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SEX-RELATED WAGE DIFFERENTIALS AND WOMEN'S INTERRUPTED LABOR CAREERS -- THE CHICKEN OR THE EGG

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ABSTRACT

Sex-related wage differentials are almost universal. Economists traditionally tend to attribute a major fraction of the differential to the difference in on-the-job training. This difference is in turn often explained by the lower profitability of this investment for women who plan to interrupt their careers for family reasons. An alternative explanation, that women do not invest because of lack of investment opportunities owing to employers' expectation that they will drop out of the market, has been given little attention in the literature. The present paper tries to ascertain, theoretically and empirically, the validity of this argument.

Employers have little stake in their employees' investment in general human capital. Thus, if employers' decisions affect investment, this has to be investment in firm-specific human capital. The paper explores the way employers and employees share in such an investment and the way employers' conceptions about women's labor force attachment can affect the size of the investment, women's wages, and their labor-force separation rate.

To test the hypothesis that employers' expectations affect women's wages, I examine the effect of plans for labor-force separation on wages. It is assumed that employers are not aware of individual plans, so that absence of a plan's effect on wages can serve as *prima facie* evidence for the hypothesis. In a simultaneous-equation system it is observed that wages affect plans but plans do not affect wages. Further investigation indicates that the skill intensity of jobs which men and women occupy is a major determinant of the wage gap. This variable is very sensitive to past performance (as measured by labor-force experience and tenure) and future plans in the case of men, but is hardly affected at all by these variables in the case of women.

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SEX-RELATED WAGE DIFFERENTIALS AND WOMEN'S INTERRUPTED LABOR CAREERS--THE CHICKEN OR THE EGG*

The wage differential between men and women is a thorn in the side of economists, theorists and empiricists alike. Theorists are by and large at a loss to explain the persistence of such a wage gap in a competitive environment, and empiricists are hard pressed to identify the factors that explain it. In their seminal study of this problem Mincer and Polachek (1974) identified on-the-job investment as the major culprit. Women expect to drop out of the labor force when they have children, the argument goes, and hence invest less in on-the-job training. Consequently, they enjoy only moderate wage rises over their life cycle, so that the wage gap widens with age. Mincer and Polachek argue that differences in labor-force experience explain 70 percent of the hourly-earnings differential between married men and women, but they also admit that post-school investment on the job may be indirectly affected by earnings differentials. In their words, "indirect effects occur in that the existence of market discrimination discourages the degree of market orientation in the expected allocation of time and diminishes incentives

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to investment in market-oriented human capital. Hence, the lesser job investments and greater depreciation of female market earning power may to some extent be affected by expectations of discrimination" (Mincer and Polachek, 1974, p. S104).

This by now traditional explanation runs into some difficulties when used to explain the persistence of the wage gap. The 1960s and 1970s have witnessed a continuous increase in the labor-force participation rate of women (and in particular married women), a change accompanied by a decline in the labor-force drop-out rate of married women with young children. Nevertheless, there has been no obvious decline in the wage gap (Fuchs, 1974; Oaxaca, 1977).[1]

In view of these difficulties, this study explores an alternative hypothesis, which argues that the traditional explanation suffers from reverse causality. Putting it informally, it is not that women do not want to invest in their careers, but that they are not given adequate opportunities to do so. Employers who expect women to drop out of the labor force when they have children are reluctant to admit them to positions that involve invesetment. Consequently, women are cofined to jobs which promise little wage promotion. Once they have children, they do not (given the nature of their job) find it worth while to stay in the labor force, thus confirming their employers' expectations and creating a vicious circle they cannot break.

This argument, often advanced by women, abounds with difficulties.

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[1] Of course, it can be argued that the increase in participation rates is associated with a decline in the average labor-force experience of women and that the average wage gap would have increased if that for the more experienced women had not narrowed.

On a formal level, wage increases are usually explained by investment in general human capital, i.e., training that increases a person's productivity regardless of where he is employed. However, in the absence of binding labor contracts, this kind of training is fully financed by the employee himself (in the form of wages which fall short of productivity during the initial stages of the investment). Since employers do not participate in this type of investment, it is not clear why they should prefer men to women unless it is assumed that they are pure discriminators.

Any formalization of our argument must therefore rely on the investment in specific training. Specific training is defined as training that increases a person's productivity only in the firm in which he was trained. Given the uncertainty of future employment, the employee may be reluctant to invest in this kind of training on his own (since he may be fired at no cost to the employer), and so will be the employer (since the employee may quit at no cost to himself). Consequently, this investment will be undertaken only if employer and employee can reach some agreement on how to share costs and returns.

The investment in specific training affects the slope of the age-earnings profile inasmuch as the employee shares in the costs and reaps part of the returns, and insofar as the investment in specific and general training is a joint venture. When it is difficult to separate the specific and the general elements in training, and the one cannot be acquired without the other, the employer's reluctance to invest in his employee's specific skills may prevent the latter from increasing his general skills.

To formalize this hypothesis, I present a formal model analysing the sharing of costs and returns of the investment in specific training. The general discussion is followed by a discussion of the specific case of women: how do the employer's conceptions (or misconceptions) about women's quit rate affect the sharing and overall size of the investment?

To confront this hypothesis with the traditional one, I examine the effect on wages of planned labor-force quits. It is assumed that if a woman plans to quit the labor force she has no reason to disclose her plans to her employer. Thus, the intention to drop out of the labor force will depress wages if women who plan to do so reduce their investment in training. On the other hand, plans to quit should have no effect on wages if access to training is controlled by an employer who has no knowledge of the plans. The absence of any plans-to-quit effect on wages can therefore serve as *prima facie* evidence for our hypothesis.

The relationship between wages and plans to quit is far from being a simple one-way relationship. Plans may affect wages (through their effect on investment in human capital), but lower wages may also induce quits. One cannot expect, therefore, to detect the effect of plans on wages in a simple one-way regression scheme. What is required is a simultaneous scheme where plans are affected by wages and wages are affected by plans. Estimating such a model, using panel data, reveals that it is lower wages which encourage quits but that quits do not affect wages.

To test the sensitivity of the results to the specification of the model, the model was expanded to incorporate on-the-job training directly. I distinguish between investment in training and the training required for the specific job (there is direct information on both variables in the data of the Michigan Panel Study of Income Dynamics). Both variables affect wages, and are (or might be) in turn affected by planned quits (which depend on wages). The estimation of the four-equation model reveals that there is no fundamental difference between men and women in the wage, labor-force separation, and on-the-job training equations (the only major difference is in the sensitivity of quits to demographic changes such as marriage, separation, children, and residential mobility). On the other hand, the sex differences in the job-requirements equation are most pronounced. On the average, women occupy jobs which require substantially less training than men's jobs. They are concentrated in occupations which involve less training, and within broad occupations they occupy positions which need less training. Their experience in the labor force and with the firm has much less weight in determining the quality of their jobs, and their future plans (in sharp contrast to those of men) are not considered at all.

In evaluating these results, observe that when race, marital status, union membership and some other variables are controlled for, women earn rather less than three quarters of the men's hourly wage. The sex differences in current training and job requirements explain about two-thirds of this differential (i.e., if women had on-the-job training and if they got jobs which require the same training as men's jobs, the wage gap would shrink to 10 percent). The sex difference in labor-force separations (which in turn is traced to the sex difference in the effect of the demographic factors on separation) explains much of the difference in training. It cannot, however, account for the difference in job requirements. In particular, if men quit the labor force at the same rate as women, if they had the same experience, tenure, and occupational structure, they would have jobs that are substantially inferior (in terms of training) to those they actually hold, and consequently much lower wages. On the other hand, if women were to reduce their quit rate, increase their labor-force experience and tenure, and change their occupational composition, they would obtain only marginally better jobs, and the wage gap would narrow by very little. What is required to close the gap is a structural change. It is only if their observed characteristics (e.g., labor-force experience and tenure) were given the same weight as men's in the allocation of jobs by employers that women would have an incentive to change their participation behavior and reduce their quit rates.

I. LABOR TURNOVER AND INVESTMENT IN SPECIFIC CAPITAL

Specific human capital has traditionally been regarded as a major determinant of labor turnover. The investment in skills which are specific to the firm is an endeavor shared by employer and employee, each being reluctant to undertake it on his own. The larger the investment, the greater the stake of the two partners in the continuation of the partnership, and hence the lower the labor turnover.

In this section the relationship between specific human capital and labor turnover is formalized. I discuss the decline in job separation as tenure increases, the effect of investment in specific human capital on the age-earnings profile, the effect of the reservation wage on this investment, and the role of the employer's conception of his employees' career attachment.

The formal presentation is based on a recent model by Hashimoto (1979) and incorporates some modifications by Carmichael (1981). Hashimoto sets out to solve an old puzzle: how do employer and employee share the costs and returns of the investment in specific human capital? The problem is as old as the concept of specific human capital itself. It was Becker (1962) who first posed the question: given that the returns to the investment are conditional on the continuation of the employee's connection with the firm, and given the high cost of enforcing labor contracts, how would each party secure its share in the returns when the other threatens to sever the connection? Becker suggested that the two parties share in the costs of the investment, so as to make breaking up the partnership costly to both. However, he did not specify the rules which should govern the allocation of costs and returns. It was later argued (Mortensen, 1978) that these rules are immaterial if labor contracts can be renegotiated and wage offers are matched whenever one of the parties threatens to sever the relationship, or alternatively, when each party has to compensate the other for damage caused by the break-up of the partnership.

Hashimoto addresses the question of what form the labor contract takes when information on some aspects of the partnership is not shared equally and is costly to convey. For example, the employee's productivity is known to the employer but not (or only partly) to the employee, and wage offers from outside (or, in Carmichael's formulation, job satisfaction) are known to the employee but are costly to convey to the employer. In this case, matching wage offers or ascertaining damages becomes very costly (and the incentive for fraud very great) and one has to revert to other ways of resolving the partnership problem. Hashimoto's solution, which is defined within a two-period optimization scheme, involves a pre-negotiated two-tier wage scheme: in the first period the employee draws a wage which is lower than his marginal productivity (and the wage he could get elsewhere) so as to pay for his share in the cost of the investment; for the second period he is promised a wage which exceeds his alternative wage (but falls short of his expected marginal productivity), where the premium in excess of the alternative wage represents the employee's share in the returns (the employer's share being the difference between marginal productivity and the wage). The returns are shared so as to maximize the overall benefits of the association. The wage rate, which determines the apportionment of the benefits, is determined so that the marginal gain to one party from a change in the share equals the marginal loss to the other.

Formally, it is assumed that employer and employee are both risk neutral. The investment in specific human capital takes place in the first period at a cost C. The outcome of the investment process is known only at the end of that period. The employer learns the employee's productivity and the employee learns the amount of satisfaction (i.e., psychic income) he derives from the job. The employer decides to fire the employee if his realized productivity falls short of the prenegotiated wage, and the employee decides to quit when his total wage package (wage plus job satisfaction) falls short of his reservation wage.

Let M denote the mean productivity of employees who have invested in the firm-specific human capital, η, the random component in productivity (varying from one person to the next) and W the prenegotiated wage; the employee is fired if

$$M + \eta < W .$$

He quits his job when

$$W + \theta < R ,$$

where θ denotes job satisfaction and R the reservation wage.[2] Let

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[2] It is assumed that η is known only to the employer and θ only to the employee so that W cannot be renegotiated in order to prevent or reduce job separations if either of these inequalities holds.

