to tailor compensation to fit individuals. To attract or retain workers, while remaining within the confines of the GS or FWS, federal employers can reclassify jobs upward (grade creep), speed up promotions, lower credentials for jobs, or give unduly large credit to previous work experience. In addition, upper-level managers are eligible for merit pay bonuses. Borjas (1980) presents some evidence on wage variation within the federal sector.

7.3   The Wage Regression Approach

The wage regression approach used by both Smith and Quinn has previously been applied to race and sex differentials. An important distinction between these applications and the present application is that sectoral attachment, unlike race and sex, is a "choice" variable. The method compares earnings or wages between similar workers in each sector. It poses the hypothetical question What would a person with some given set of observed characteristics (education, sex, race, etc.) earn in each sector? Unexplained or residual differences in pay between sectors are interpreted as quasi rents to employment in the higher-paying sector.

A serious empirical problem arises because choices not taken are not observed. Associated with each worker is a public sector wage or a private sector wage, but never both. The wage a private sector worker would earn if he were to obtain a public sector job is not observed, nor is the wage a government worker would earn in a private sector job. Direct wage comparisons are impossible. The best one can do is somehow impute an alternative wage for each worker. Inevitably this requires basing the analysis on workers employed in one sector or the other.

Smith and Quinn perform these imputations using the results of OLS wage equations fitted to each sector. Parameter estimates based on employed private sector workers are used to predict what "public sector workers would earn in the private sector."[5] The portion of the wage differential that cannot be explained by differences in measured characteristics between workers in each sector is interpreted as the

extent of overpayment: a quasi rent to employment in the higher-paying sector.

Such an interpretation, however, hinges on two crucial assumptions. First, the disturbances in each wage equation are classically behaved. This assumption implies that given observed personal characteristics, workers are randomly distributed across sectors. Yet this restriction may be inconsistent with even the simplest models of employee and employer behavior which suggest sectoral attachment is a choice variable. Each employment match is the end result of a search process in which employees attempt to choose the job offering the greatest net advantage and employers try to obtain labor at the lowest cost. Many, if not most, of the factors involved in these choices (worker and employer preferences, job attributes, worker quality, etc.) are measured only imperfectly. If the matching process is effective, we expect that, say, a worker with unobserved skills valued most in one sector to be observed working in that sector. Thus self-selected (or firm-selected) samples, which imply different unobserved productivity characteristics of workers in each sector, may provide an alternative explanation of residual wage differences predicted by the wage regression technique.

The second assumption crucial to the Smith-Quinn interpretation is that pay differentials do not represent equalizing differences for non-pecuniary job attributes of each sector. If workers view the federal and private sectors as offering fundamentally different quantities of important nonwage job attributes, then workers will, in general, not face the same wage offers from each sector. The worker side of an employer-employee match suggests that workers desire employment in the sector offering the most advantageous package of job attributes *and* wages. For some workers higher public sector wages may not be enough to offset dissatisfaction with nonwage aspects of public sector jobs. Other workers may view public sector jobs more favorably.

In a competitive labor market, distributions of preferences across workers and nonwage attributes across jobs together determine the market trade-off between components of the total (pecuniary and non-pecuniary) compensation package.[6] The presumption of "equilibrium" that permits interpretation of market trade-offs as equalizing differences in pay is open to question in the public sector. Thus without the "equilibrium" assumption, it is difficult to distinguish equalizing differences from noncompetitive quasi rents.

The above arguments suggest that wage differences between the public and private sectors can be decomposed into four "sources": (a) observed productivity or skill differences, (b) unobserved productivity or skill differences, (c) equalizing differences in pay for nonpecuniary job attributes, and (d) quasi rents or overpayment by government employers. The Smith-Quinn application of the wage regression approach

is directed toward the distinction between (*a*) and (*d*), but their framework can be modified to also consider (*b*) and (*c*). Let the (log) wage offer to the ith individual by the jth sector (federal or private) be given by

(1) $$W_i^j = Z_i'\delta^j + \mu_i^j + a^j + \eta_i^j; \qquad j = f,p;$$

where Z_i is a vector of individual productivity characteristics, and δ^f and δ^p are vectors of sector-specific weights. The μ_i^j represent the value of unobserved (to the analyst) productivity in each sector. Without loss of generality they are scaled to have zero mean in the population. The a^j represent the market evaluation of nonwage job attributes in each sector and the η_i^j are white noise.

The two assumptions required to interpret the unexplained residual as a quasi rent can be more formally stated. Let S_i be a binary variable that takes on a value of unity if the ith individual is observed to be employed in the federal sector and a value of zero otherwise. The assumption of no worker sorting implies that unobserved productivity characteristics are distributed randomly across sectors:

(2) $$E(\mu_i^j/S_i = 1) = E(\mu_i^j/S_i = 0) = 0; \qquad j = f,p.$$

The assumption of no equalizing differences in pay implies

(3) $$E(a^f) = E(a^p).$$

If both of these assumptions are satisfied, then separate wage regressions estimated on subsamples of public and private sector workers will yield consistent estimates of δ^f and δ^p. These parameter estimates can be used to decompose the observed wage differential into "explained" and "unexplained" components. This decomposition is generally evaluated at the sample means (indicated by bars):[7]

(4) $$\Delta w = w^f - w^p = (\bar{Z}^f - \bar{Z}^p)'\delta + (\delta^f - \delta^p)'\bar{Z}.$$

The first term of the decomposition measures the part of the gross differential attributable to sectoral differences in the productivity characteristics of workers. The second term measures the quasi rent to sectoral attachment.

We consider next the effect of relaxing assumptions (2) and (3) on the interpretation of the decomposition in equation (4). First, if workers are sorted between sectors on the basis of unobserved productivity characteristics, assumption (2) will be violated. Empirical disturbances for the wage functions of observed workers in each sector (the estimation subsamples) will include nonrandomly selected samples from

the population distributions of μ^f and μ^p. For workers employed in the public sector, expected wages are

$$E(w_i^f/S_i = 1) = Z_i'\delta^f + E(\mu_i^f/S_i = 1),$$

and for workers in the private sector:

$$E(w_i^p/S_i = 0) = Z_i'\delta^p + E(\mu_i^p/S_i = 0).$$

Wage regressions based on samples of observed workers may be misspecified due to an omitted variable measuring the expected effect of unobserved productivity characteristics given sectoral choice.[8] Estimated δ^j may be biased. In the context of the wage decomposition discussed above, the effects of omitted productivity will be captured by the unexplained component $\bar{Z}'(\delta^f - \delta^p)$. Unobserved productivity differences between workers in each sector may account for what previously appeared to be quasi rents. Thus if assumption (2) does not hold consistent, estimates of δ^j can only be obtained by jointly considering the wage and sector choice ($S_i = 0,1$) functions.

A more difficult problem to deal with is the presence of unmeasured job attributes. The a^j in equation (1) represents market trade-off between wage offers and nonpecuniary job attributes in each sector.[9] Ignoring complications due to unobserved productivity, violation of the "no equalizing differences" assumption (3) yields a wage decomposition:

$$\Delta w = w^f - w^p = (\bar{Z}^f - \bar{Z}^p)'\delta + (\delta^f - \delta^p)'\bar{Z} + (a^f - a^p).$$

The part of the gross differential not explained by differences in productive characteristics is comprised of "overpayment" of $(\delta^f - \delta^p)'\bar{Z}$ and the market value of nonwage job attributes $(a^f - a^p)$. The coefficients on the intercepts in the wage regression model will capture $(a^f - a^p)$, but because the difference in intercepts depends on the scaling and measurement of the Z variables, one cannot retrieve $(a^f - a^p)$ (see Jones 1983). Thus equalizing differences may also account for what previously appeared to be quasi rents to sectoral attachment.

The troublesome effects of unobserved productivity characteristics (μ_i^j) and equalizing differences (a^j) both arise from the sorting of workers between sectors. In the unobserved productivity case, workers end up in the sector yielding the greatest return to unobserved skills, all else constant. In the equalizing differences, case workers choose the sector where, say, they "spend" the least for desirable job attributes. However, the two effects are quite different because payment to the μ_i^j is worker-specific, but payment of a^j determined at the market level is not worker-specific. As a result, the a^j will be independent of sectoral choice at the individual level. Unlike the troublesome effects of unob-

served productivity, joint consideration of individual sectoral choice and wage offers will not resolve the problem. In the context of the wage regression approach to differentials, there is no easy way to separate the effects of equalizing differences from quasi rents.

7.4 Queues and the Determination of Federal Employment

The preceding section suggests that the method of wage decomposition often employed to analyze wage differentials may fail to disentangle quasi rents to employment in the government sector from the effects of either unobserved productivity characteristics or equalizing differences in pay. We consider an alternative approach to this problem. The approach is motivated by the simple supply argument that appears to be the original objective of comparability legislation; a cost-minimizing federal employer would set wages no higher than necessary to attract the required work force. If wages are above this level, the government "overpays." Workers seeking quasi rents to government employment will queue up for federal jobs.

Evidence of queues is our indicator of overpayment. As a practical matter the length and composition of these queues will rarely be observed. It is likely that many workers who desire federal jobs at current relative wages are employed in the private sector and never formally seek employment. To determine whether the federal government overpays, we need to identify these workers.

In the absence of direct observation of worker preferences for federal sector employment, we develop below a simple model of the "matching" or sorting process between workers and employers. The model is used to determine the length and composition of queues. An additional advantage is that the selection mechanism central to this model enables us to adjust wage regressions for the biasing effects of unobserved productivity characteristics.

The model contains two sectors (public and private) and many workers. To focus attention on the fundamental differences between sectors (job security, unique nature of public service, bureaucratic work environment, etc.) we assume all employers within each sector are homogeneous. According to our characterization, certain nonwage job attributes are intrinsic to the government in its capacity as employer. These attributes are thus considered fixed—neither sector can provide the unique attributes of the other sector at any cost. It follows that employers in each sector are primarily concerned with wage offers (given the market value of job attributes) rather than manipulating packages of wages and job attributes.

Unlike employers, who are of only two types, workers have heterogeneous tastes and preferences. Associated with each sector is a wage structure that relates the wage offered each worker to the worker's

bundle of productivity characteristics. We assume all workers are aware of the best wage offers they could obtain in each sector. We focus on two choices; one by employees and one by employers.

First, at the prevailing public-private relative wage, workers decide whether they prefer public or private sector employment. At the same time federal employers, perhaps anticipating queues for jobs, decide how they will select workers from the pool of potential employees demanding jobs. Given exogenous (legislated) levels of both employment and the federal wage scale, employers adopt a set of hiring standards to ration workers from the queue.[10]

A worker will be employed in a particular sector if the worker both desires employment in that sector and the sector chooses to hire the worker. In addition, some workers may be either unemployed or out of the labor force. In the present analysis we deal only with employed persons. Moreover, we assume all workers can obtain a job in the private sector if needed, although many of these workers may prefer employment in the public sector. This assumption is consistent with the presumption of implicit queues for government jobs, that is, many private sector workers may prefer federal sector jobs at current relative wages between the sectors.

We call the sector preference decision of workers the "job acceptance" decision because it implicitly answers the hypothetical question Would the individual accept a federal sector job if offered (at some specified relative wage)? We call the employer decision to ration employment the "job offer" decision because it implicitly answers the hypothetical question Would the federal sector offer this individual a job if the individual applied? The job acceptance decision is based on a utility comparison between packages of wages and nonwage job attributes offered by each sector. The job offer decision follows from cost minimizing behavior by employers. In particular, the federal sector attempts to select those workers from the queue (identified by productivity characteristics) that are most productive given the wage the federal sector must offer.

It is also important to recognize that the hiring standards employed by the federal sector at a particular time are derived from a single point on the public sector demand curve for labor. At this point the wage is above the "competitive" level and queues result. The job offer decision summarizes how workers are chosen from the queues. At other points on the public sector demand curve—representing say, alternative budgets specifying different wage and employment levels—different hiring standards will be in effect.

This narrow formulation of the job offer decision is the consequence of not modeling the general equilibrium determination of public and private sector wages at the macrolevel. Thus one must bear in mind that the hiring standards we specify may be useful predictions of the

likelihood of choosing a marginal worker from the queue, but the same hiring standards would be inappropriate for nonmarginal changes in any of the factors that affect the length of the queue.[11]

More formally, we consider first the worker, or job acceptance side, of the employment match. For each individual the decision to seek work in a particular sector will depend on the worker's evaluation of nonwage job attributes offered and on the potential wage that could be earned in each sector. The federal sector is fundamentally different from the private sector due to certain nonwage aspects of the job. Workers with different characteristics may vary in their evaluation of the nonwage aspects of each sector. These heterogeneous preferences may, in part, be represented by worker characteristics X_i. Worker choice between sectors also depends on relative wages. We denote the log wage differential between sectors as $(w^f - w^p)$, where w^f and w^p are the log wage offers individual i would receive should the individual obtain employment in the federal (f) or private (p) sectors. We represent worker preference or desire for employment in each sector by h_i^f and h_i^p where[12]

$$(5) \qquad h^f = X_1'\beta^f + \alpha^f(w^f - w^p) + e^f;$$

$$h^p = X_1'\beta^p + \alpha^p(w^f - w^p) + e^p.$$

The β^j indicate the relationship between measured characteristics and tastes for work in each sector. The α^j measure the sensitivity of worker sectoral choice to the relative wage differential. Thus the β's and α's together characterize each individual's evaluation of job packages offered by each sector. The e^j represent unobserved worker heterogeneity.

From equation (5) it follows that an individual will desire to work in the federal sector if $h^f - h^p > 0$. Let $P_1 = h^f - h^p$ be

$$(6) \qquad P_1 = X_1'(\beta^f - \beta^p) + (\alpha^f - \alpha^p)(w^f - w^p) + (e^f - e^p)$$

$$= X_1'\beta_1 + \alpha_1(w^f - w^p) + e_1.$$

If sectoral attachment were purely a supply decision, this equation would determine sectoral choice. However the proportion of workers desiring federal employment may exceed the number of jobs available in the government sector. For example, a private sector worker may be qualified for and desire a post office job at some favorable (to the worker) $w^f - w^p$, yet the worker can do no more than queue up for the job.

To determine observed sectoral attachment we need to bring in the employer or job offer side of each match. At issue are the standards used by the federal sector to ration the queue of potential employees.

We assume the objective of the federal sector is to maximize worker productivity per dollar spent on labor input. Toward this end we define a job offer function that evaluates each potential employee by productivity characteristics (X_2) and the absolute cost w^f. Let P_2 be an index of the desirability of a worker to the federal government:

$$(7) \qquad\qquad P_2 = X_2'\beta_2 + \alpha_2 w^f + e_2.$$

The matching process that generates observed sectoral attachment can now be made more explicit. Since neither P_1 nor P_2 are directly observed, we can arbitrarily scale each such that $P_j > 0$ indicates that a worker will accept a public sector job ($j = 1$) or the government will hire the worker ($j = 2$) and $P_j \le 0$ indicates that the worker does not desire a public sector job ($j = 1$) or will not be hired ($j = 2$). Then, a worker is employed in the federal sector with probability:

$$(8) \qquad\qquad P^* = \text{Prob}[P_1 > 0, P_2 > 0].$$

We emphasize that the functions P_1 and P_2 are *population* relationships in the above model. All workers have relative preferences for federal versus private sector work, and the public sector can potentially evaluate all workers. P_1 tells us which workers implicitly enter the queue, and P_2 indicates which individuals will be chosen.[13] Some workers who would be acceptable to the federal government do not desire federal employment and thus remain in the private sector. Similarly, many private sector workers may desire employment in the federal sector but are never hired. It is in this spirit that we refer to $P_1(\cdot)$ as the job acceptance decision (Would the individual accept a federal sector job if offered?) and $P_2(\cdot)$ as the job offer decision (Would the federal sector hire an individual if that individual were to appear in the queue?).

7.5   Estimation Issues

Equation (8) indicates that an individual will be observed to be employed in the federal sector with bivariate probability P^*. The probability of observing an individual to be employed in the private sector is $1 - P^*$. If both w^f and w^p are known for each worker and e_1 and e_2 are distributed joint normal, the parameters of P_1 and P_2 can be estimated directly.[14]

Poirer (1980) has shown that identification can be achieved through a single exclusion restriction. The problem is one of choosing variables that determine either the job acceptance or job offer decisions, but not both. As a practical matter we believe there are several defensible restrictions we can impose. However, rather than relying solely on

exclusion restriction, we also tap an additional source of identification by using information on prior employment status of individuals.