$f(\eta)$ and $q(\theta)$ denote the density functions of the random components η and θ, respectively. The probability of the employee being fired is then

(1) $$F = F(W - M) = \text{prob}(\eta < W - M),$$

where F is the distribution function of η. Similarly, the probability of a quit is

(2) $$Q = Q(R - W) = \text{prob}(\theta < R - W),$$

where Q is the distribution function of θ. For simplicity it is assumed that the mean values of η and θ are zero and that they are uncorrelated,

$$E(\eta) = E(\theta) = \text{cov}(\eta, \theta) = 0.$$

A wage-raise increases the employee's share of returns and reduces the probability of his quitting but increases the risk of his being fired. This risk may be reduced by reducing the wage but only at the expense of an increase in the probability of quitting. The optimum wage rate is that which maximizes the joint gains from the association. These gains (G) can be reaped only if the association persists, and they are composed of the gains in productivity and psychic income associated with the investment,

(3) $$\begin{aligned} G &= (1 - F)(1 - Q)[(M - R) + E(\eta|\eta > W - M) + E(\theta|\theta > R - W)] \\ &= (1 - F)(1 - Q)[\mu_\eta(W - M) + \mu_\theta(R - W)], \end{aligned}$$

where $\mu_z(Z) = E(z - Z|z > Z)$ denotes the expected residual (i.e., the difference between the truncated mean and the truncation point).[3] The

[3] In the notation used here, $z = \eta$ or θ, and $Z = (W - M)$ or $(R - W)$,

optimum wage satisfies the condition

$$\mu_\eta(W - M)\lambda_\theta(R - W) = \mu_\theta(R - W)\lambda_\eta(W - M), \tag{4}$$

where $\lambda_z(Z) = f(Z)/[1 - F(Z)]$ is the hazard rate, i.e., the conditional density of z at Z given $z \geq Z$.[4] The average benefits accruing to each partner from the continuation of the partnership are measured by μ_z;[5] the marginal change in the probability that the partner will break the association is measured by λ_z; and equation (4) indicates that the optimum wage balances the expected losses from a break-up of the partnership.

The optimum wage (i.e., the optimum allocation of returns) determines the probability of job separation and the gains to be reaped from the investment. The optimum size of the investment (h) is determined by the traditional equality of marginal returns and marginal costs

$$\frac{\partial G}{\partial h} = \frac{\partial C}{\partial h} . \tag{5}$$

The share of each partner in the returns determines his share in the costs.

How are the wage rate, the probability of separation and the size of the investment affected by an increase in the employee's mean productivity

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respectively. To derive (3) the expected net gains of the two parties can be broken into three disjoint events: the employee quits, he is fired, and the association continues. For details see Hashimoto (1979).

[4] Equation (4) and the subsequent equations in this section are proved in the appendix.

[5] For example, $\mu_\theta(R - W) = (W - R) + E(\theta | \theta > R - W)$. The first term measures the pecuniary rewards, the second term the nonpecuniary rewards, from continuation of the employment.

(M)?[6] To answer this question, the nature of the distributions of the random components η and θ must be defined more explicitly. For the rest of this section it will be assumed that these distributions are normal $z \sim N(0, \sigma_2^2)$.[7] In this case an increase in productivity, other things being equal, increases the employer's share and his incentive to maintain the association. The employer responds by increasing the wage rate, allowing the employee to participate in the increased rewards. The wage increase, however, falls short of the increase in productivity (i.e., $W - M$ declines). Consequently, the probability of firing and the probability of quitting both diminish, and the expected gain accruing to each partner increases. The reduced risk of job separation and the increased gains result in an increase in G and in the investment.

An increase in the reservation wage, on the other hand, reduces the employee's incentive to stay at the job. It leads to increased wage demands, to a decline in the employer's profits, and hence an increase in the probability of job separation (at the initiative of either party). The gains from the association diminish and so does the investment in specific human capital.

An increase in the stock of specific human capital increases the

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[6] For analytical purposes, it is for the time being assumed that this change in M is not associated with changes in the variance of η, nor is it accompanied by a change in the reservation wage R. At this point the presentation departs from that of Hashimoto and Carmichael.

[7] The results of this section apply to a much wider range of distributions, whose properties are described in the appendix (I have so far not been able to specify the general family of distributions for which the conclusions hold). They are, however, by no means universal. The exponential distribution (which satisfies $\lambda = 1/\mu$ = constant) is a notable counter example, where an interior solution does not exist.

employee's productivity and should increase his wage rate and reduce the probability of job separation.[8] However, when it comes to investment in human capital, it is very difficult to draw the line between investment in specific and general skills. The two are very often joint outputs of the investment process, and there is no way of acquiring one sort of skill without acquiring also the others (for example, one cannot acquire the skills required to become an executive without learning the features of the trade which are specific to the firm). Thus, an increase in the stock of human capital may raise the employee's productivity outside as well as in the firm. In that case, the increase in M is accompanied by an increase in the reservation wage, R. Both changes raise the wage rate. However, so long as the increase in the reservation wage falls short of the increase in productivity ($dR < dM$), the investment in specific human capital reduces both quit rates and firing.[9]

II. THE INVESTMENT IN HUMAN CAPITAL AND THE MARRIED WOMAN

Ignoring personal variation in productivity and job satisfaction, the investment in specific capital, wages, and job separation are affected by the employee's expected productivity in the firm and by his reservation wage. It is legitimate to assume that except for occupations which require

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[8] Thus $\partial G/\partial h = (\partial G/\partial M)(\partial M/\partial h) > 0$ since both $\partial G/\partial M$ and $\partial M/\partial h$ are positive.

[9] Throughout the analysis it is assumed that the random components η and θ are invariant to the stock of human capital. The analysis can easily be modified for the case where job satisfaction and personal variation in productivity increase with the investment in human capital. Hashimoto (1979) and Carmichael (1981) assume that M, R, η, and θ increase at the same rate. If this is so, the investment in specific human capital should not affect the separation rate.

physical strength, there is no inherent productivity difference between the sexes. Sex-related differences in specific (and perhaps general) on-the-job investment, wages, and tenure are therefore attributable to differences in the reservation wage.

A man's reservation wage is usually the best wage offer he can generate outside the firm. Barring unexpected events, such as drastic changes in his state of health, his expected reservation wage changes systematically with his stock of general human capital. As shown in the preceding section, so long as the change in their reservation wage falls short of the change in their productivity in the firm, men's wages and specific investment are expected to increase and their separation rates to decrease, as tenure increases.[10]

This is not true for women. In the labor force, women (in particular the married) usually face a three-way choice: to stay with their firm, to move to another firm, or to withdraw from the labor force altogether (i.e., to choose self-employment in the home sector). Women's reservation wage is the alternative market wage or the value of home productivity, whichever is the higher. In contrast to men's reservation wage, where the major source of variation over time is the accumulation of human capital, the reservation wage of married women varies sharply with the value of time at home. Thus, it varies with demographic changes (marriage, divorce, more children) and with the husband's income, not to mention husband-instigated residential mobility (Mincer, 1978). These factors are subject

[10] This is true subject to two qualifications: (a) Given a finite time horizon, the investment in specific as in other forms of human capital will decline as the date of retirement approaches; and (b) like general capital, specific capital may be subject to obsolescence.

to sharp variation over time; very often they also involve asymmetry of information: they are known to the woman but not to her employer.[11]

To illustrate the woman's decision process, let it be assumed that she faces two alternative wage schedules (Figure 1): a flat wage schedule W_A involving no investment in human capital, and a wage schedule W_B associated with investment in specific capital. The latter is composed of a lower initial wage W_{B1} in the first period and a higher wage $(W_{B2} > W_{B1})$ thereafter. The woman's value of home production is R_1 in the first period but (because of demographic changes) it jumps to R_2 in the second (where $W_A < R_2 < W_{B2}$).[12] A man who faces a constant value of home production of R_1 will regard it as an inferior alternative, and make his decision whether to invest or not on the basis of W_A and W_B alone. A woman facing an exogenous jump in her home production can opt for one of two alternatives. She can either opt for job A in the first period and drop out of the labor force thereafter, or she can choose job B and invest in human capital. The latter will be preferred if the present value of the W_B income stream exceeds the best alternative, namely W_A in the first period and R_2 in the second. If the woman chooses W_B she will stay at her job (and, of course, in the labor force) throughout her two-period career.

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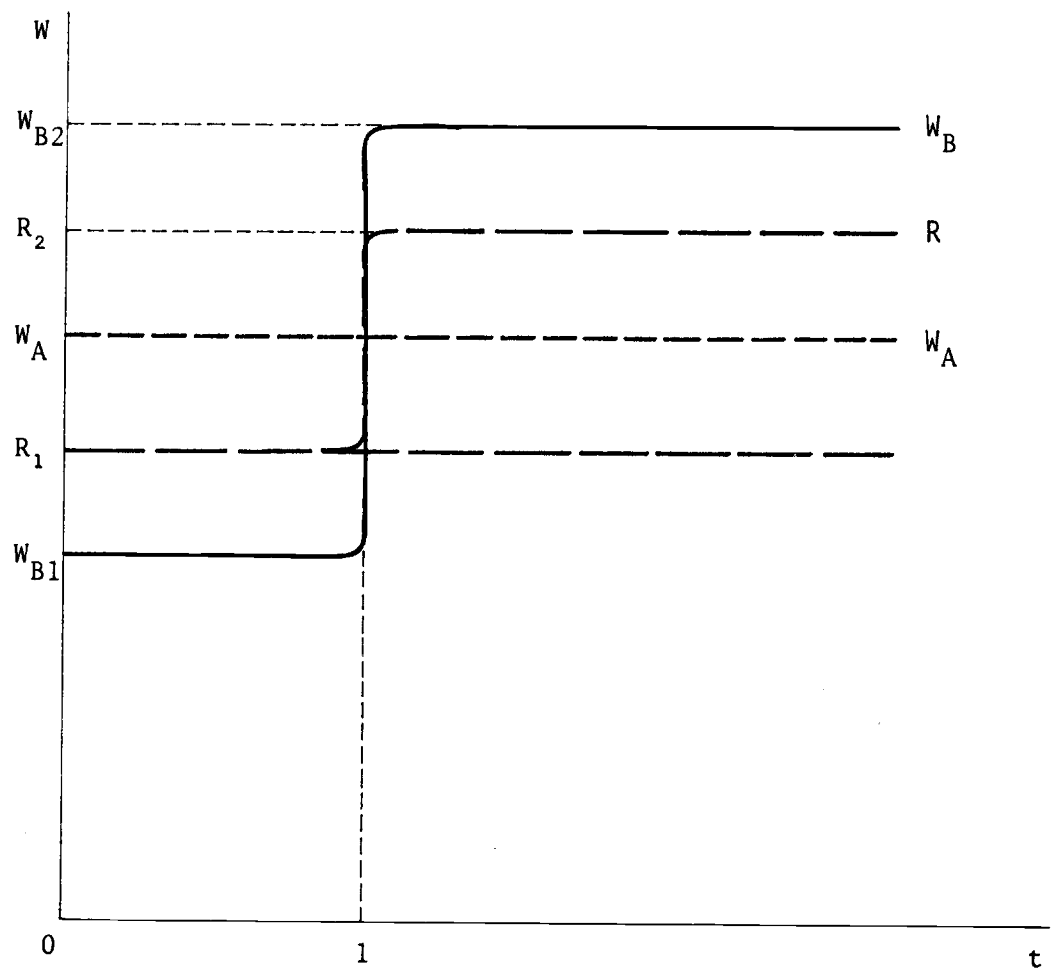
[11] Throughout this paper I shall ignore another factor which may play an important role in the sex-related differences in mobility and tenure. Men's interfirm mobility may be impeded by transaction costs (e.g., costs of search) which are much lower for a woman who chooses self-employment at home. The interaction of search costs and the investment in specific capital and their effect on labor turnover are discussed by Jovanovic (1979).

[12] In Figure 1 it is assumed that $R_1 > W_{B1}$. This assumption is not essential to the discussion.

Figure 1.



However, as Figure 1 conveniently illustrates, given the higher home reservation wage R_2, women have less incentive to invest in human capital than men (who are assumed to have a fixed home wage of R_1 throughout). Furthermore, given their higher reservation wage in period 2 $(R_2 > W_A)$, it has been shown that women may demand a higher wage, reducing the profitability of the investment from the employer's point of view. Both factors will result in a lower level of specific investment. Furthermore, if specific and general capital are joint outputs, the employer's reluctance to participate in the specific investment reduces the level of general training.

Up to this point the analysis does not in essence depart from the tradition. It does, however, give rise to some new questions. Of special interest is the question of misconceptions concerning the career attachment of women. Assuming that the value of home production is unobserved by the employer, can a bias in his expectations concerning the woman's value of time and the probability that she will quit be self-fulfilling?[13]

To answer this question one has to return to Hashimoto's model described in the preceding section. It was argued there that the optimum wage is the one that maximizes the joint gains from the investment in specific human capital. It was implicitly assumed that the two parties are in complete agreement about the parameters of the decision rules: the joint gains, function G [equation (3)] is therefore acceptable to both.

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[13] The employer is usually not aware of the employee's personal plans concerning children, marriage, divorce, or residential mobility. Even if he knows the woman's family plans, he may be unable to assess her quit probability because it will to a large extent depend on the family's willingness to use substitutes for the woman's time (market services or time of other members of the household).