Let S_{t-1} and S_t indicate employment status in periods $t - 1$ and t respectively, where $S_t = 0$ indicates private sector attachment and $S_t = 1$ indicates federal sector attachment. Further identification is provided by assuming that all workers with federal sector jobs in period $t - 1$ may, if they choose, remain employed in the federal sector in period t, that is, all federal sector separations are voluntary. Evidence for 1982, the year of our data, provides support for this assumption. For example, executive branch employment dropped by over 113,000 in the first two years of the Reagan administration. Over 90 percent of this reduction was achieved through normal processes of attrition (and early retirement) rather than by reduction-in-force procedures (separations, downgrades, or lateral reassignments).[15]

Let π^{mn} be the probability of observing an individual with employment pattern $S_{t-1} = m$ and $S_t = n$. This assumption implies the likelihood that an individual will be observed to make the $\{S_{t-1} = 1, S_t = 0\}$ transition is the joint probability of being offered a federal job in period t $(P_2 > 0)$, but not accepting it $(P_1 \leq 0)$:[16]

$$(9) \qquad \pi^{10} = \mathrm{Prob}[P_1 \leq 0, P_2 > 0].$$

For the individual known to make this transition, other combinations of job acceptance and offer decisions resulting in private employment $([P_1 > 0, P_2 \leq 0]$ and $[(P_1 \leq 0, P_2 \leq 0])$ are assumed to occur with zero probability.

The likelihoods of observing remaining transition patterns of employment are unaffected by the assumption. We have

$$(10) \qquad \pi^{00} = \mathrm{Prob}[P_1 \leq 0, P_2 > 0] + \mathrm{Prob}[P_1 \leq 0, P_2 \leq 0]$$

$$+ \mathrm{Prob}[P_1 > 0, P_2 \leq 0]$$

$$= 1 - \mathrm{Prob}[P_1 > 0, P_2 > 0];$$

$$\pi^{01} = \mathrm{Prob}[P_1 > 0, P_2 > 0];$$

$$\pi^{11} = \mathrm{Prob}[P_1 > 0, P_2 > 0].$$

For workers in the federal sector in period t, we cannot distinguish between transitions $\{S_{t-1} = 0, S_t = 1\}$ and $\{S_{t-1} = 1, S_t = 1\}$, so $\pi^1 = \pi^{01} = \pi^{11}$. However, for workers in the private sector in period t we can distinguish between those employed in the government sector in the prior period (π^{10}) and those not employed in the private sector in the prior period (π^{00}).

Both wage offers w^f and w^p enter each of the π^{mn}. Up to this point we have considered them known. Although individual workers may be

aware of wage offers in each sector, the observed data contain one or the other. We deal with this problem by explicitly incorporating these wage offers in the model. To do so, a slight reparameterization is useful. Let $\hat{w}^f = Z'\delta^f$ and $\hat{w}^p = Z'\delta^p$. Then equations (1), (6), and (7) can be rewritten (omitting individual subscripts) as

(11) $$P_1 = X_1'\beta_1 + \alpha_1(\hat{w}^f - \hat{w}^p) + \epsilon_1 = p_1^* + \epsilon_1;$$

$$P_2 = X_2'\beta_2 + \alpha_2\hat{w}^f + \epsilon_2 = p_2^* + \epsilon_2;$$

$$w^f = Z'\delta^f + \epsilon_3;$$

$$w^p = Z'\delta^p + \epsilon_4;$$

where,

$$\epsilon_1 = \alpha_1(\epsilon_3 - \epsilon_4) + e_1;$$

$$\epsilon_2 = \alpha_2\epsilon_3 + e_2;$$

$$\epsilon_3 = \mu^f + \eta^f;$$

$$\epsilon_4 = \mu^p + \eta^p.$$

The unidentified a^j are captured by coefficients on the intercept contained in Z. To maintain full generality, the reduced form disturbances are jointly distributed with density $f(\epsilon_1, \epsilon_2, \epsilon_3, \epsilon_4)$.

We can now derive the likelihood function of the sample. Using our earlier classification scheme we can partition sample observations into three categories. These categories and the contribution of each to the likelihood function of the sample are

1. All federal sector workers:
$$\pi^{01} = \pi^{11} = Pr[P_1 > 0, P_2 > 0, w^f - \hat{w}^f];$$

2. Private sector workers with prior federal sector status:
$$\pi^{10} = Pr[P_1 \leq 0, P_2 > 0, w^p - \hat{w}^p];$$

3. Private sector workers with no prior federal sector status:
$$\pi^{00} = 1 - Pr[P_1 > 0, P_2 > 0, w^p - \hat{w}^p].$$

Since w^f and w^p are never both observed for the same individual, each of these expressions is based on trivariate density derived from $f(\cdot)$ by

"integrating out" either ϵ_3 or ϵ_4. For example, π^{10} is based on the density

$$g(\epsilon_1, \epsilon_2, \epsilon_4) = \int_{-\infty}^{\infty} f(\cdot)d\epsilon_3,$$

which enables us to calculate:

$$\pi^{10} = \int_{-\infty}^{-p_1^*} \int_{-p_2^*}^{\infty} g(\epsilon_1, \epsilon_2, w^p - \hat{w}^p)d\epsilon_2 d\epsilon_1.$$

Remaining probabilities are based on similar expressions.

Let n_1, n_2, n_3 refer to the subsamples of observations from the appropriate categories. The natural log of the likelihood function of the sample is

$$L = \sum_{n_1} \log(\pi^1) + \sum_{n_2} \log(\pi^{10}) + \sum_{n_3} \log(\pi^{00}),$$

where $\pi^1 = \pi^{01} = \pi^{11}$. The model described by this likelihood function may be considered an endogenous switching model with a bivariate regime classification function.

The joint density $f(\cdot)$ is assumed joint normal with mean vector zero and covariance matrix with typical element σ_{ij}. Following the conventional probit normalization, we set $\sigma_{11} = \sigma_{22} = 1$. Because ε_3 and ε_4 are never jointly observed, σ_{34} is not identified in this model. The parameter vector is thus

$$\Omega = \{\beta_1, \beta_2, \alpha_1, \alpha_2, \delta^f, \delta^p, \sigma_{12}, \sigma_{13}, \sigma_{14}, \sigma_{23}, \sigma_{33}, \sigma_{44}\}.$$

The likelihood function is maximized with respect to Ω using a modified scoring algorithm proposed by Berndt, et al. (1974).

7.6 Data

The primary data source used for estimation is the Current Population Survey (CPS) for the second quarter (April–June) of 1982. This source has several advantages over other surveys. Sampling procedures based on rotation groups make it possible to match respondents in adjacent years. This permits creation of the large longitudinal file we need to classify observations by previous period employment status.[17] Another advantage over other longitudinal data files (NLS, PSID) is that the CPS provides detailed information on the level (federal, state, or local) of government.[18]

The data used include all respondents who worked in either the federal or private sectors in 1981 and also worked in either the federal or private sectors in 1982. Any individual that did not work in either year, or worked in state or local government in either year, is excluded. Although we recognize that these exclusion restrictions are not exogenous, the costs of taking explicit account of them are prohibitive.

The sample contains 6,064 men and 4,561 women. Summary statistics for these data are contained in table 7.1. Definitions of most variables are obvious. The dependent variable is the natural log of the hourly wage rate calculated by dividing usual weekly earnings by usual hours worked per week. Region variables are based on census definitions, and unemployment rates are at the state level. The variable "Percent federal employment" is an index of the federal presence in each state obtained by dividing federal civilian employment by total employment in each state. Finally, the variable "Years of potential experience" is calculated as age minus schooling minus 5.

Table 7.1   Summary Statistics

Variable	Males		Females	
	Mean	S.D.	Mean	S.D.
Log wage: federal sector	2.41	.39	2.05	.40
Log wage: private sector	2.13	.50	1.72	.43
Nonwhite	.10	.30	.12	.33
Veteran	.42	.49	—	—
Married	.73	.44	.58	.49
Widowed, divorced, or separated	.08	.26	.21	.41
Central city	.21	.41	.24	.43
SMSA but not central city	.37	.48	.34	.47
Northeast	.24	.43	.24	.43
North central	.27	.44	.27	.44
West	.21	.40	.20	.40
Percent federal employment	.03	.06	.03	.07
Unemployment rate	.09	.21	.09	.21
Years of education	12.64	2.77	12.48	2.30
Years of potential experience	21.66	13.94	21.20	14.18
Professional	.15	.36	.13	.34
Managerial	.14	.34	.08	.26
Clerical	.09	.28	.42	.49
Craft	.27	.44	.03	.17
Operative	.21	.41	.14	.35
Laborer	.07	.25	.01	.11
Number of observations	6,064		4,561	

Note: Omitted categories are "South" for the regional dummies and "Service" for the occupational dummies.