If not, and if the parties differ in their estimates of these parameters, the problem has to be reformulated so as to take separate account of the gains accruing to each party.

The gains to the employer (G_e) accrue only so long as the association between him and the employee continues, and are equal to the difference between the employee's marginal productivity and the wage the employer is committed to pay,

$$(6) \qquad G_e = (1 - F)(1 - Q)[(M - W) + E(\eta|\eta > W - M)]$$
$$= (1 - F)(1 - Q)\mu_\eta(W - M) \ .$$

The employee gets wage W plus job satisfaction so long as the partnership survives; should the partnership collapse, he gets the reservation wage R,

$$(7) \qquad G_w = (1 - F)(1 - Q)[W + E(\theta|\theta > R - W)] + [1 - (1 - F)(1 - Q)]R$$
$$= R + (1 - F)(1 - Q)\mu_\theta(R - W) \ .$$

From the employer's point of view the optimum wage is the one maximizing G_e. The employer will press for lower wages so long as his increased profits are not offset by the risk of the employee quitting the firm. A necessary condition for an optimum is

$$(8) \qquad \lambda_\theta(R - W_e)\mu_\eta(W_e - M) = 1 \ ,$$

where W_e is the employer's optimum wage.[14] Roughly speaking, lowering the wage rate by \$1 increases profits by \$1 but increases the risk of a quit by λ_θ where the loss associated with a quit is μ_η. Similarly,

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[14] Equation (8) and subsequent results are proved in the appendix.

the employee's gains are maximized when the wage he receives, W_w, balances gains with potential losses

(9) $$\lambda_\eta(W_w - M)\mu_\theta(R - W_w) = 1 .$$

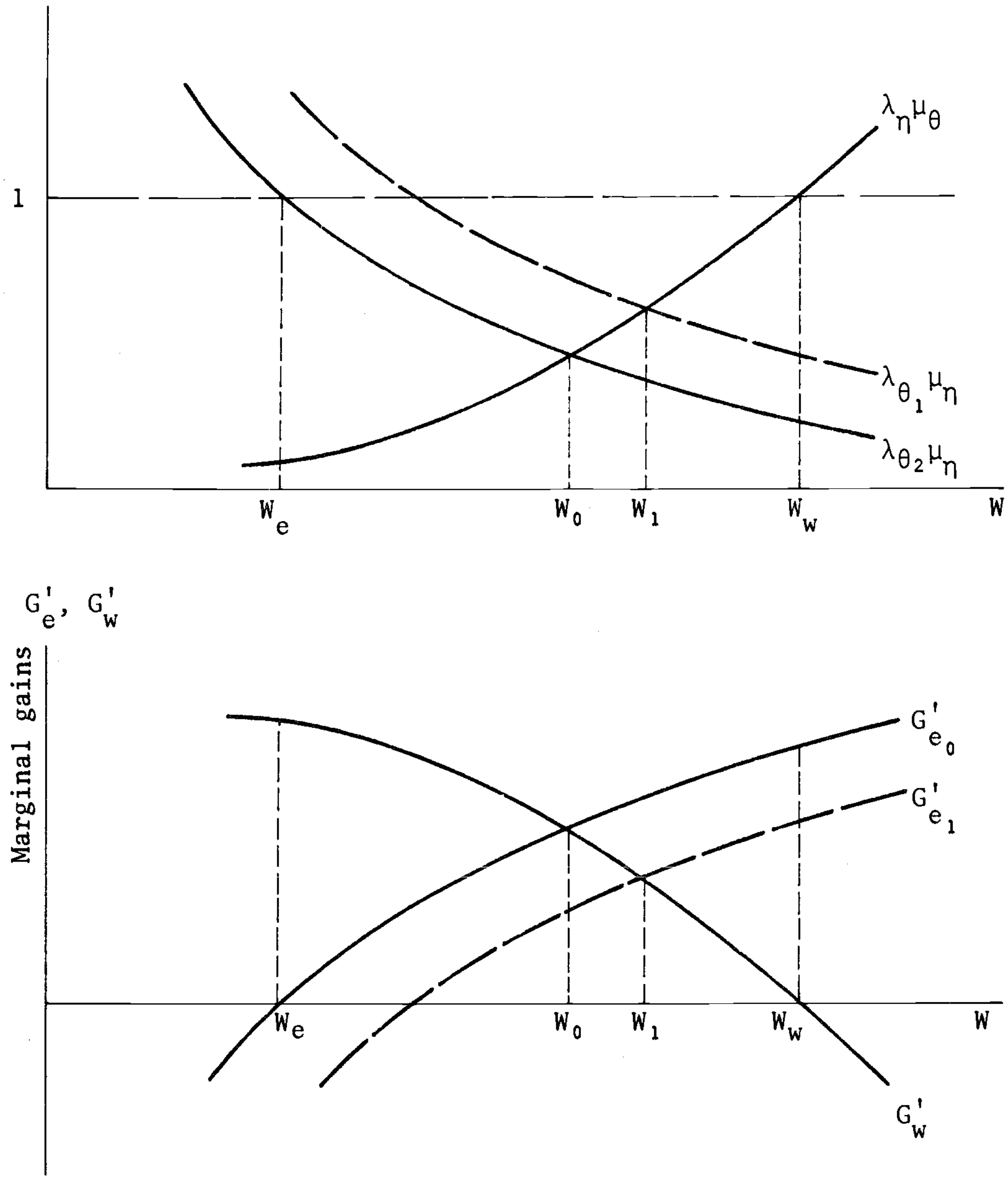
Comparison of (8) and (9) indicates that a wage which is optimal from the employer's point of view is not necessarily optimal from the employee's. Furthermore, comparison of (8) and (9) with the necessary condition for joint maximization [equation (4)] indicates that neither of them maximizes the joint returns of the partnership. In maximizing his own gains, each party ignores the loss imposed on the other by a change in the wage rate. Hence, not surprisingly, the individual optimum diverges from the joint optimum.

This divergence is demonstrated in Figure 2. The employee's desired wage, W_w, is assumed to exceed that preferred by the employer, W_e.[15] Consequently, at W_w the marginal gain to the employee from raising the wage falls short of the marginal gain to the employer from lowering it, $G'_w < G'_e$. Similarly, at W_e an increase in wages entails marginal gains to the employee which exceed the marginal losses to the employer. These differences give rise to a wage renegotiation whose outcome is W_0, the wage at which the marginal gain to one party equals the marginal loss to the other $(G'_w = G'_e)$.[16]

[15] This is true in the case where η and θ have uniform distributions (see appendix). I suspect that it is also true in general (or at least for all the distributions discussed in the preceding section), but I have not yet been able to prove this. The point is, however, not essential to the rest of the discussion.

[16] The renegotiation may assume the form of trading W against changes in the share of investment costs, C.

Figure 2.


1
$\lambda_\eta \mu_\theta$
$\lambda_{\theta_1} \mu_\eta$
$\lambda_{\theta_2} \mu_\eta$
W_e
W_0
W_1
W_w
W
G'_e, G'_w
Marginal gains
G'_{e_0}
G'_{e_1}
W_e
W_0
W_1
W_w
W
G'_w

The separate analysis of the employer's and employee's motives allows the incorporation of misconceptions. Assume that the employer is wrong about the value of the employee's home productivity. If he overestimates the employee's reservation wage and if the marginal probability of a quit (i.e., the hazard rate) increases with the reservation wage $[\partial\lambda_\theta(R - W)/\partial R] > 0$,[17] he will be more reluctant to press for lower wages for fear of inducing a quit. Consequently, the negotiated wage (W_1 in Figure 2) will be higher, but so will the probability of the employee's being fired. The higher wage and the higher probability of separation reduce the profitability of the employer's investment and his investment in specific capital. Thus, while in the short run this form of misconception might increase the employee's share in the returns, it will in the long run lower his wage rate (and flatten his wage-age profile) because the investment has been curtailed. The lower wage rate makes the employee more prone to quit when his reservation wage really goes up, thus confirming the employer's expectations.

In an extreme case, the employer depicted in Figure 1 believes that his employee's second-period reservation wage will exceed his productivity in the market, M. In that case the employer refuses to participate in the investment altogether. Thus the woman may be barred from investing in specific human capital (i.e., in job B) and is forced to pick jobs which involve little investment in training, such as job A; the result is frequent entries and exits from the labor force associated with fluctuations in her home wage.[18]

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[17] This is true whenever the distribution of θ is characterized by an increasing hazard rate (e.g., when the distribution is uniform or normal), or when $\partial q/\partial\theta > 0$ in the relevant range.

[18] It may be argued that the mere willingness to choose job B may serve

It should be noted that when quit expectations are biased upward no self-correcting mechanism exists. The employee who is offered a higher wage (than if his quit probability had been correctly estimated) is naturally not going to refuse, thus undercutting his long-run prospects for investment in specific capital and wage advance. The higher quit probability associated with the flat wage-age profile generates a vicious circle of self-fulfilling prophecies.[19]

III. WAGE RATES AND TURNOVER--PRELIMINARY EVIDENCE

The preceding section established that self-confirming expectations resulting in lower wages, a slower wage increase over the life cycle, and a higher turnover rate are a definite theoretical possibility. Can the direction of causation be ascertained empirically? Is it labor-force (or more precisely, planned) separations that lead (through lower on-the-job

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as a signal that the woman intends to stay in the labor force (since job A would be preferred by anyone restricting his job tenure to one period). This is admittedly true in the initial period, but need not be true subsequently, when the wages in job B may exceed those in job A. For more on the issue of the investment in specific capital as a signal, see Salop and Salop (1976).

[19] Note that underestimation of the reservation wage and the quit rate is subject to a self-correcting mechanism. When underestimating R, the firm may push the wage below the optimum level W_0. This will generate a suboptimal level of investment and will raise the quit rate. The latter will tell the employer that his estimate of R is off the mark. If the employer overestimates R, the effect on wages can be offset only if the employee underestimates his future productivity M, and therefore moderates his wage demands. Even so, the perceived gains from the investment will be underestimated, leading to suboptimal investment and self-fulfilling expectations on both sides.

investment) to lower wages, or is it lower wages which lead to labor-force separations? Put in the context of sex-related wage differentials, the question can be reformulated: is it women's plans which shape their age-earnings profiles, or are they shaped by the employer's expectations?[20] This section reports on some preliminary tests, while the final verdict is reserved for the next section.

A prerequisite for separating the two hypotheses is data on the person's labor-force attachment as reflected in his future participation plans. It is reasonable to assume that this piece of information, which is, naturally, known to the employee, is not known to the employer. If a person contemplates leaving the labor force (or quitting the firm) he will as a rule be wiser not to disclose his intentions to his employer prematurely. Similarly, an employee's declaration that he is not going to quit the firm in the foreseeable future may be discounted on the grounds that it serves his interest to convey the impression that he is going to stay with the firm, whatever his actual intentions. It may of course be argued that the employee may hesitate to reveal his quitting plans to an outside interviewer for the same reasons that he is reluctant to divulge them to his employer. But one can then replace the data on plans by data on their realization, namely, the employee's subsequent behavior

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[20] Sandell and Shapiro (1980) address themselves to the first part of this question. They report that the investment in general training of young women who plan to be out of the labor force at age 35 is lower than of those who reported 5 years earlier that they intend to stay in the labor force. Their study ignores the possibility that plans may change, and their findings are restricted to young women (aged 19-29 in 1973). Even if these findings are accepted, they do not preclude employers' expectations from affecting women's age-earnings profiles.

(specifically, his subsequent exit from the labor force).

The data on women's labor force participation plans (or their realization) are the cornerstone of my test. In order to disentangle cause and effect, I employ a simultaneous-equation scheme in which both wage rates and planned (or future) labor exits are the endogenous variables. The test is in essence a test of omission. If it is shown that women's wages affect their planned exits but planned exits do not affect wages, it will serve as *prima facie* evidence of employer discrimination. If this is the case, it will be argued that women's plans do not matter, the effective constraint being that the employer's expectations prevent women from attaining higher wages irrespective of whether they plan to stay in the labor force.

Given the woman's wage in period t, the test requires knowledge of her labor force plans and their subsequent realization. To obtain this sort of data panel studies have to be used. The findings reported in this paper are based on the Panel Survey of Income Dynamics (PSID) conducted by the Institute for Social Research at the University of Michigan. The ninth wave (1976) of this panel contained data of women's (as well as men's) labor-force plans,[21] and the subsequent waves (1977-79) provide data on their realization.