One potentially important variable not included in our analysis is union status. This exclusion may be defended on grounds that it is preferable to let union effects implicitly enter the model in reduced form rather than deal directly with the endogeneity of union status. In any event, the absence of information on collective bargaining prohibited the analysis of union status.[19]

7.7 Results

7.7.1 Parameter Estimates

Equation (6) suggests that an individual's desire for employment in the public sector will depend on relative wage offers ($W^f - W^p$). According to this formulation, a percentage increase in W^f will have the same effect as a percentage decrease of the same percentage magnitude in W^p. However, an empirical problem arises because of the omission of relevant information on pensions and other nonwage forms of pecuniary compensation. Theory suggests an inverse relationship between wages and fringes in the compensation package. This prediction has received little empirical support (see Smith and Ehrenberg 1983). Instead, evidence indicates that the public sector (or high-wage employers in general) may offer workers both high wages *and* attractive fringes.[20] Moreover, the pension component of the compensation package is often an actuarial (frequently linear) function of wage payments. This suggests workers will not be indifferent between changes in relative wages due to changes in federal sector (high-fringe) wages on the one hand and private sector (low-fringe) wages on the other. To allow for this possibility we generalize our empirical formulation of the job acceptance decision to permit asymmetric responses to public and private sector wages:

(6') $$P_1 = X_1'\beta_1 + \alpha_1^f w^f + \alpha_1^p w^p + e_1.$$

Parameter estimates for this version of the model are presented in table 7.2 for males and table 7.3 for females. Columns (1) and (2) of each table present results for the job acceptance (P_1) and job offer (P_2) equations. Remaining columns contain estimated wage functions for the federal sector (w^f) and private sector (w^p). Estimates of the σ_{ij} are presented at the bottom of each table.

We first consider estimates for the job offer and acceptance decisions for males. Since most of the individual parameters are not of primary interest, we will be brief. Higher federal sector wage offers increase the probability a worker will desire to work in the public sector but

Table 7.2   **Parameter Estimates for Males**

Variable	(1) Job Acceptance Probability (P_1)	(2) Job Offer Probability (P_2)	(3) Federal Wage (w^f)	(4) Private Wage (w^p)
Nonwhite	−.283	.330	.047	−.077
	(.134)	(.184)	(.043)	(.021)
Veteran	.501	−.286	−.009	.023
	(.144)	(.156)	(.036)	(.014)
Married	.179	—	—	—
	(.057)			
Widowed, divorced, or separated	.141	—	—	—
	(.128)			
Central city	.320	−.393	—	—
	(.114)	(.195)		
SMSA but not central city	.526	−.836	—	—
	(.176)	(.227)		
Northeast	.036	.271	−.048	.055
	(.099)	(.169)	(.034)	(.017)
North central	.375	.187	−.135	.074
	(.200)	(.179)	(.044)	(.014)
West	.307	.143	−.073	.151
	(.155)	(.132)	(.046)	(.017)
Percent federal employment	—	26.023	—	—
		(5.782)		
Unemployment rate	−1.383	—	.961	.585
	(.535)		(.277)	(.221)
Years of education	—	.061	−.007	.007
		(.035)	(.015)	(.008)
(Years of education)^{2a}	—	−.017	.175	.151
		(.066)	(.049)	(.033)
Years of potential experience	—	—	.037	.039
			(.004)	(.001)
(Years of potential experience)^2	—	—	−.059	−.063
			(.007)	(.003)
Professional	—	—	.440	.448
			(.046)	(.027)
Managerial	—	—	.381	.496
			(.046)	(.027)
Clerical	—	—	.329	.243
			(.037)	(.030)
Craft	—	—	.272	.430
			(.041)	(.025)
Operative	—	—	.103	.304
			(.038)	(.025)
Laborer	—	—	.059	.186
			(.044)	(.029)
Ln w^f	3.683	−1.202	—	—
	(.229)	(.345)		
Ln w^p	−2.275	—	—	—
	(.323)			

Table 7.2   (continued)

Variable	(1) Job Acceptance Probability (P_1)	(2) Job Offer Probability (P_2)	(3) Federal Wage (w^f)	(4) Private Wage (w^p)
Intercept	−4.873	2.668	1.291	.897
	(.733)	(.823)	(.183)	(.060)
Covariance Matrix				
Job acceptance (P_1)	1.000			
Job offer (P_2)	−.868	1.000		
	(.066)			
Federal wage (w^f)	.053	−.056	.121	
	(.042)	(.037)	(.008)	
Private wage (w^p)	.081	−.266	—	.164
	(.046)	(.048)		

Log-likelihood function: −3,964.08
Number of observations: 6,064
N_{00}: 5,626
N_{01}:   25
N_{10}:   32
N_{11}: 381

Note: Asymptotic standard errors in parentheses
[a]Scaled by 100.

decrease the probability the worker will be hired. Worker preference for the public sector decreases with the private sector wage offer. Comparison of α_1^f and α_1^p suggests worker choice is more sensitive to federal wages than to private sector wages. This difference may, as the previous discussion indicated, reflect more generous fringe benefits in the federal sector.

Other estimates reveal that married or previously married individuals are more likely to desire employment in the federal sector than never-married individuals. Nonwhites are less likely to desire government employment but more likely to receive a public sector job offer. Workers in the South are both less likely to want and less likely to be offered federal jobs. The coefficient on the federal employment variable indicates that federal presence in a state strongly increases the likelihood of a federal job offer.

We present the estimated wage functions for males in columns three and four of table 7.2. Most parameters of the wage functions are precisely measured. The estimated covariance parameters indicate wages, and the matching process are not independent. This relationship suggests that OLS estimates of sectoral wage functions may be biased.

Table 7.3   **Parameter Estimates for Females**

Variable	(1) Job Acceptance Probability (P_1)	(2) Job Offer Probability (P_2)	(3) Federal Wage (w^f)	(4) Private Wage (w^p)
Nonwhite	.177	.100	.021	.018
	(.179)	(.176)	(.056)	(.020)
Married	−.035	—	—	—
	(.064)			
Widowed, divorced, or separated	−.006	—	—	—
	(.071)			
Central city	.644	−.693	—	—
	(.220)	(.295)		
SMSA but not central city	.995	−1.073	—	—
	(.364)	(.401)		
Northeast	.930	−.585	−.129	.069
	(.388)	(.353)	(.072)	(.017)
North central	.080	−.022	−.036	.029
	(.141)	(.126)	(.047)	(.016)
West	.297	.075	−.071	.119
	(.166)	(.144)	(.050)	(.016)
Percent of federal employment	—	16.098	—	—
		(4.500)		
Unemployment rate	−4.427	—	1.238	.106
	(1.823)		(.566)	(.253)
Years of education	—	.425	−.077	.002
		(.103)	(.024)	(.011)
(Years of education)[2a]	—	−1.427	.383	.128
		(.386)	(.092)	(.046)
Years of potential experience	—	—	.026	.019
			(.005)	(.001)
(Years of potential experience)[2a]	—	—	−.043	−.034
			(.010)	(.003)
Professional	—	—	.555	.516
			(.091)	(.022)
Managerial	—	—	.422	.465
			(.077)	(.023)
Clerical	—	—	.380	.302
			(.063)	(.016)
Craft	—	—	.281	.389
			(.102)	(.036)
Operative or laborer	—	—	.138	.245
			(.072)	(.021)
$Ln\ w^f$	2.902	−.757	—	—
	(.178)	(.324)		
$Ln\ w^p$	−1.697	—	—	—
	(.430)			
Intercept	−3.795	−.736	1.647	.955
	(.992)	(.390)	(.246)	(.080)

Covariance Matrix

Job acceptance (P_1)   1.000

Table 7.3   (continued)

Variable	(1) Job Acceptance Probability (P_1)	(2) Job Offer Probability (P_2)	(3) Federal Wage (w^f)	(4) Private Wage (w^p)
Job offer (P_2)	$-.920$	1.000		
	(.051)			
Federal wage (w^f)	$-.073$	.081	.116	
	(.048)	(.043)	(.013)	
Private wage (w^p)	.004	$-.146$	—	.135
	(.058)	(.066)		(.055)

Log-likelihood Function: $-2,727.74$
Number of observations: 4,561
N_{00}: 4,339
N_{01}:   14
N_{10}:   16
N_{11}:   192

Note: Asymptotic standard errors in parentheses.
[a]Scaled by 100.