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[21] The 1976 questionnaire contained the question, "Do you think you will keep on working for the next few years, or do you plan to quit?" The 1976 wave serves as a convenient base for two other important reasons: (a) In that year heads of households and their wives were asked the same questions (in other years heads were asked about the activities of their spouses); and (b) the 1976 wave is one of the few containing information on the wife's tenure on the job (i.e., position) and with the firm (i.e., the same employer).

The sample contains information on about 1,900 women (married and non-married) who were employed in a civilian job in 1976.[22] A similar sample of about 2,400 men served as a control group. About 10 percent of the women in the sample (12 percent of the married women) reported that they intended to quit the labor force within the foreseeable future (versus 3.5 percent of men). Actual exists, however, by far exceeded reported intentions. Almost 30 percent of the women and 7 percent of the men dropped out of the labor force for at least one year (more precisely, reported being out of the labor force in at least one of the subsequent waves). Moreover, as Table 1 indicates, only 20 percent of the women quitting in 1977-79 reported any intention of doing so in 1976, and over one third of those who planned to quit did not do so within the next 3 years. Since we cannot separate unexpected exits from unreported plans, we shall use the data on plans and realizations interchangeably.

Hourly earnings are computed as the ratio of labor income and annual hours. Following tradition (e.g., Mincer, 1974) the variable appears in its logarithmic form.[23] The explanatory variables in the hourly-earnings function include years of schooling, years of experience, tenure with the employer and on the job, whether the person belongs to a union, and

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[22] The sample excludes farmers and farm managers and all other self-employed and is restricted to those who were either head of household or head of household's spouse in 1977 and for whom there were data throughout the period 1976-79 (i.e., it excludes people who died or moved to other households during that period). The sample changes somewhat from one test to the next because of missing information.

[23] The data on hourly earnings reported in 1976 refer to 1975. Similar results are obtained when one uses the 1977 wave data (which refer to 1976).

Table 1. The Distribution of Plans to Quit (1976) and Actual Labor Force Exits (1977-79)

(percent)

Actual exits, 1977-79	Plans to quit, 1976					
	Women			Men		
	Yes	No	Total	Yes	No	Total
Yes	6	22	28	2	5	7
No	3	68	72	2	91	93
Total	9	91	100	4	96	100

whether the job is a government (federal, state, or local) job. Marital status, race, and region serve as control variables. In addition to these traditional variables, two new variables were included in the regression: years of training required for the job and on-the-job training. The labor-force-separation and the plans-to-quit functions omit the tenure on the job and required training but incorporate additional demographic variables: presence of children, age of youngest child, children born in the period 1977-79, whether the person married or separated during that period, and whether he moved to a new home. Finally, the labor-force-separation function includes an income variable (family income, excluding the respondent's earnings). The list of variables and their definitions are presented in Table 2.

Comparison of the means of the two samples (Table 3) highlights the major differences between the labor-market attributes of the two sexes. Working women have a somewhat higher level of schooling than their male counterparts, but have significantly less experience (in the labor force, in the firm, and in the job) as a result of having spent more time out of the labor force. There are considerable sex differences in the occupational structure. Men have a greater tendency to belong to a union, and women have a greater tendency to work for the government. A smaller percentage of employed women are married and a higher percentage are non-white. This reflects the lower participation rate of married women and the higher participation rate of non-white women. The percentage of women reporting on-the-job learning that may lead to a better job is only slightly lower than the corresponding percentage of men, but there are substantial differences in job requirements: on the average

Table 2. The Variables

Human capital (years)	
Schooling	SC
Experience, years worked since age 18	EX
Tenure with employer[a/]	TE
Tenure on the job[b/]	TJ
Time out of labor force[c/]	TO
Age	
Occupation (DV)	
Professional, technical, and kindred workers (base group)	OC_1
Managers, officials, proprietors	OC_2
Clerical and sales workers	OC_3
Foreman, craftsmen, firemen, police, transport	OC_4
equipment operators	OC_5
Laborers	
Family variables	
Children (DV = 1 if children present)	CH
Age of younger child, years	CY
New child (DV = 1 if child born 1977-79)	CN
Newly married (DV = 1 if married 1977-79)	MN
Family separations (DV = 1 if respondent separated 1977-79)	FS
Family move (DV = 1 if respondent moved 1977-79)	FM
Family income excluding respondent's earnings ($10,000 units)	FY
Control variables	
Marital status (DV = 1 if respondent married)	MS
Government (federal, state, or local) job (DV)	GV
Union membership (DV)	UM
Health impairment (DV)[d/]	HI
Region (DV = 1 if South)	RG
Race (DV = 1 if black or Spanish-American)	RC

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Table 2 (continued). The variables

Endogenous variables	
log of hourly earnings	LHE
Labor force separation (DV = 1 if respondent left labor force 1977-79)	LSP
Plans to quit (DV = 1 if respondent planned to quit in 1976)	PTQ
On-the-job training (DV = 1 if respondent reports training)[e/]	OJT
Job requirement, years of training required for job[f/]	RQT

a/ Based on the question "How long have you worked for your present employer?"

b/ Based on the question "How long have you had your present position?"

c/ Time out of labor force since age 18 is measured as: age *less* experience *less* post-18 schooling *less* 18.

d/ Based on the question "Do you have a physical or nervous condition that limits the type of work or the amount of work you can do?"

e/ Based on the question "Do you feel you are learning things in your job that could lead to a better job or to a promotion?"

f/ Based on the question "On a job like yours, how long would it take the average new person to become fully trained and qualified?"

Table 3. Sample Means by Sex[a/]

	Women	Men	Difference
Schooling	12.12	11.87	0.25
Experience	12.67	17.63	-4.96
Tenure: with employer	5.08	7.83	-2.75
on the job	3.20	3.80	-0.60
Time out of labor force	5.21	0.63	4.37
Age	36.30	36.51	-0.21
Occupation: 1	0.156	0.138	0.018
2	0.041	0.110	-0.069
3	0.364	0.119	0.245
4	0.169	0.479	-0.310
5	0.270	0.154	0.116
Children	0.558	0.625	-0.067
Age of youngest child	4.14	3.89	0.25
Child born 1977-79	0.187	0.206	-0.019
Married in 1977-79	0.055	0.037	0.018
Family separation	0.057	0.054	0.003
Family move	0.373	0.407	-0.034
Family income	0.916	0.424	0.491
Marital status	0.668	0.868	-0.200
Government job	0.251	0.193	0.058
Union member	0.142	0.300	-0.158
Health impairment	0.066	0.064	0.002
Region	0.424	0.425	-0.001
Race	0.368	0.322	0.046
log hourly earnings	5.7982	6.2059	-0.4077
Labor-force separation	0.283	0.068	0.215
Plans to quit	0.093	0.037	0.056
On-the-job training	0.675	0.741	-0.066
Job requirement	0.745	1.695	-0.950
Sample size	1,936	2,398	

[a/] See Table 2 for detailed definition of variables.

women report that their jobs require only 9 months of training, compared with 20 months for men. Finally, labor-force separations are four times as prevalent among women as among men, and men's hourly earnings exceed women's by one half.

The simple multivariate relationships between hourly earnings, labor-force separations and the set of explanatory variables are described in Table 4. These equations contain hardly any surprises. Schooling and experience are the major determinants of the hourly-earnings profiles. Tenure on the job and with the employer have an effect which by far exceeds the marginal effect of labor-force experience. If the tenure effect reflects the returns to specific training, these results underline the importance of investment in specific human capital in shaping the earnings profile. Career interruptions tend to reduce wages, at least in the case of women (Mincer and Ofek, 1981).[24] Union members receive higher wages than others with the same observed qualifications. A government job is associated with higher pay for women but lower pay for men. Married men are better paid than non-married, but marital status has no effect on women's hourly earnings. Health impairment, being non-white, and living in the south tend to depress wages.

The effect of on-the-job investment on earnings is, in principle, ambiguous. The cost of the investment should lower earnings early in one's career but the returns on it raise earnings later on. Given the average age of workers in the sample (36 years) the second effect predominates, on-the-job training having a positive effect on women's earnings. Job requirements reflect the amount of skill required for the job. This

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[24] Detailed discussion of the differences between the regressions for men and women is deferred to the next section.

Table 4. The Determination of Hourly Earnings and Labor-Force Separations (OLS)

	Women				Men			
	log hourly earnings (LHE)		Labor force separations (LSP)		log hourly earnings (LHE)		Labor force separations (LSP	
	b	t	b	t	b	t	b	t
Cons	4.6541	60.16	0.7303	6.15	4.8936	84.74	0.2984	4.61
SC	0.0685	13.29	0.0011	0.22	0.0601	18.27	0.0009	0.46
EX	0.0163	4.31	-0.0124	3.52	0.0234	7.97	-0.0103	5.71
EX^2	-0.0004	4.16	0.0005	5.32	-0.0004	6.08	0.0004	9.67
TE	0.0348	5.46	-0.0059	1.37	0.0277	6.24	-0.0028	1.37
TE^2	-0.0006	3.25	0.0001	0.86	-0.0005	3.72	0.0002	2.75
TJ	0.0724	4.37			0.0419	3.12		
TJ^2	-0.0094	5.08			0.0048	3.31		
TO	-0.0058	3.86	0.0088	6.00	0.0027	0.55	0.0124	4.55
OJT	0.0653	2.88	-0.0541	2.68	0.0199	0.99	-0.0018	0.16
RQT	0.0359	4.14			0.0460	10.29		
CH			0.0869	2.91			-0.0066	0.45
CY			-0.0135	4.81			-0.0036	2.53
CN			0.3565	13.78			-0.0186	1.45
MN			0.1619	3.66			-0.0281	0.97
FS			0.0898	2.18			-0.0026	0.12
FM			0.0536	2.47			0.0130	1.18
FY			0.0246	1.69			-0.0161	1.57
MS	0.0124	0.54	0.1037	3.84	0.1096	4.28	-0.0086	0.45
GV	0.1056	4.16	-0.0531	2.34	-0.0320	1.48	0.0420	3.47
UM	0.2114	6.81	0.0133	0.47	0.2335	12.08	-0.0107	0.97
HI	-0.1215	2.89	0.0808	2.14	-0.1162	3.33	0.0549	2.81
RG	-0.0470	2.00	-0.0168	0.79	-0.1132	5.92	0.0076	0.71
RC	-0.1040	4.17	-0.0415	1.82	-0.0865	4.12	0.0124	1.06
LHE			-0.0983	4.89			-0.0352	3.15
LSP	-0.1010	4.22			-0.1055	2.89		
R^2		0.33		0.20		0.44		0.17

variable proves to have an important positive effect which is independent of the person's actual experience in the labor force and on the job.

The labor-force separation functions highlight two features: (a) the probability of exit from the labor force declines as experience in the labor force and with the firm increase (the age-separation probability profile is convex); people who have left the labor force once are more likely to do so again,[25] and (b) through their effect on home productivity, demographic variables are important determinants of women's career interruptions, but they hardly affect men.[26] Thus being married, having children (particularly young ones), having a husband with a high income, and changes in family circumstances (getting married, separating, or having more children), all increase women's tendency to leave the labor force.

Finally, the simple OLS equations cannot disentangle the direction of causality: wages have a significant negative effect on separations and future separations have a significant negative effect on wages.

The picture changes dramatically, however, once the two equations

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[25] The convexity of this function is discussed in detail by Mincer and Jovanovic (1979). It may reflect the effect of general and specific human capital or selectivity (people with a lower tendency to separate have more labor-force experience and longer tenure). The positive effect of time out of labor force may also be interpreted as an age effect.

The separation functions (like all other dichotomous functions in this paper) are estimated using linear OLS regression. I have experimented with logit estimates but they did not alter the conclusions.

[26] Other important differences occur in the case of race, non-white women being more attached to the labor force than white women, while the reverse is true of men, and women holding a government job have a smaller tendency to drop out of the labor force while the reverse is again true of men.

are estimated simultaneously (Table 5).[27] A simultaneous-equation system explaining the determination of wages and labor-force separation abounds with difficulties; a major one is the distinction between endogenous and exogenous variables. An economist will be hard put to it to justify the definition of children (and additional children) as exogenous in such a scheme. Similarly, it is not clear how experience and tenure (i.e., past non-separation) should be treated in this context. Nevertheless, at this stage the list of endogenous variables is restricted to two: hourly earnings and labor-force separation.

The simultaneous equations yield seemingly unambiguous conclusions on the direction of causality. Lower wages tend to encourage labor-force separation for both men and women, but separations (or plans to separate) have no effect on wages. Thus the previously observed (Table 4) negative effect of separations on wages is an artifact of the negative effect of wages on separations. The simultaneous equations contain no indication that women who plan to drop out of the labor force have lower wages as a result, thus lending support to the hypothesis that it is employer's expectation and actions which determine women's wages irrespective of women's plans.[28]

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[27] The coefficients in Table 5 and subsequent tables are derived by two-stage least-squares (TSLS).

[28] In an earlier version of this paper separations included also those quitting into unemployment. Expanding this definition of separation does not affect our conclusions with respect to women, but in the case of men it is found that plans to separate reduce wages.

Table 5. The Simultaneous Determination of Hourly Earnings and Labor Force Participation (TSLS)

	Women				Men			
	LHE		LSP		LHE		LSP	
	b	t	b	t	b	t	b	t
Cons	4.6190	54.43	2.4998	3.97	4.9288	62.37	0.5811	2.29
SC	0.0687	13.30	0.0299	2.64	0.0599	17.99	0.0048	1.22
EX	0.0181	4.32	-0.0050	1.08	0.0198	3.22	-0.0088	3.89
EX^2	-0.0004	4.19	0.0003	2.47	-0.0003	1.50	0.0003	7.60
TE	0.0354	5.52	0.0069	1.06	0.0261	5.07	-0.0009	0.36
TE^2	-0.0006	3.29	-0.0001	0.68	-0.0004	2.54	0.0001	1.99
TJ	0.0751	4.47			0.0425	3.13		
TJ^2	-0.0098	5.17			-0.0048	3.25		
TO	-0.0059	3.95	0.0061	3.28	0.0059	0.85	0.0124	4.53
OJT	0.0698	3.01	-0.0251	1.03	0.0198	0.97	0.0008	0.07
RQT	0.0370	4.22			0.0448	9.15		
CH			0.0939	2.87			-0.0071	0.47
CY			-0.0146	4.71			-0.0035	2.48
CN			0.3427	11.97			-0.0202	1.56
MN			0.1766	3.64			-0.0291	1.00
FS			0.1106	2.43			-0.0091	0.41
FM			0.0528	2.23			0.0122	1.10
FY			0.0441	2.56			-0.0141	1.34
MS	0.0035	0.14	0.0897	3.00	0.1022	3.62	-0.0018	0.09
GV	0.1096	4.26	-0.0028	0.09	-0.0212	0.78	0.0398	3.23
UM	0.2117	6.80	0.0990	2.31	0.2276	10.57	0.0018	0.12
HI	-0.1284	3.01	0.0299	0.67	-0.0999	2.32	0.0478	2.32
RG	-0.0465	1.98	-0.0320	1.35	-0.1105	5.59	0.0010	0.08
RC	-0.1023	4.09	-0.0750	2.72	-0.0837	3.86	0.0052	0.39
LHE			-0.0483	3.56			-0.0930	1.81
LSP	-0.0339	0.48			-0.3713	0.92		
R^2		0.33		0.17		0.44		0.17

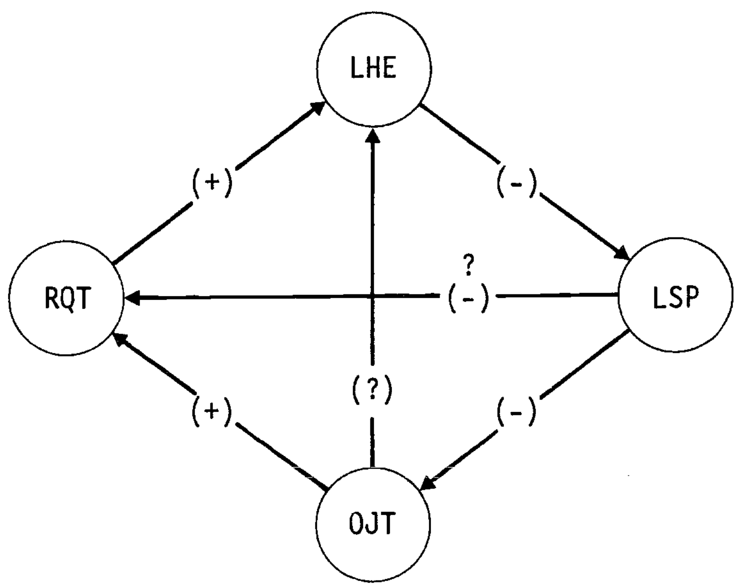
IV. *WAGE RATES, TURNOVER AND ON THE JOB TRAINING--SOME MORE EVIDENCE*

Are the results of the last section as unambiguous as they seem? A reassessment of the procedure used raises some doubts. The doubts concern the validity of the specification and in particular the assumption that on-the-job training (OJT) and job requirements (RQT) are exogenously determined. It is after all inherent in the problem that these variables are determined by the person's participation plans and what the employer conceives the plans to be. A person who expects to drop out of the labor force in the near future will be more reluctant to invest in human capital and choose a job which requires more training. Furthermore, a person who is expected to drop out of the labor force may not get the opportunity to work on a job that requires a high level of training, irrespective of his actual plans. Thus the natural place of these factors is among the endogenous rather than the exogenous variables.

Accordingly, I extended the model to include four endogenous variables: log hourly earnings (LHE), separation from labor force (LSP) (or alternatively, PTQ, plans to quit the labor force), on-the-job training (OJT) and job requirements (RQT). The relationships between them are described schematically in Figure 3. Hourly earnings are assumed to depend only indirectly on labor-force separation. Planned separations are assumed to affect on-the-job training and the kind of job the person chooses (as measured by the job requirements), which in turn affect wages. Job separations depend on the wage rate but not on the opportunities for on-the-job training and not on job requirements.[29] On-the-job training

[29] In theory, a person may be more reluctant to quit his job and the labor force if the job offers opportunities for promotion and greater

Figure 3.



is expected to increase with job requirements and be reduced by plans to quit the labor force. The probability that a person is investing in human capital on the job is expected to decline with age, experience, and tenure with the employer. Schooling is conventionally assumed to facilitate on-the-job training and union membership has been shown (Mincer, 1981) to discourage it.[30] Job requirements (RQT) will be inversely related to labor force quits (LSP) if employees who plan to drop out of the labor force opt for jobs that are less skill (and training) intensive. They may be positively related to the person's readiness to invest in human capital (OJT). The amount of training required for the job naturally depends on the occupation and it is expected that the more educated and the more experienced (in terms of both overall experience and experience with the firm) will land the more skilled jobs. Jobs held by union members may require less training than others.[31]

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responsibility (as measured by OJT and RQT, respectively). This is not, however, supported by the data.

[30] Other exogenous variables appearing in the OJT equation are government job, marital status, and race. Although OJT is a dichotomous variable, the OJT equation employs a linear specification.

[31] Other exogenous variables in the RQT equation are government job, marital status, and race. The variable RQT has been interpreted (Duncan and Hoffman, 1979, p. 596) to mean "the volume of training attached to the current job and acquired on the job." There is, however, nothing in the survey question (see notes to Table 2) to suggest that the training was obtained on the current job, and not in other firms or jobs. By Duncan and Hoffman's definition, the person invests in specific capital whenever RQT exceeds the person's tenure on the job (TJ). Comparing this definition of training with ours (OJT) for white men and women, it can be seen that they differ considerably (the numbers in parentheses are percentages within the OJT group).

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The estimates of the structural equations are presented in Table 6. The hourly-earnings functions (Table 6, Part A) do not differ substantially from those reported in the preceding section (Table 5)--on-the-job training and job requirements have a strong positive effect on wages. Comparing the equations for men and women it is observed that schooling, experience, and tenure each have essentially the same effect on the wages of both sexes, as have on-the-job training and job requirements (the only exception is job tenure, which has a stronger effect in the case of women). The negative effect of career interruptions is more pronounced in the case of women. The wage premium enjoyed by union members is greater in the case of men, and government jobs tend to favor women (in the case of men, such a job is associated with lower wages).[32]

Neither are our earlier conclusions with respect to labor separations affected by the change in the estimation scheme in Table 6, Part B. Comparison of the equations indicates that schooling, labor-force experience, tenure, and wages have the same effect on both sexes, and

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OJT	White women			White men		
	RQT < TJ	RQT > TJ		RQT < TJ	RQT > TJ	
0	(86)	(14)	34	(81)	(19)	26
1	(75)	(25)	66	(61)	(39)	74
	79	21	100	66	34	100

The differences are even larger for non-whites.

[32] Contrary to previous findings, it is found that the wage differential between whites and non-whites is greater for women than for men. This contradiction may be explained by the fact that the regression reported controls for job requirements, in which there are substantial inter-race differences for men, but which are almost the same for women of both race groups.

Table 6. The Simultaneous Determination of Hourly Earnings, Labor Force Separation, On-the-Job Training and Job Requirements.
A. Log Hourly Earnings

	Women		Men		Difference	
	b	t	b	t	b	t
Cons	4.5328	27.95	4.6331	23.22	-0.1003	0.51
SC	0.0262	2.51	0.0320	4.65	-0.0058	0.62
EX	0.0164	3.32	0.0167	3.40	-0.0003	0.05
EX^2	-0.0004	3.38	-0.0002	2.59	-0.0002	1.65
TE	0.0225	2.56	0.0177	2.88	0.0048	0.60
TE^2	-0.0003	1.24	-0.0003	1.80	0.0000	0.05
TJ	0.0943	3.82	0.0460	2.59	0.0483	2.14
TJ^2	-0.0096	3.66	-0.0040	2.10	-0.0056	2.33
TO	-0.0031	1.50	0.0090	1.28	-0.0121	2.10
MS	0.0051	0.17	0.0711	1.97	-0.0660	1.83
GV	0.0365	1.02	-0.0361	1.20	0.0725	2.06
UM	0.2496	6.03	0.3158	10.83	-0.0662	1.76
HI	-0.1076	1.93	-0.0563	1.12	-0.0513	0.91
RG	-0.0763	2.41	-0.1546	5.43	0.0783	2.44
RC	-0.1151	3.30	-0.0151	0.32	-0.1001	2.24
OJT	0.7910	5.04	0.6643	2.52	0.1268	0.53
RQT	0.1929	4.27	0.1488	3.95	0.0441	1.00
R^2		0.23		0.31		

Table 6. The Simultaneous Determination of Hourly Earnings, Labor Force Separation, On-the-Job Training and Job Requirements.
B. Labor Force Separation

	Women		Men		Difference	
	b	t	b	t	b	t
Cons	1.3830	3.99	0.6813	2.80	0.7016	1.62
SC	0.0119	1.64	0.0062	1.62	0.0057	0.74
EX	-0.0093	2.44	-0.0082	3.67	-0.0012	0.27
EX^2	0.0004	4.15	0.0003	7.40	0.0001	0.63
TE	-0.0007	0.14	-0.0003	0.13	-0.0004	0.07
TE^2	0.0000	0.21	0.0001	1.84	-0.0001	0.61
TO	0.0080	5.00	0.0124	4.50	-0.0045	1.10
CH	0.0954	3.15	-0.0068	0.45	0.1021	3.23
CY	-0.0148	5.17	-0.0036	2.48	-0.0112	3.75
CN	0.3542	13.44	-0.0206	1.58	0.3747	13.68
MN	0.1638	3.65	-0.0293	1.00	0.1931	3.60
FS	0.0989	2.36	-0.0114	0.51	0.1103	2.44
FM	0.0514	2.33	0.0121	1.08	0.0394	1.71
FY	0.0327	2.16	-0.0135	1.28	0.0462	2.46
MS	0.0969	3.52	0.0006	0.03	0.0963	2.75
GV	-0.0355	1.43	0.0390	3.16	-0.0745	2.88
UM	0.0495	1.52	0.0059	0.39	0.0436	1.33
HI	0.0572	1.44	0.0451	2.19	0.0122	0.29
RG	-0.0258	1.20	-0.0012	0.10	-0.0247	1.04
RC	-0.0556	2.33	0.0027	0.20	-0.0583	2.22
LHE	-0.2464	3.37	-0.1133	2.31	-0.1331	1.50
R^2		0.19		0.17		

Table 6. The Simultaneous Determination of Hourly Earnings, Labor Force Separation, On-the-Job Training and Job Requirements.
C. On-the-Job Training