We make some comparisons with OLS to investigate the extent of this bias in subsection 7.3.

The parameter estimates indicate that wage functions in the federal and private sectors are slightly different in several respects. Nonwhites have an (insignificant) wage advantage in the federal sector but a wage disadvantage in the private sector. Federal wages appear to be lower outside of the South (which includes Washington, D.C.), but private sector wages are higher in all regions other than the South. The estimates indicate that an additional year of education adds 3.7 percent to wages in the federal sector and 4.5 percent in the private sector (evaluated at means). An additional year of potential experience adds about 1.1 percent to wages in each sector.

For females the estimated α's again have the expected signs. Most of the other coefficients in the job offer, acceptance, and wage equations are of the same sign and approximate magnitude as the coefficients for males. A notable exception is the curious effect of education on the probability an individual will be offered a public sector job. For both males and females an additional year of education has the same effect on the job offer probability evaluated at mean (12.6) years of schooling. However, additional years of schooling beyond the sample mean have much larger positive effects on the job offer probability for men than for women. Indeed, for women the effect of an additional year of schooling turns negative at slightly under fifteen years of schooling.

7.7.2   Direct Wage Comparisons

The advantage of joint estimation of wage offer functions and the sectoral choice mechanism is that the biasing effect of unobserved worker quality is eliminated. As section 7.3 argues, the resulting "unexplained" wage differences may represent the combined effects of government payment of quasi rents and equalizing differences. Direct wage comparisons cannot distinguish between these effects. However, "equal" wage structures is itself a current policy goal, so these wage comparisons indicate how this goal has been met.

Before considering the estimates it is useful to clarify a problem of interpretation of direct wage comparisons. "Equal" wage structures is taken to mean that a randomly chosen individual will face identical wage offers from each sector ($\bar{w}_i^f = \bar{w}_i^p$). This definition of "equal" wages implicitly takes a wage function based on *all* private sector workers as the standard of comparison.Whether this should be so is a policy issue we do not address here. Previous analyses (Smith, Quinn) have used the average wage of all private sector workers as the standard; to compare our findings with theirs, we continue this tradition. However, one may argue that the "correct" comparison group should include state and local employees, or be limited to the unionized private sector, be restricted to large private employers, or contain only white males. Indeed, the puzzling question of why survey evidence used in federal wage policy (the PATC Survey) suggests federal workers are "underpaid," yet estimates based on the CPS samples indicate federal workers are "overpaid," may be the result of different comparison groups (see Freeman 1984). In any event, the standard used in this section is the wage function of a random sample of all private sector workers. Our primary concern is the effect of observed and unobserved productivity characteristics on sectoral wage differences.

Predicted percentage wage differences between the federal and private sectors are presented in table 7.4.[21] The first row gives mean differences for each sex. In our sample, males in the federal sector average 32.8 percent more and females 38.7 percent more than their counterparts in the private sector. The second row of table 7.4 presents estimated federal-private differentials "adjusted" for differences in observed productivity-related characteristics of workers in each sector. These estimates, based on the wage regression approach, indicate that almost two-thirds of the male gross differential can be attributed to observed individual differences. The analogous figure for females is about 40 percent. Finally, parameter estimates from the model jointly estimating wage functions and the sectoral choice mechanism (row 4) suggest that the "unexplained" wage difference is 4.2 percent for males and 22.1 percent for females.[22]

Table 7.4   **Predicted Percentage Federal/Private Wage Differences**

Method of Estimation	Males	Females
Sample mean[a]	32.8	38.7
OLS[b]	11.7	22.6
	(2.1)	(2.6)
OLS[c]	12.1	20.3
	(2.0)	(2.5)
MLE[d]	4.2	22.1
	(6.5)	(7.9)

Note: Standard errors in parentheses.

[a]Unadjusted.

[b]Adjusted for observed productivity characteristics listed in column (3) of tables 7.2 and 7.3.

[c]Adjusted for observed productivity characteristics listed in column (3) of tables 7.2 and 7.3 and indicators of part-time work, widowed, divorced, or separated, married, two urbanization dummies, and five additional product terms between the included variables.

[d]Adjusted for observed productivity characteristics listed in column (3) of tables 7.2 and 7.3 and unobserved productivity differences.

It is interesting to compare these findings to the most recently published results (using 1978 data) of Smith (1981). Employing the wage regression technique, she finds a wage advantage of 10 percent to 11 percent for males and 20 percent to 21 percent for females. These figures are remarkably close to our reported OLS results in row 2 of table 7.4. However, an important difference between these findings and those of Smith is that she specified her wage equations with twelve variables (mostly quadratic and product terms involving experience, education, and marital status) not included in our specification. Row 3 of table 7.4 presents the results of adding most of these same variables to our OLS wage functions. The wage advantage increases slightly to 12.1 percent for males and drops to 20.3 percent for females.

The comparison between rows 2 and 3 suggests that wage regression estimates of the wage advantage may not be very sensitive to omitted variables. (Many of the variables included in row 3 but not in row 2 are highly significant.) Therefore it is surprising that the maximum likelihood (ML) correction for unobservables further reduces the wage advantage for males. Although computation costs prohibited inclusion of a variable list as exhaustive as Smith's in our ML model, the OLS results suggest that the addition of these variables would probably have little effect. Thus observed wage differences appear attributable to unobserved as well as observed productivity differences for males, but for females the effect of unobserved characteristics is apparently nil.

7.7.3   Simulated Probabilities and Queues

If employers pay no equalizing differences for sectoral differences in nonwage job attributes, the earlier figures represent our best estimates of the federal-private wage advantage. If this is not the case, we need an alternative indicator of the "comparability" of wages. One such indicator is the length of queues for federal sector jobs.

Recall that neither the job acceptance nor the job offer decisions are directly observed. We can use the parameter estimates of the model to simulate these events. In table 7.5 we present predicted marginal probabilities of job acceptance and job offer. These predictions are obtained by calculating probabilities for each member of the sample and then averaging.

The first entry in this table indicates that the average predicted probability of job acceptance of males in the sample was 0.18.[23] Our interpretation is that 18 percent of all sample men would accept a federal sector job if offered. The analogous figure for females is a bit higher, about 29 percent. This suggests that federal-private wage differentials are more attractive to women in this sample.

The job offer probabilities presented in the second row indicate that 83 percent of all males would be acceptable to federal employers, but only 67 percent of females would be hired. This reflects the expected "reverse" sorting in the matching process, that is, most measured personal characteristics have opposite effects in the acceptance and offer decisions. In addition, the estimated correlations between unobserved factors entering each decision are also negative (− 0.87 for males

Table 7.5   Simulated Probabilities

	Males	Females
(1) Probability of job acceptance (P_1)	0.180	0.286
(2) Probability of job offer (P_2)	0.829	0.676
(3) Joint probability of employment match	0.064	0.047
(4) Length of queue	2.811	6.107

Source: (1): $\dfrac{1}{n} \sum\limits_{i=1}^{n} Pr\ (P_1 \rangle\ 0)$.

(2): $\dfrac{1}{n} \sum\limits_{i=1}^{n} Pr\ (P_2 \rangle\ 0)$.

(3): $\dfrac{1}{n} \sum\limits_{i=1}^{n} Pr\ (P_1 \rangle\ 0,\ P_2 \rangle\ 0)$.

(4): (1)/(3).

and -0.92 for females). Thus those individuals most likely to desire a federal sector job are also least likely to be offered a federal sector job. This pattern is most striking when the joint probability of being offered a job *and* accepting a job (the probability of being employed in the federal sector) is considered. If joining the queue (job acceptance) and being chosen from the queue (job offer) were independent, the probability of observing a worker in the federal sector would simply be the product of marginal probabilities: 0.134 for males and 0.160 for females.[24] However, neither the acceptance nor offer decisions are pure random behavior, so the predicted joint probability based on the negative estimated correlation is 0.064 for males and 0.047 for females (row 3).

These simulated probabilities provide useful new information about the matching process. Yet they do not say much about whether wages are "comparable" between sectors. We can attempt to answer this more difficult question by noting that if the public-private wage differential observed in the sample exceeds the equalizing difference that must be paid to attract workers to the federal sector, then queues for federal sector jobs will result. If we ignore worker quality and concentrate on numbers of workers, we are able to obtain an informal measure of the length of the queue by comparing the fraction of the work force desiring government employment (at sample wages) to the fraction that is employed in the federal sector.