	Women		Men		Difference	
	b	t	b	t	b	t
Cons	0.6991	6.64	0.8276	8.52	-0.1285	0.92
SC	0.0108	1.40	0.0035	0.63	0.0073	0.79
EX	-0.0004	0.18	0.0009	0.21	-0.0012	0.27
TE	0.0008	0.29	-0.0022	1.10	0.0030	0.90
TJ	-0.0185	3.41	-0.0095	2.33	-0.0091	1.37
Age	-0.0035	2.46	-0.0081	1.95	0.0046	1.04
MS	-0.0028	0.12	0.0442	1.61	-0.0471	1.31
GV	0.0146	0.53	0.0429	1.84	-0.0283	0.80
UM	-0.0320	1.02	-0.0304	1.25	-0.0017	0.04
RG	0.0362	1.52	0.0532	2.62	-0.0170	0.56
RC	0.0529	2.08	0.0984	3.16	-0.0455	1.15
LSP	-0.1365	2.40	-0.2182	1.49	0.0817	0.52
RQT	0.0486	1.52	0.0749	2.83	-0.0263	0.65
R^2		0.05		0.08		

Table 6. The Simultaneous Determination of Hourly Earnings, Labor Force Separation, On-the-Job Training and Job Requirements.
D. Job Requirements

	Women		Men		Difference	
	b	t	b	t	b	t
Cons	0.3374	0.80	0.6733	0.81	-0.3360	0.38
SC	0.1154	7.67	0.1307	6.74	-0.0152	0.60
EX	0.0143	3.86	0.0341	4.66	-0.0198	2.55
TE	0.0094	1.47	0.0340	5.18	-0.0246	2.45
OC_2	-0.4365	2.72	0.1847	1.08	-0.6212	2.44
OC_3	-0.9770	10.42	-0.9909	5.95	0.0139	0.08
OC_4	-1.0986	7.45	-0.5262	3.25	-0.5724	2.43
OC_5	-1.1351	7.65	-1.0759	4.72	-0.0591	0.22
MS	0.0448	0.71	-0.0175	0.14	0.0623	0.46
GV	0.1728	2.47	-0.0263	0.23	0.1990	1.52
UM	-0.0830	0.99	-0.4059	3.79	0.3229	2.29
RG	-0.0141	0.21	0.1213	1.14	-0.1354	1.10
RC	-0.0321	0.41	-0.7346	6.87	0.7025	5.22
LSP	-0.1318	0.84	-2.0879	3.31	1.9560	3.52
OJT	-0.5340	1.20	-0.5548	0.56	0.0207	0.02
R^2		0.22		0.23		

demographic changes are significantly more important in the case of women.

The linear probability functions of on-the-job investment are (statistically) the same for men and women (Table 6, Part C). The probability is not directly affected by schooling, experience in the labor force, or tenure with the firm, but declines as job tenure and age increase. Being a union member discourages training, and (surprisingly) non-whites report more often than whites that what they learn on the current job may help them gain better jobs in the future. Finally, as expected, the greater the amount of training required on the job, the greater the probability that the person is engaged in investment; and the greater the probability of dropping out of the labor force, the smaller the probability of investment.

The fact that schooling has no direct effect on on-the-job training may at first be surprising, given past studies in the field. The puzzle however, disappears once the fourth equation, job requirements, is incorporated into the analysis (Table 6, Part D). According to this equation, schooling affects on-the-job training through its effect on job requirements. Thus the skill intensity of a job increases both with formal schooling and experience (both in the labor force and with the firm).[33] It is, however, noteworthy that while the effect of schooling on the type of job a person gets is almost the same for men and women, there is a substantial difference in the effect of experience. When it comes to securing a better (i.e., a more skill intensive) job, women's

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[33] Other factors worth noting are: marital status does not seem to affect the type of job a person gets; women may get more challenging jobs in the government sector; jobs held by union members are, in the case of men, less training intensive; non-white men get worse jobs than whites (Duncan and Hoffman, 1979).

years in the labor force and with the firm count as less than one half of the men's. The lower weight given to women's years of experience may be due to an actual tendency for women to invest less on the job (i.e., a year's experience represents a smaller increment to human capital); or to employers' belief in the existence of such a tendency.

Furthermore, though there is no significant difference between the sexes in the job requirement of professional, technical, and kindred workers (the intercept is lower for women, but not significantly so), there is a significant difference in two out of the other four occupational groups. Thus, even if one controls for other observed variables and allows for differential effects, women in managerial occupations and women employed as foremen (forepersons?), craftsmen, police, etc., report fewer months of training required for their jobs than reported by their male counterparts.[34]

Finally, there is a remarkable difference between men and women in the effect of labor-force separations on the type of job a person has (as measured by RQT).[35] While men's plans to quit are associated with lower job requirements, women's plans to quit have no effect on job requirements.

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[34] I am aware that it can be argued that this is essentially a reporting problem. Men, to bolster their self image, tend to overestimate job requirements while women and members of minority groups tend to understate them. There is no way to verify or reject this argument from our data. It is worth noting, however, that in the related issue of on-the-job training, non-whites do not believe themselves to fare worse than whites.

[35] I do not present the estimates of the OJT and RQT equations where LSP is replaced by PTQ. These regressions are virtually identical to the ones reported, indicating that our conclusions concerning the effect of future separations hold also for plans to quit.

Assuming that employers are ignorant of their employees' plans, I interpret this finding to mean that whereas men are free to choose their jobs, and thus choose a job with lower training requirements when they expect to drop out of the labor force, women are forced to take jobs which are less skill intensive regardless of their participation plans. It may be argued that women are forced into these lower skilled jobs by discrimination. It is my belief that it is due to misconceptions of women's market attachment and the difficulty of separating those with low from those with high attachment.

V. EVALUATION

Supporters of the traditional views concerning the sources of wage differentials between men and women may find comfort in the findings of the last section, particularly those concerning the participation of married women. Once again it was demonstrated that women are more sensitive than men to changes in the family environment. Planned changes in their family life, such as additional children, are associated with labor-force quits, which are in turn associated with reduced on-the-job investment. But one can detect an additional undercurrent--women are relegated to low-skill jobs regardless of their labor-force plans, and when it comes to choice (or allocation) of jobs (as measured by RQT), their labor-force experience carries a much lower weight than that of men with the same observable (or, to be more precise, measurable) qualifications.

How important is this second factor in explaining sex-related wage differentials? Can one distribute the blame for the wage differential between the two explanations? These are difficult but important questions, and I shall risk some tentative answers.

In order to isolate the different factors contributing to the wage differentials, the variables appearing in regression (6A) are combined into five groups: the intercept, variables measuring the person's human capital (schooling, experience, tenure with the employer, tenure on the job, time out of labor force), on-the-job training (OJT), job requirements (RQT), and control variables (government job, union membership, health impairment, region, race, and marital status). Furthermore, equation (6A) was re-estimated for both men and women with the coefficients whose sex difference was found to be statistically nonsignificant (e.g., schooling, experience, tenure with employer, health impairment, on-the-job training, and job requirements) constrained to be identical in the regressions for men and women.[36] The new estimates are used to break down the wage differential into the five major components (see panel A of Table 7).

Women earn two thirds of men's hourly earnings. This is consistent with the findings of many other studies in the field. The composition of the differential may, however, come as a surprise to some. Job requirements and on-the-job training (in particular the first) are by far the most important factors explaining the wage gap, accounting for half of it. By comparison, the direct contribution of schooling, labor-force experience, and tenure (holding job requirements constant), is very small (about 4 percent), as is the autonomous factor (measured by the difference in intercepts).[37] The wage differentials can be broken down into the part

[36] The regressions are presented in the appendix. They allow for a different intercept even when the differences in intercepts reported in Tables 6 were not significant.

[37] The 'other' variables account for about one quarter of the wage gap, the major contributors being union membership, race, and marital status.

Table 7. The Decomposition of the Sex Differentials in the Endogenous Variables[a/]

	Total	Explained by difference in means, weighted by		Explained by difference in coefficients, weighted by	
		$\hat{\beta}_f$	$\hat{\beta}_m$	$\bar{x}_f$	$\bar{x}_m$
	(1)	(2)	(3)	(4)	(5)
A. Hourly earnings (LHE)					
Constant	-0.0634 0.94	- 1.00	- 1.00	-0.0634 0.94	-0.0634 0.94
Human capital	-0.0376 0.96	-0.0699 0.93	-0.0200 0.98	-0.0176 0.98	0.0323 1.03
Control	-0.1076 0.90	-0.0479 0.95	-0.0717 0.93	-0.0359 0.97	-0.0597 0.94
OJT	-0.0458 0.96	-0.0458 0.96	-0.0458 0.96	- 1.00	- 1.00
RQT	-0.1636 0.85	-0.1636 0.85	-0.1636 0.85	- 1.00	- 1.00
Total	-0.4179 0.66	-0.3271 0.72	-0.3010 0.74	-0.1169 0.89	-0.0908 0.91
B. Labor force separation (LSP)					
Constant	-0.0352	-	-	-0.0352	-0.0352
Human capital	0.0063	0.0087	0.0181	-0.0118	-0.0024
Family	0.2079	-0.0206	-0.0064	0.2143	0.2285
Control	-0.0426	-0.0095	-0.0027	-0.0399	-0.0331
LHE	0.0780	0.0780	0.0780	-	-
Total	0.2144	0.0566	0.0870	0.1274	0.1578
C. On-the-job training					
Constant	0.0248	-	-	0.0248	0.0248
Human capital	0.0150	0.0199	0.0191	-0.0041	-0.0049
Control	-0.0128	0.0070	0.0089	-0.0217	-0.0198
LSP	-0.0421	-0.0421	-0.0421	-	-
RQT	-0.0515	-0.0515	-0.0515	-	-
Total	-0.0666	-0.0667	-0.0656	-0.0010	0.0001

Table 7 (continued). The Decomposition of the Sex Differentials in the Endogenous Variables

	Total	Explained by difference in means, weighted by		Explained by difference in coefficients weighted by	
		$\hat{\beta}_f$	$\hat{\beta}_m$	$\bar{x}_f$	$\bar{x}_m$
	(1)	(2)	(3)	(4)	(5)
D. Job requirements (RQT)					
Constant	-0.5677	-	-	-0.5677	-0.5677
Human capital	-0.5960	-0.0686	-0.2298	-0.3662	-0.5274
Occupations	-0.3090	-0.0021	-0.2157	-0.0933	-0.3069
Control	0.3792	0.0120	0.0353	0.3439	0.3672
LSP	0.1081	-0.0253	-0.4492	0.5573	0.1334
OJT	0.0352	0.0352	0.0352	-	-
Total	-0.9502	-0.0488	-0.8242	-0.1260	-0.9014

a/ Columns (1) through (5) are respectively calculated from the columns of Table A2 as follows: (1) - (3); (1) - (2); (4) - (3); (1) - (4); (2) - (3). Small numerals in panel A are the antilogs of the difference of the logarithms.

which is 'explained' by the difference in the means of the two sexes, and the 'unexplained' part (the part due to differences in regression coefficients).[38] Three quarters of the hourly-earnings differential is explained by the difference in the observed characteristics of men and women (and their jobs), and only about one quarter cannot be explained. Again, job requirements ranks high among the explanatory variables (contributing two thirds of the explanation) and overshadow the direct effect of differences in experience and tenure.

By our assumptions, labor-force turnover does not affect wages directly, but does so indirectly through its effect on training (OJT) and job requirements (RQT). On the other hand, lower wages have been shown to lead to increased turnover. To disentangle cause and effect one should separate the causes of labor force separation.

The difference between the 3-year separation rates of men and women is 21 percentage points. Decomposing this difference by a method similar to the one described above (panel B, Table 7)[39] indicates that demographic

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[38] Following standard procedures, if $\bar{Y}_j = \Sigma\hat{\beta}_{ji}\bar{X}_{ji}$ for group j,

$$\bar{Y}_f - \bar{Y}_m = \sum_i\hat{\beta}_{fi}(\bar{X}_{fi} - \bar{X}_{mi}) + \Sigma(\hat{\beta}_{fi} - \hat{\beta}_{mi})\bar{X}_{mi}$$
$$= \sum_i\hat{\beta}_{mi}(\bar{X}_{fi} - \bar{X}_{mi}) + \Sigma(\hat{\beta}_{fi} - \hat{\beta}_{mi})\bar{X}_{fi},$$

where $\bar{Y}$ denotes mean of log hourly earnings, $\bar{X}_i$ the mean of explanatory variable i, $\hat{\beta}_i$, the estimated regression coefficients, and m and f denote male and female, respectively. The first and second terms on the RHS are respectively the explained and unexplained part of the wage differential.