This indicator of the length of the queue, calculated as $Pr(P_1 > 0)/Pr(P_1 > 0, P_2 > 0)$, is presented in the last row of table 7.5. This expression is the inverse of the probability that a worker desiring a federal sector job will be chosen from the implicit queue. Roughly three times as many men would be willing to work at the sample wage differential as will be hired at that differential. The analogous figure for women is double that of men.

7.7.4   An Alternative Indicator of Comparability

An alternative approach to comparability can be based on a simple supply argument: a cost-minimizing federal employer would pay wages no higher than necessary to attract the required work force and eliminate the queues described earlier. This approach has considerable theoretical appeal. In particular, the inability of the wage regression approach to distinguish between payment of rents and payment of equalizing differences for job attributes is no longer a problem because each individual's choice of sector is based on an implicit valuation of both the wage and nonwage aspects of jobs.

This supply principle can be made operational by using the parameter estimates obtained in section 7.6 to simulate the employment effects of changes in federal wages. To simplify matters we consider only

policies that alter federal wages by the same percentage amount for all individuals. Other policies that alter the return to individual attributes or otherwise result in different percentage changes across individuals are not considered. In the notation of the wage offer functions discussed earlier, all changes in federal wages are obtained by altering the intercept.

Let $\bar{c}$ be the proportion of male (or female) workers employed in the federal sector. The probability of job acceptance can be rewritten (using equation 6' as

(12) $$\tilde{P}_{1i} = F[X_1'\beta_1 + \alpha_1^f(\hat{w}_i^f + k) + \alpha_1^p \hat{w}_i^p],$$

where $F[\cdot]$ denotes the normal distribution function and the new term, k, approximates a constant (across individuals) percentage change in the federal wage offer.

Given the parameter estimates, we can use equation (12) to simulate the number of persons desiring employment in the government sector for any change in federal wage offers. In particular, the federal wage reduction that eliminates queues is given by the k that satisfies $(1/N)$ $\sum_{i=1}^{N} \tilde{P}_{1i} = \bar{c}$. This procedure yields values of k of about minus 16 percent for males and minus 42 percent for females, which suggests that the federal government could continue to attract a work force of current size with substantially lower wages.

Several important issues are raised by these figures. First, since the simulation procedure fixes the level of employment but not labor "quality," one consequence of lower federal wages may be deterioration of the quality of the federal work force. The severity of this problem depends on the relative importance of the federal wage structure (W^f) and hiring standards (P_1) in determining who enters and is chosen from queues. As an empirical matter the "quality" effect has been minimized by considering only constant percentage changes in wages. Apparently the *number* of individuals desiring employment in the federal sector is primarily a function of the wage *level,* and the *"quality"* (attributes) of individuals desiring federal employment is more strongly related to the wage *structure* (the relative valuation of individual attributes by each sector). A comparison of simulated work forces before and after the wage reduction indicates that the quality problem is not severe. For example, the 16 percent wage reduction for males will reduce the average level of education of the male federal work force from 13.9 years to 13.8 years. Comparable figures based on the 42 percent wage reduction for women are 13.1 and 12.8. Levels of work experience were slightly higher for the low-wage federal work force than for the high-wage work force.

Another issue is the particularly large response for women. Perhaps the most likely explanation is our choice of a private sector comparison group (see the discussion in section 7.7.2). If the private sector is imperfect (unions, discrimination, monopoly, etc.), the wage the government must offer to attract workers will be affected. For instance, if sex or race discrimination exists in the private sector, the price the federal sector must pay for its work force will be lower. Although payment of these lower wages may be cost-effective given the imperfections in the private sector, it may be legally or politically inappropriate for the federal government to simply match (or slightly exceed) discriminatory wages. Thus perhaps some of the apparent government wage advantage, particularly for females, can be attributed to imperfections in the private sector labor market. Our results may indicate that the private sector "underpays" certain groups of workers.

Finally, two additional limitations of the model may also be relevant. First, some of the assumptions required to calculate k are not likely to be satisfied. In particular, we have implicitly assumed that the demand curve for public employees is perfectly inelastic: as relative wages change, the "target" employment level $\bar{c}$ remains fixed. Finally, we note once again that the role of pensions in the public sector may complicate our interpretation of relative wage differences.

7.8   Summary

Our empirical effort is directed toward two goals. First, we seek to determine if wage structures in the federal and private sectors have been "equalized" by the federal comparability process. Our second goal is to develop a more choice-theoretic approach to the issue of wage comparability. A difficulty with previous work is that when markets do not clear, as is likely to be the case for the public sector, the conventional wage regression approach to comparability is unable to distinguish equalizing differences from quasi rents. Explicit modeling of worker and employer choices appears to be an appealing alternative.

With respect to the first goal, a comparison of 1982 wages for federal workers and all private sector workers suggests wages were not equal. Although much of the gross differential in average wages can be explained by differences in observed and unobserved attributes of workers in each sector, federal sector wage advantages of about 4 percent for males and 22 percent for females remained unexplained.

With respect to the second goal, we formulate and estimate a model permitting prediction of the wage differential that eliminates implicit queues for federal sector jobs. The estimates suggest that the elimination of queues will require substantial reductions in federal wages

for both sexes.Subject to limitations detailed in section 7.7, the simulations suggest that the federal sector is able to attract a work force of current size and roughly current "quality" by offering average wages 16 percent lower than the 1982 level for men and 42 percent lower for women.

Notes

This paper was prepared for the NBER Conference on Public Sector Payrolls, held in Williamsburg, Va., November 15–17, 1984. Useful comments were provided by Tom Barthold, Alan Gustman, Jane Mather, Sharon Smith, and conference participants. Partial support from the Faculty Committee on Research at Dartmouth College is gratefully acknowledged.

1. Federal Salary Reform Act of 1962.

2. This is the standard method of estimating equalizing differences in the private sector where observed wage differentials can be assumed to be "equilibrium" differences. See Smith 1979, Brown 1980, and Duncan and Holmlund 1983 for examples. Quinn 1979 makes some adjustments for public-private differences in nonwage job attributes. See also Bellante and Link 1981.

3. See President's Panel on Federal Compensation 1976, chap. 2. This is a brief description of GS pay determination. FWS pay rates are set to be "in line with prevailing levels for comparable work within a local wage area." Postal service rates are set by collective bargaining, although "On a standard of comparability to the compensation and benefits paid for comparable levels of work in the private sector of the economy."

4. See Smith 1977, 1982 and President's Panel on Federal Compensation 1976, chap. 5. The most important is the minimum establishment size, which leads to oversampling of high-pay employers. Another problem is the lack of information on fringe benefits.

5. Alternatively, wage functions can be estimated for public sector employees, and the estimated coefficients can be used to predict what private sector workers would earn in the public sector. See Smith 1977, 49–52.

6. See Smith 1979 or Rosen 1983.

7. We ignore the index number problem of choosing a base.

8. See, for example, Heckman 1979.

9. The a^j say nothing about individual preferences for wages versus job attributes unless preferences are homogenous in the population or the particular individual is at the margin between sectors.

10. In the short run we assume federal employers cannot use the wage mechanism to shorten the queue. This seems to be an accurate description of pay procedures for lower- and middle-level jobs, but it may be less valid for upper-level jobs.

11. A more elaborate and complete model specifying the mechanisms governing wage adjustments at the macrolevel is beyond the scope of this chapter.

12. We omit the individual subscript where no ambiguity will result.

13. P_2 also indicates whether workers who do not enter the queue ($P_1 \leq 0$) would be chosen were they to enter the queue. Thus P_2 should not be interpreted as conditional on being in the queue.

14. Empirical investigations of similar models in which wages enter in reduced form are Abowd and Farber 1982 and Farber 1983.

15. See Office of Personnel Management 1983. The assumption is similar to the "job rights" assumption of Abowd and Farber 1982.

16. Although period $t - 1$ employment status is used to *classify* observations, we do not *condition* on prior employment status. Thus all arguments in the following probability expressions pertain to period t.

17. Only about 15 percent of the respondents can be matched across one year (rotation groups four and eight). To obtain a large enough file we combined three monthly surveys.

18. Information on level of government has always been collected as part of the CPS, but until 1979 this information was available only sporadically. Availability of this information gives us a distinct advantage over some previous efforts using the CPS to analyse federal-private differentials in which only half of all public sector workers could be identified by industrial classification.