[39] The explanatory variables included in regression (6B) were combined into five groups: the intercept, the human capital variables, family variables (MS, CH, CY, CN, FS, MN, FM, FY), hourly earnings (LHE), and the rest. Note that marital status is here included in family variables (not, as elsewhere, as a control variable).

changes (e.g., children, marriage, divorce, migration) are the major contributor to this difference. In the absence of this factor, labor-force turnover would have been about the same for both sexes. The wage differential stands second in the order of importance. However, closing the wage gap, other things being the equal, would not have eliminated the difference in turnover rates (though it would have cut it by about one third). The difference in wages is a major source of the 'explained' difference, while sex differences in responsiveness to demographic factors are the most important contributor to the unexplained part.

The difference between the percentage of men and women reporting on-the-job learning which would be helpful in gaining a better (or a better-paid) job is surprisingly small (74 versus 67 percent, respectively). Almost the whole of this difference is explained by differences in the observed characteristics, the difference in turnover and job requirements being the most important.

Finally, the skill intensity of the job (as measured by RQT) has throughout this paper been shown to be crucial in explaining the sex differential in training and wages (and indirectly, through the latter, in turnover). How helpful are the regressions in explaining the huge gap in job requirements? The answers they provide are at once puzzling and illuminating. Men's jobs require training that exceeds that of women's by almost a whole year (20 and 8.9 months of training, respectively). Standardizing for racial composition, marital status, union membership and the 'other' variables (government job, region) increases the difference to 16 months, almost one half of which is explained by the autonomous factor (i.e., the intercept).[40] The other half is traced to differences

[40] The result stands in contrast to the results reported in Table 6, part D, where the sex difference in intercepts is found to be nonsignificant.

in experience (in the labor force and with the employer) and to the occupational structure of the two sexes. Surprisingly, the difference in turnover tends to moderate the difference in training requirements.

How much of these differences are explained by differences in the observed characteristics? The answers to this question differ widely according as one adopts a 'masculine' or a 'feminine' point of view. Judging from men's experience (i.e., when the men's coefficients of labor-force experience, turnover, and occupational composition are applied in the standardization procedure), close to 90 percent of the difference in RQT is explained by the difference in observed characteristics. In that case, changing the participation behavior (labor-force separation, experience, and tenure with the employer) and the occupational structure of women to make them similar to men would eliminate the differential almost entirely (it would reduce the difference in job requirements to less than one month). On the other hand, judging from women's experience (i.e., if we weight the difference in characteristics by the regression coefficients derived from the women's sample), such a change would have only a small effect. Specifically, if women's quits were reduced to the level of men's, the quality of their jobs (as measured by RQT) would go up by only 3 percent (the RQT differential would decline by 2 percent). Equalization of labor-force experience and tenure would have increased RQT by another 14 percent, and adoption of the men's occupational structure would yield less than 1 percent.[41] All in all (using this scheme)

[41] The last statement is, of course, true only if confined to the broad occupational definitions used in this study; it may prove to be wrong if one uses a more detailed definition. Put differently: given our definition, although occupational structure is important in explaining the wage distribution (through the effect of RQT on hourly earnings)

differences in observed characteristics explain about 5 percent of the difference in RQT.

When the control variables (GV, UM, HI, RG, RC, and MS) are controlled for, women's hourly earnings are about three quarters of the men's. If women had reacted to demographic changes in a fashion similar to men there would have been no sex difference in labor-force quit rates. In consequence women would invest more on the job and would obtain better jobs. These changes would in turn raise women's wages (and result in a further decline in quit rates). Going by men's experience (i.e., given the effect of labor-force separation on RQT from the men's regression) this first-round effect would close over 40 percent of the wage gap (i.e., reduce it from 27 to 16 percent of men's wages). On the other hand, given women's experience the wage gap would decline by only about 10 percent (from 27 to 24 percent).

VI. SUMMARY AND CONCLUSIONS

In this paper I have tried to formalize an alternative to the traditional hypothesis concerning the wage differential between men and women. Admittedly, there is little new in the general concept. The notion that women suffer from 'statistical discrimination' has been with us now for more than a decade (Arrow, 1973, Phelps, 1972). What is new, on the theoretical side, is the attempt to show, within the framework of the theory of human capital, how employers' misconceptions (the statistical discrimination) translate into flatter wage profiles for women. I also try to explain why there are no self-correcting mechanisms (or if they do

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there remain substantial intra-occupational differences between men and women.

exist, why they operate very slowly) to reveal his mistake to the employer. In the absence of such mechanisms, women may be confronted by a vicious circle of self-confirming expectations, expectations of increased job mobility resulting in increased job mobility.

On the empirical level, I have shown that women's labor force participation decision is definitely more sensitive to demographic changes than men's. On the other hand, this difference goes only part of the way in explaining the wage differential between the sexes. The amount of training required for the job is an intervening factor crucial for explaining the wage gap. The fact that employers give different weight to the observed characteristics of men and women when making job offers seems to be an essential ingredient of the situation.

To the best of my knowledge, this is the first attempt to separate cause and effect in the hourly-earnings and labor-career-interruption functions. Naturally, it suffers from many shortcomings. In a simultaneous-equation scheme such as the one presented, it is hard to justify the choice of labor-force experience, tenure, and occupational choice as exogenous variables. Similarly, it can be argued that family stability and fertility behavior are affected by the labor-force-participation decision as well as affecting it.

I have focused on hourly earnings and the participation decision at the expense of other dimensions of the phenomenon. I have emphasized participation, ignoring other aspects of the work decision (e.g., the number of hours worked) which may serve as an indicator of the woman's involvement with the market. In the empirical sections I discuss labor force turnover, although in principle the variable one should discuss is job turnover. The wage variable used in the statistical analysis is the level of hourly earnings. The panel data, however, allow us to examine the effect of turnover on temporal changes in wages. Finally, as mentioned, the crucial variable in my analysis, job requirements (RQT), has elsewhere been interpreted as "the volume of training attached to the current job and acquired on the job" (Duncan and Hoffman, 1979). In my interpretation the required training need not necessarily be obtained on the current job (see also note 31).

On a more fundamental level it may be argued that women's labor-force experience and tenure count for less than men's in the determination of RQT because women invest less on the job, so that a year of experience represents a smaller stock of human capital. This argument is refuted by the wage function which indicates that once one controls for the quality of the job, experience and tenure have the same effect for both sexes. It may of course be argued that the training received by women differs from what men receive because they occupy different jobs, but this argument would only establish the existence of the vicious circle.

The final question is, naturally, is there a way of escape? There is no clearcut answer. To judge from on-the-job training the differences between men and women are relatively small, indicating that the the gap in training and wages is closing on its own. The conclusions derived from the simultaneous-equation system are much more pessimistic. What is required is a structural change which will open to women the opportunities enjoyed by men. Allowing women into jobs requiring the same degree of skill may give rise to a chain of events that will narrow (though perhaps not eliminate) the difference in turnover. In the short run, closing the wage gap should, according to our estimates, cut the women's labor-force separations by more than one quarter. In the long run, it may affect the structural equation, reducing women's sensitivity to demographic changes and reducing their turnover even further.

If the structural change in the jobs open to women does not take place one can expect economists to continue to argue from their own experience: the men, that if women only invested more in their careers the wage gap would disappear, and the women, that this would make no difference.

MATHEMATICAL APPENDIX

The gains from continuing the association between employer and employee in the post-investment period are

$$\text{(A1)} \qquad G = (1 - F)(1 - Q)[(M - R) + E(\eta|\eta > W - M) + E(\theta|\theta > R - W)],$$

where

$$\text{(A2)} \qquad \begin{aligned} F(W - M) &= \text{prob}(\eta < W - M) = \int_{-\infty}^{W-M} f(\eta)d\eta \\ Q(R - W) &= \text{prob}(\theta < R - W) = \int_{-\infty}^{R-W} q(\theta)d\theta \end{aligned}$$

are the probabilities of firing and quitting, respectively. Denoting the expected residuals by

$$\text{(A3)} \qquad \begin{aligned} \mu_\eta(W - M) &= E[\eta|\eta > (W - M)] - (W - M) \\ &= [1 - F(W-M)]^{-1} \int_{W-M}^{-\infty} [1 - F(\eta)]d\eta \\ \mu_\theta(R - W) &= E[\theta|\theta > (R - W)] - (R - W) \\ &= [1 - Q(R-W)]^{-1} \int_{R-W}^{-\infty} [1 - Q(\theta)]d\theta \ , \end{aligned}$$

equation (A1) can be rewritten as

$$\text{(A4)} \qquad \begin{aligned} G = {} & (1 - F)(1 - Q)\{[M - W + E(\eta|\eta > W - M)] + \\ & \qquad + [W - R + E(\theta|\theta > R - W)]\} \\ = {} & (1 - F)(1 - Q)[\mu_\eta(W - M) + \mu_\theta(R - W)] \ . \end{aligned}$$

Maximizing G with respect to W,

(A5) $$\frac{\partial G}{\partial W} = q(1 - F)\mu_\eta(W - M) - f(1 - Q)\mu_\theta(R - W) ,$$

where f and F are evaluated at the point (W - M) and q and Q at (R - W).[42] Denoting the hazard rate by $\lambda_z(Z) = f(Z)/[1 - F(Z)]$, equation (A5) can be rewritten as

(A6) $$\frac{\partial G}{\partial W} = qf\left(\frac{\mu_\eta(W - M)}{\lambda_\eta(W - M)} - \frac{\mu_\theta(R - W)}{\lambda_\theta(R - W)}\right)$$

$$= (1 - F)(1 - Q)[\lambda_\theta(R - W)\mu_\eta(W - M) - \lambda_\eta(W - M)\mu_\theta(R - W)];$$

setting this expression to equal zero, one derives the necessary condition for the optimum wage given by (4) in the text.

The sufficient condition for a maximum is[43]

(A7) $$\frac{\partial^2 G}{\partial W^2} = -fq\left[\frac{\mu_\eta}{\lambda_\eta}\left(\frac{\partial \log f}{\partial(W - M)} + \frac{1}{\mu_\eta}\right) + \frac{\mu_\theta}{\lambda_\theta}\left(\frac{\partial \log q}{\partial(R - W)} + \frac{1}{\mu_\theta}\right)\right] < 0 ,$$

since

$$\frac{\partial \lambda_z(Z)}{\partial Z} = \lambda_z(Z)\left[\frac{\partial \log f(z)}{\partial Z} + \lambda_z(Z)\right]$$

(A8) $$\frac{\partial \mu_z(Z)}{\partial Z} = \lambda_z(Z)\mu_z(Z) - 1$$

$$\frac{\partial(\mu/\lambda)}{\partial Z} = -\frac{\mu_z(Z)}{\lambda_z(Z)}\left[\frac{\partial \log f(Z)}{\partial Z} + \frac{1}{\mu_z(Z)}\right]$$

The bracketed terms in (A7) are positive when f and q increase with (W- M) and (R - W), respectively (i.e., $f' > 0$ and $q' > 0$).

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[42] To obtain (A5), recall that $\partial[1 - F(Z)]\mu_z(Z)/\partial Z = -[1 - F(Z)]$, by (A3).

[43] μ_η, λ_η, and f are evaluated at (W - M); μ_θ, λ_θ, and q, at (R - W).

However, one of the two terms may be negative without impairing the validity of the second-order condition.[44] The conclusions of Section I, however, only hold when both terms are positive.

To derive the effect of an increase in productivity, M, one has to compute

$$\text{(A9)} \qquad \frac{\partial^2 G}{\partial W \partial M} = fq\frac{\mu_\eta}{\lambda_\eta}\left[\frac{\partial \log f}{\partial (W - M)} + \frac{1}{\mu_\eta}\right] .$$

The wage increases with productivity,

$$\partial W/\partial M = -(\partial^2 G/\partial W \partial M)/(\partial^2 G/\partial W^2) > 0$$

whenever (A9) is positive. Similarly, an increase in the reservation wage, R, increases the wage rate when

$$\text{(A10)} \qquad \frac{\partial^2 G}{\partial W \partial R} = \frac{\mu_\theta}{\lambda_\theta}\left[\frac{\partial \log q}{\partial (R - W)} + \frac{1}{\mu_\theta}\right]$$

is positive. If both (A9) and (A10) are positive, it can easily be shown that $1 > \partial W/\partial M > 0$ and $1 > \partial W/\partial R > 0$, and hence $(W - M)$ and $(R - W)$ decline as M increases and as R decreases. Consequently, an increase in productivity reduces the probability of firing, F, and the probability of quits, Q, while an increase in the reservation wage increases them.