19. One-third of our sample has recorded union status. These are not enough observations for a meaningful analysis. Both the rate of unionization and the nature of unionization differ between the public and private sectors. Thus unions may offer an "explanation" for noncomparability of wages. See Ehrenberg and Schwarz, n.d.

20. In particular, federal pension contributions measured as a proportion of wages are several times greater than private sector contributions. See Leonard 1983 and Smeeding 1983.

21. Percentage changes are calculated as $(e^m - 1)$ where m is the difference in logs.

22. The last row of table 7.4 is calculated as $\hat{w}^f - \hat{w}^p = \bar{X}(\hat{\beta}^f - \hat{\beta}^p)$. To obtain the standard error of this estimate we first calculate $var(\hat{\beta}^f - \hat{\beta}^p) = \Sigma$ from the covariance matrix of parameters. The reported standard error is the square root of $\bar{X}'\hat{\Sigma}\bar{X}$.

23. This probability is *not* conditional on a job offer. Also, all probabilities are evaluated at the appropriate adjusted sample wage differences.

24. The joint probability is calculated for each member of the sample and then averaged. In a heterogeneous population this joint probability will not equal the product of the two average marginal probabilities.

References

Abowd, J., and H. Farber. 1982. Job queues and the union status of workers. *Industrial and Labor Relations Review* 35:354–67.

Bellante, D., and A. Link. 1981. Are public sector workers more risk averse than private sector workers. *Industrial and Labor Relations Review* 34:408–12.

Bellante, D., and J. Long. 1981. The political economy of the rent-seeking economy: The case of public employees and their unions. *Journal of Labor Research* 2:1–14.

Berndt, E., B. Hall, R. Hall, and J. Hausman. 1974. Estimation and inference in nonlinear models. *Annals of Social and Economic Measurement* 4:653–65.

Borjas, G. 1980. *Wage policy in the federal bureaucracy.* Washington, D.C.: American Enterprise Institute.

Brown, C. 1980. Equalizing differences in the labor market. *Quarterly Journal of Economics* 94:113–34.

Carow, R. 1981. Total compensation comparability in the evolution of federal compensation policy. In *Public sector labor markets,* ed. P. Mieszkowski and G. Peterson. Washington, D.C.: Urban Institute.

Duncan, G., and B. Holmlund. 1983. Was Adam Smith right after all? Another test of the theory of compensating wage differentials. *Journal of Labor Economics* 1:366–79.

Ehrenberg, R. and J. Schwarz. N.d. Public sector labor markets. In *Handbook of labor economics,* ed. O. Ashenfelter and R. Layard. Amsterdam: North-Holland.

Farber, H. 1983. The determination of the union status of workers. *Econometrica* 51:1417–37.

Freeman, R. 1984. How do public sector wages and employment respond to economic conditions. Paper presented at the NBER Conference on Public Sector Payrolls, Williamsburg, Va., Nov. 15–17.

Heckman, J. 1979. Sample selection bias as a specification error. *Econometrica* 47:153–61.

Jones, F. 1983. On decomposing the wage gap: A critical comment on Blinder's method. *Journal of Human Resources* 18:126–30.

Leonard, H. 1983. The federal civil service retirement system: An analysis of its financial condition and current reform proposals. Paper presented at the NBER Conference on Pensions, Labor, and Individual Choice, Puerto Rico, March 23–26.

Office of Personnel Management. 1983. *OPM: The year in review, 1982.* Washington, D.C.: Government Printing Office.

Poirier, D. 1980. Partial observability in bivariate probit models. *Journal of Econometrics* 14:209–17.

President's Panel on Federal Compensation. 1976. Staff report. Washington, D.C.: Government Printing Office.

Quinn, J. 1979. Wage differentials among older workers in the public sector. *Journal of Human Resources* 14:41–62.

———. 1982a. Compensation in the public sector: The importance of pensions. In *Public finance and public employment,* ed. R. Haveman. Detroit: Wayne State University Press.

———. 1982b. Pension wealth of government and private sector workers. *American Economic Review* 72:283–87.

Rosen, S. 1983. The equilibrium approach to labor markets. NBER Working Paper No. 1165.

Smeeding, T. 1983. The size distribution of wage and nonwage compensation: Employer cost versus employee value. In *The measurement of labor cost,* ed. J. Triplet. Chicago: University of Chicago Press.

Smith, R. 1979. Compensating wage differentials and public policy: A review. *Industrial and Labor Relations Review* 32:339–52.

Smith, R., and R. Ehrenberg. 1983. Estimating wage-fringe trade-offs: Some data problems. In *The measurement of labor cost,* ed. J. Triplett. Chicago: University of Chicago Press.

Smith, S. 1976. Pay differentials between federal government and private sector workers. *Industrial and Labor Relations Review* 29:179–97.

———. 1977. *Equal pay in the public sector: Fact or fantasy.* Princeton: Princeton University, Industrial Relations Section.

————. 1981. Public/private wage differentials in metropolitan areas. In *Public sector labor markets,* ed. P. Mieszkowski and G. Peterson. Washington, D.C.: Urban Institute.

————. 1982. Prospects for reforming federal pay. *American Economic Review* 72:273–77.

Comment   Sharon P. Smith

It is now more than twenty years since Pres. John F. Kennedy called for action to assure that "federal pay rates be comparable with private enterprise rates for the same level of work" (U.S. Civil Service Commission, 1968, p. 27). The present system for setting federal pay evolved in an attempt to implement this policy statement. However, even in 1962 when President Kennedy proclaimed the Comparability Doctrine, it was not a new idea for a guiding principle for federal pay policy. Instead, this concept can be traced to an 1862 law requiring that the wages of federal blue-collar workers "conform with those of private establishments in the immediate vicinity" (U.S. Civil Service Commission, 1968, p. 27).

The persistence of comparability as the guiding principle for federal pay policy—though not in recent years, the actual practice, as will be discussed later—has inspired a large body of research evaluating its effectiveness.[1] Chapter 7 by Steven F. Venti makes a valuable contribution to this literature by providing more current estimates of federal-private pay differentials and by giving more explicit attention to the effects of differences between the two sectors in unmeasured productivity and in nonpecuniary job attributes. In addition, Venti offers a challenging "supply side" interpretation of comparability and tests its implications for actual federal pay levels. Although I do not fully agree with this supply orientation—as I shall detail later—its presentation and discussion offer a useful vehicle for reconsidering both the implications of comparability as it is presently implemented and its ultimate validity as a principle for pay policy.

The rationale for comparability as a pay policy is relatively simple: since government is not a profit-making enterprise, there is no market discipline to help guide pay setting. Consequently, government can turn to the private sector—where wages are disciplined by market forces—

Sharon P. Smith is district manager of labor relations at the American Telephone and Telegraph Company.

for guidance. Although this rationale appears simple, in practice, comparability has evolved into a convoluted process for pay setting.

Under the original formulation of the comparability doctrine for blue-collar workers, each federal agency set its own wages using different job definitions. As a result, wage differentials appeared between similar federal jobs in different agencies in the same locality. By 1964 these differentials had grown to as much as $0.64 an hour—an enormous amount in view of the fact that the minimum wage at that time was $1.25 an hour. The reforms in federal pay policy enacted in the 1960s attempted to correct the problems that had crept into the application of the comparability principle to blue-collar workers, to extend the principle to other federal workers as well, and to correct supply shortages that were appearing at certain skill levels of white-collar workers. However, a murkiness reflecting conflicting goals has crept into the present application of comparability.[2]

A number of conceptual and technical difficulties—which I have documented elsewhere (Smith 1977, 23–34)—hinder the practical application of the comparability principle. Major problems include the fact that the presence of noncompetitive forces in the private sector—such as the presence of unions or of race or sex discrimination—may produce wages different from those reflecting the free play of competitive forces sought by the comparability process.[3] Moreover, the comparability system, as presently enacted, ignores differences between the sectors both in fringe benefits and in other nonpecuniary returns. At the technical end, there appear to be a number of problems in the survey universe used to sample private sector wages; thus the resulting estimate is likely to be biased upward. The net result of these conceptual and technical problems is that even when fully implemented, the comparability process has not been successful in attaining its policy goal, but instead produces federal wages that are as much as 20 percent higher than those paid comparable private sector workers (Smith 1982, 273–77). Indeed, the failure to make a strict "comparability" adjustment to federal pay scales in any year since 1976 has been attributed at least in part to a recognition of this bias (Office of Personnel Management 1984, 3). Nevertheless, use of such an ad hoc means of correcting for upward bias in the process makes the full effect in terms of relative wage patterns extremely difficult to project.

Therefore, with federal pay increases manipulated to satisfy policy goals unrelated to the needs or preferences of federal employers or employees, a fresh set of estimates of comparative federal and private pay patterns is needed. This alone would validate Venti's research. However, Venti has also added two new dimensions to this research. First, in an attempt to measure both observed and unobserved worker quality in his wage comparisons, Venti goes beyond the customary

observation that the estimating equations do not measure all the potential differences in quality between workers in the two sectors. Second, Venti observes that a policy of equal wages in the federal and private sectors may be inappropriate because nonpecuniary aspects of employment differ between the two sectors. Instead, he suggests that a supply side interpretation should be considered: Are wages high enough to attract the required number of workers?

Taking a fresh approach to the study of federal-private pay differentials, Venti has noted that these wage differences can be attributed to four potential sources: observed productivity or skill differentials; unobserved productivity or skill differentials; equalizing differences in pay for nonpecuniary job attributes; and quasi rents or overpayments to government employees. The bulk of the prior empirical research in this area has concentrated on the first and the last sources of overall differentials. Where the other two sources are acknowledged, they have generally been discounted as unmeasurable and unlikely to have significant impact in most instances.

Not content with this reasoning, Venti makes a commendable attempt to account for each of these sources of wage differences between the public and the private sectors by jointly estimating wage functions and sectoral choice mechanisms. However, it must be emphasized that in the case of the second source of wage differences—unobserved productivity or skill differentials—this problem is not unique to a study of government wage differentials but rather applies to the analysis of wages for any two different workers. It is simply impossible to measure and take account in a wage regression of all the sources of difference in worker quality or productivity.

Venti's estimates suggest that unobserved skill differentials have little explanatory power for the female federal wage advantage but explain a substantial portion of the male federal wage advantage. One possible explanation for these differing impacts is the effect of unions, which unfortunately cannot be accounted for in this data set. My research has suggested that the wage advantage enjoyed by male federal workers (whether in the postal service or in other federal employment) is roughly equal to that enjoyed by comparable unionized private sector workers, whereas the wage advantage enjoyed by female federal workers (in nonpostal employment) is sharply larger than that enjoyed by comparable unionized private sector workers (Smith 1977, 120–29). In other words, the unobserved productivity or skill differentials may largely reflect the effects of union membership, which is a much more important influence on the wages of private sector males than of any other group.

The underlying reasoning for Venti's suggestion that a supply side orientation provides a more appropriate approach for the comparability

doctrine derives from a recognition that sector of employment is a choice variable—unlike race or sex, for which the decomposition analysis to provide estimates of explained and unexplained wage differentials originated. Thus, in choosing a particular sector of employment, an individual is expressing a preference for a certain package of wages and nonpecuniary benefits. Consequently, part of any public-private wage difference may be an equalizing difference for nonwage job attributes. A policy of wage equalization across the sectors then may be both inequitable and inefficient. Thus Venti suggests that it is more appropriate to determine the differential that sets wages just high enough to attract the required number of workers. Indeed, Venti maintains that such a supply orientation was the original motivation for the comparability policy.

Certainly it is true that the nonpecuniary characteristics of a job differ across sectors. An efficient wage policy must make some allowance for the impact of nonpecuniary advantages and disadvantages of employment because these influence the job acceptance decision. At the same time, however, such differences are not unique to the distinction between federal and private employment. Indeed, the differences may be greater between two private sector employers than between the federal government and a private firm; such differences have a part in most firms' wage policies. Moreover, certain of these nonpecuniary factors, which are unobservable to researchers, may also be unknown to individuals until after they hold the job in question. In that case the nonpecuniary factor is unlikely to play much of a role in the job acceptance decision.

Nevertheless, to advocate a wage policy that, after allowing for the influence of the nonpecuniary advantages of federal employment, proposes paying wages just high enough to attract the required number of workers, ignores the quality implications of such an approach, the ambiguity of the wage level it implies, and its divergence from the original specification of the comparability principle (as quoted in the first sentence of these comments). The level of wages an employer chooses to offer potential employees and the relationship of that wage to the level prevailing in the market from which that employer can draw workers have clear implications for the quality of workers attracted to a particular job and the length of the interested queue. However, while offering wages significantly above the market norm will likely result in a long queue of potential employees of above-average quality, it does not guarantee a superior-quality work force. Instead, it is the hiring decision that determines whether or not the relevant employees are of superior quality. Moreover, this supply side interpretation which Venti advocates offers too vague a guideline for the actual setting of federal pay, without some fairly explicit assumptions

about the quality of workers preferred and the labor supply conditions (whether surplus or shortage) prevailing in the relevant market. Finally, the original statement of the comparability principle offered such an explicit statement; I find it impossible to justify any other interpretation of the doctrine than that federal workers should be paid the average rate prevailing for comparable jobs with private sector employers.

From the employer's perspective, comparability was intended to be an efficient pay policy that would assure government that it could attract sufficient numbers of qualified workers to fill its staffing needs, which is very much in keeping with Venti's interpretation. However, this is only part of the policy's purpose. From the employee's perspective, it was supposed to be an equitable pay policy that would assure workers that they would not suffer a wage disadvantage by working for the federal government. Consequently, to advocate Venti's supply side view is to take an incomplete interpretation of the comparability policy and its implications.

Venti relies on this supply side interpretation to formulate and estimate a model to predict the wage differential between federal and private sectors that would account for the influence of nonpecuniary characteristics of employment, but still eliminate queues for federal jobs. I have long advocated reforms in federal pay that would help eliminate these queues. However, Venti suggests that these queues could be eliminated if the wages of male federal workers were reduced 16 percent and the wages of female federal workers were reduced 42 percent. Such a policy hardly seems a viable governmental reform since part of the difference in the relative positions of males and females is due to the fact that sex discrimination appears less intense in the federal than in the private sector (Smith 1977, 106–14).

The problems with the comparability process that were recognized more than a decade ago have not disappeared but rather have become even more complex and worthy of immediate legislation. Despite the reservations I have discussed, I believe Venti's chapter makes an interesting and valuable contribution to our knowledge and understanding in this area and provides a fresh perspective for considering what federal pay policy really says and what it should really mean.

Notes

1. See Smith 1977; Quinn 1979; Hartman and Weber 1980; and Borjas 1980.
2. In practice, the comparability process does not proceed automatically. In the event of a national emergency, or because of general economic conditions, the president can propose an alternative pay plan to the full comparability adjustment. However, the adoption of an alternative pay plan has become the rule rather than the exception: it has occurred in eight of the last ten pay decisions. Such a practice suggests that the federal pay policy is being used

to serve other policy purposes than to attract and retain adequate numbers of competent employees. Indeed, further evidence of this distortion of policy goals can be found in President Reagan's December 1984 budget proposal which called for a 5 percent cut in federal wages—the first such cut since 1932—to take effect in January 1986 as a means of trimming the federal deficit.

3. See U.S. GAO, 1973, p. 5, for further discussion of this intended goal of the comparability process.

References

Borjas, George. 1980. *Wage policy in the federal bureaucracy.* Washington, D.C.: American Enterprise Institute.

Hartman, Robert W., and Arnold R. Weber. 1980. *The rewards of public service compensating top federal officials.* Washington, D.C.: Brookings Institution.

Office of Personnel Management. 1984. *Reforming federal pay: An examination of more realistic pay alternatives.* Washington, D.C.: Government Printing Office.

Quinn, Joseph. 1979. Wage differentials among older workers in the public sector. *Journal of Human Resources* 14:41–62.

Smith, Sharon P. 1977. *Equal pay in the public sector: Fact or fantasy.* Research Report Series No. 122. Princeton: Princeton University, Industrial Relations Section.

———. 1982. Prospects for reforming federal pay. *American Economic Review Papers and Proceedings* 72:273–77.

U.S. Civil Service Commission. 1968. *Challenge and Change: Annual Report 1968.* Washington, D.C., U.S. Government Printing Office.

U.S. General Accounting Office. 1973. *Report to the Congress: Improvements Needed in the Survey of Non-Federal Salaries Used as a Basis for Adjusting Federal White Collar Salaries,* B-167266. Washington, D.C. May 11, 1973.