Example: Let η and θ have a normal distribution, $z \sim N(0, \sigma_z^2)$, then

$$\text{(A11)} \qquad \begin{aligned} \mu_z(Z) &= \lambda_z(Z)\sigma_z^2 - Z \\ \mu_z(Z)/\lambda_z(Z) &= \sigma_z^2 - [Z/\lambda_z(Z)] = \sigma_z^2[1 - X/\lambda_x(X)] , \end{aligned}$$

where $x = z/\sigma$ is the standardized normal variable $(X = Z/\sigma)$. Hence

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[44] In the case of the exponential distribution, $\mu/\lambda = \lambda^{-2}$ and $\partial^2 G/\partial W^2 = 0$.

$$\text{(A12)} \qquad \frac{\partial}{\partial Z}\frac{\mu_z(Z)}{\lambda_z(Z)} = -\frac{\sigma}{\lambda_x(X)}[1 + X^2 - X\lambda_x(X)] < 0 \ ,$$

since the expression in brackets is positive Johnson and Kotz, 1969, p. 279).

The optimum wage satisfies $\partial G/\partial W = 0$, i.e.,

$$\text{(A13)} \qquad \sigma_\eta^2\left[1 - \frac{X}{\lambda_x(X)}\right] = \sigma_\theta^2\left[1 - \frac{Y}{\lambda_y(Y)}\right] \ ,$$

where $x = \eta/\sigma_\eta$ and $y = \theta/\sigma_\theta$ are standardized normal variables, and $X = (W - M)/\sigma_\eta$ and $Y = (R - W)/\sigma_\theta$. Using our previous results,

$$\text{(A14)} \qquad \frac{\partial W}{\partial M} = \frac{\partial^2 G}{\partial W \partial M} \div \frac{\partial^2 G}{\partial W^2} = \frac{\frac{\sigma_\eta}{\lambda_x(X)}[1 + X^2 - X\lambda_x(X)]}{\frac{\sigma_\eta}{\lambda_x(X)}[1 + X^2 - X\lambda_x(X)] + \frac{\sigma_\theta}{\lambda_y(Y)}[1 + Y^2 - Y\lambda_y(Y)]} \ ,$$

and it is easy to show that $1 > \partial W/\partial M > 0$.

Turning now to the separate maximization of employer gains, G_e, and employee gains, G_w, we get

$$\text{(A15)} \qquad \begin{aligned} G_e &= (1 - F)(1 - Q)\mu_\eta(W_e - M) \\ G_w &= R + (1 - F)(1 - Q)\mu_\theta(R - W_w) \ . \end{aligned}$$

Maximizing G_e and G_w with respect to W_e and W_w, respectively, yields the necessary conditions

$$\text{(A16)} \qquad \begin{aligned} \frac{\partial G_e}{\partial W_e} &= -(1 - F)(1 - Q)[1 - \lambda_\theta(R - W_e)\mu_\eta(W_e - M)] = 0 \\ \frac{\partial G_e}{\partial W_w} &= (1 - F)(1 - Q)[1 - \lambda_\eta(W_w - M)\mu_\theta(R - W_W)] = 0 \ . \end{aligned}$$

The second-order conditions are

(A17)
$$\frac{\partial^2 G_e}{\partial W_e^2} = -(1 - F)(1 - Q)\left(\frac{\mu_\eta \partial(\log q)}{\partial(R - W)} + 1 - \lambda_\eta + \lambda_\theta\right) < 0$$
$$\frac{\partial^2 G_w}{\partial W_w^2} = -(1 - F)(1 - Q)\left(\frac{\mu_\eta \partial \log f}{\partial(W - M)} + 1 - \lambda_\theta + \lambda_\eta\right) < 0 \; .$$

Example: Let η and θ have a uniform distribution,

(A18)
$$f(\eta) = 1/t \qquad -\tfrac{1}{2}t < \eta < \tfrac{1}{2}t$$
$$q(\theta) = 1/s \qquad -\tfrac{1}{2}s < \theta < \tfrac{1}{2}s .$$

Hence

(A19)
$$F(W - M) = \tfrac{1}{2} + \frac{W - M}{t}$$
$$Q(R - W) = \tfrac{1}{2} + \frac{R - W}{s}$$

and

(A20)
$$\lambda_\eta(W - M) = f/(1 - F) = 1/[\tfrac{1}{2}t - (W - M)]$$
$$\lambda_\theta(R - W) = q/(1 - Q) = 1/[\tfrac{1}{2}s - (R - W)] \; .$$

The expected residuals are

(A21)
$$\mu_\eta(W - M) = \tfrac{1}{2}[\tfrac{1}{2}t - (W - M)] = 1/2\lambda_\eta$$
$$\mu_\theta(R - W) = \tfrac{1}{2}[\tfrac{1}{2}s - (R - W)] = 1/2\lambda_\theta$$

Inserting (A20) and (A21) in (A16) and solving yields

(A22)
$$W_e = [\tfrac{1}{2}(t - 2s) + (M + 2R)]/3$$
$$W_w = [\tfrac{1}{2}(2t - s) + (2M + R)]/3 \; ,$$

and solving for the joint optimum, (A6), we get

(A23)
$$W = [\tfrac{1}{2}(t - s) + (M + R)]/2 \; .$$

When the random components η and θ have the same dispersion, the employer and the employee share equally in the returns to the joint investment $[(W = R + \frac{1}{2}(M - R)]$. Since in this case the gains $[\mu_\eta(W - M) + \mu_\theta(R - W)]$ are constant and independent of the wage rate, the way to maximize the expected joint gains G is to minimize separation rates (i.e., maximize $(1 - F)(1 - Q)]$. Hence, when, for example, the variance of η increases (i.e., t increases), the increase in the risk of being fired due to a marginal change in wages (λ_η) declines. Consequently, the optimum wage will be higher. Similarly, an increase in the variance of θ (i.e., an increase in s) results in quit rates being less sensitive to changes in the wage and reduce the employee's share in total returns (i.e., reduce W).

The gains to each side $(\mu_\eta$ and $\mu_\theta)$ are naturally not constant and depend on W. The turnover rate is only one of the factors affecting the decision of the maximizing individual (or firm). Not surprisingly, the individual optimum (A22) differs from the joint optimum (A23). It can easily be shown that the wage desired by the employee exceeds the joint optimum, which in turn exceeds the wage desired by the employer $(W_w > W > W_e)$, where

(A24) $$W_w - W = W - W_e = [\tfrac{1}{2}(t + s) + (M - R)]/6 > 0 .$$

Table A1. The Simultaneous Determination of Hourly Earnings, Labor Force Separation,

	LHE				LSP			
	Males		M-F difference		Males		M-F difference	
	b	t	b	t	b	t	b	t
Constant	4.6417	59.41	-0.0634	1.39	1.1035	5.28	-0.0352	0.99
SC	0.0289	6.82	-	-	0.0102	2.85	-	-
EX	0.0137	5.64	-	-	-0.0080	3.94	-	-
EX^2	-0.0002	4.39	-	-	0.0003	7.66	-	-
TE	0.0201	5.26	-	-	0.0000	0.00	-	-
TE^2	-0.0004	3.30	-	-	0.0001	1.47	-	-
TJ	0.0439	3.17	0.0524	2.61				
TJ^2	-0.0035	2.35	-0.0068	2.96				
AGE								
TO	0.0092	1.78	-0.0122	2.32	0.0123	3.22	-0.0037	0.95
OC_2								
OC_3								
OC_4								
OC_5								
CH					-0.0063	0.31	0.1071	3.54
CY					-0.0028	1.43	-0.0122	4.21
CN					-0.0264	1.49	0.3863	14.64
MN					-0.0307	0.76	0.1921	3.59
FS					-0.0225	0.74	0.1183	2.63
FM					0.0058	0.39	0.0532	2.44
FY					-0.0079	0.54	0.0343	1.89
MS	0.0736	2.72	-0.0538	1.54	0.0104	0.38	0.0922	2.66
GV	-0.0333	1.46	0.0874	2.66	0.0385	2.27	-0.0847	3.38
UM	0.3256	15.07	-0.0748	2.09	0.0265	1.73	-	-
HI	-0.0817	2.97	-	-	0.0491	2.34	-	-
RG	-0.1553	7.57	0.0807	2.75	-0.0120	0.78	-0.0121	0.55
RC	0.0087	0.31	-0.1291	3.87	-0.0109	0.65	-0.0357	1.52
LHE					-0.1915	4.62	-	-
LSP								
OJT	0.6857	7.33	-	-				
RQT	0.1722	9.23	-	-				
R^2		0.47				0.25		

On-the-Job Training, and Job Requirements--Males and Females (Constrained Equations)

OJT				RQT			
Males		M-F difference		Males		M-F difference	
b	t	b	t	b	t	b	t
0.7432	13.31	0.0248	0.80	0.7421	1.68	-0.5677	2.90
0.0079	1.92	-	-	0.1251	10.30	-	-
-0.0013	0.87	-	-	0.0339	6.92	-0.0191	3.05
-0.0010	0.67	-	-	0.0340	6.54	-0.0245	2.57
-0.0120	3.18	-0.0013	0.26				
-0.0042	3.35	-	-				
				0.1781	1.32	-0.625	2.48
				-1.0015	7.48	0.0496	0.29
				-0.5447	4.53	-0.5145	2.81
				-1.0965	6.89	0.0007	0.00
0.0154	0.90	-	-	-0.0197	0.19	0.0639	0.48
0.0228	1.38	-	-	-0.0234	0.27	0.1915	1.51
-0.0364	2.07	-	-	-0.4050	4.99	0.3243	2.38
0.0574	2.87	-0.0266	0.91	0.1154	1.47	-0.1248	1.14
0.0781	2.98	-0.0264	0.79	-0.7414	9.01	0.7142	5.95
-0.1961	4.19	-	-	-2.0903	4.42	1.9727	3.88
				-0.5268	1.10	-	-
0.0542	3.22	-	-				
	0.08				0.20		

Table A2. The Decomposition of the Endogenous Variables

	Women		Men	
	$\Sigma\hat{\beta}_f\bar{X}_f$ (1)	$\Sigma\hat{\beta}_f\bar{X}_m$ (2)	$\Sigma\hat{\beta}_m\bar{X}_m$ (3)	$\Sigma\hat{\beta}_m\bar{X}_f$ (4)
A. Hourly earnings (LHE)				
Constant	4.5783	4.5783	4.6417	4.6417
Human capital	0.6580	0.7279	0.6956	0.6756
Control	-0.0207	0.0272	0.0869	0.0152
OJT	0.4629	0.5087	0.5087	0.4629
RQT	0.1283	0.2919	0.2919	0.1283
Total	5.8068	6.1339	6.2247	5.9237
B. Labor force separation (LSP)				
Constant	1.0683	1.0683	1.1035	1.1035
Human capital	0.1632	0.1545	0.1569	0.1750
Family	-0.0326	-0.0231	0.0100	0.0073
Control	0.1937	0.2143	-0.0142	-0.0206
LHE	-1.1102	-1.1882	-1.1882	-1.1102
Total	0.2824	0.2258	0.0680	0.1550
C. On-the-job training (OJT)				
Constant	0.7680	0.7680	0.7432	0.7432
Human capital	-0.1216	-0.1415	-0.1366	-0.1175
Control	0.0437	0.0367	0.0565	0.0654
LSP	-0.0554	-0.0133	-0.0133	-0.0554
RQT	0.0404	0.0919	0.0919	0.0404
Total	0.6751	0.7418	0.7417	0.6761
D. Job requirements (RQT)				
Constant	0.1744	0.1744	0.7421	0.7421
Human capital	1.7521	1.8207	2.3481	2.1183
Occupations	-0.8389	-0.8368	-0.5249	-0.7456
Control	0.0460	0.0340	-0.3332	-0.2979
LSP	-0.0332	-0.0079	-0.1413	-0.5905
OJT	-0.3556	-0.3908	-0.3908	-0.3556
Total	0.7448	0.7936	1.6950	0.8708

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