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ABSTRACT

Glass Ceilings or Sticky Floors?*

According to surprising raw data from the British Household Panel Survey, full-time women are more likely than men to be promoted. Controlling for observed and unobserved individual heterogeneity, we find that women are promoted at roughly the same rate as men, but receive smaller wage increases consequent upon promotion. These facts contradict the conventional view that 'glass ceilings' limit the promotion of women. They are consistent with our new 'sticky floors' model of discrimination where women are just as likely as men to be promoted, but find themselves stuck at the bottom of the wage scale for the new grade.

JEL Classification: J3, J16, J41, J44
Keywords: promotion, gender gaps, glass ceilings

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Submitted 20 July 1998

NON-TECHNICAL SUMMARY

It is well established that women fare badly in the labour market relative to men. But how does the status of women change over the course of their careers? Do 'glass ceilings' exacerbate the male-female wage differential, or are women able to take advantage of promotions to catch up partially to male wage rates?

The conventional view is that women are less likely to be promoted than men. This can be explained by a 'glass ceilings' story, whereby women are blocked from progression up the career ladder by an invisible barrier caused by covert discrimination in promotion procedures. Alternatively, following the argument in Lazear and Rosen (1990), women might have lower promotion rates even in the absence of discrimination. If women have better non-market opportunities than men, it is inefficient for them to make the investment in specific human capital that is required for promotion.

Surprisingly, recent evidence from the British Household Panel Survey (BHPS) contradicts the popular view that women are promoted less than men. Over 1991–5, full-time male workers had only a 9.2% chance of receiving a promotion each year compared to 11.6% for full-time female workers. This result is different from recent UK firm-level empirical studies (Audas et al. (1997) and Jones and Makepeace (1996)), although it is not inconsistent with the findings in McCue (1996) based upon US representative survey data. McCue has examined the Michigan Panel Study on Income Dynamics and finds that single white women do not have a significantly different hazard rate for promotion than white men, although married women do have a lower hazard rate.

The BHPS data also show that promoted men received wages 20.4% higher than unpromoted men, while promoted women gained wages only 9.8% higher than unpromoted women. Neither the glass ceilings nor the Lazear and Rosen approach has a ready explanation for why women should not gain the same wage increases as men consequent upon promotion. Indeed, in the Lazear and Rosen model, the average promoted woman is of higher ability than the average promoted man. If workers are paid their marginal products, then the average wage of promoted women exceeds that of promoted men.

In this paper, we present a new 'sticky floors' model of discrimination that is consistent with both of the stylized facts from the BHPS data. We assume that workers can put in additional effort to acquire specific human capital. To

induce workers to invest in training, the firm contractually commits to a promotion rule and to a minimum post-promotion wage rate. If a promoted worker has a higher outside offer, the firm can match that offer. We assume that there is discrimination in the sense that women in the post-promotion job are treated as being less productive than men even though, objectively, their productivity is exactly the same. The guaranteed wage increase on promotion provides a comparable incentive to both women and men to train, and therefore there are comparable promotion rates. Since the firm does not put the same value on women as men in the post-promotion job, however, it is less likely to match outside wage offers. As a result promoted women receive lower wage increases over time than men. We use the term 'sticky floors' to describe the situation where women are promoted and receive a one-off wage increase, but then find it hard to rise in the wage scales after promotion.

We use our theoretical model to inform the empirical analysis of the data. Using appropriate controls, and correcting for unobserved heterogeneity and for endogeneity of promotions, we reach some conclusions about the relationship between promotions, wage rises and gender. These results weaken the raw data calculation that women are more likely to be promoted than men. After allowing for individual specific variables, it is still the case that women are significantly more likely than men to be promoted. Introducing occupation into the analysis leads to an insignificant difference between men and women, however. The empirical results provide considerable support for the claim that women gain lower wage increases from promotion. We therefore conclude that the British data are consistent with our new sticky floors model of discrimination.

This conclusion has important policy implications. In our model, a discriminating firm has the same promotion rates for men and women, and the same contractual wages are offered. The firm can point to clearly distinguishing features – the outside offers – in explaining why a particular woman of a given grade is paid less than a man of the same grade, or why the average wage of women in a grade is less than the average wage of men of the same grade. Nonetheless, the driving force behind these apparently subtle manifestations of discrimination is a very clear prejudice leading women to be incorrectly perceived as having lower productivity in promoted jobs.

1. Introduction

It is well established that women fare badly in the labour market relative to men. But how does the status of women change over the course of their careers? Do 'glass ceilings' exacerbate the male-female wage differential, or are women able to take advantage of promotions to catch up partially to male wage rates?

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Surprisingly, recent evidence from the British Household Panel Survey (BHPS) contradicts the stylised fact that women are promoted less than men. Over 1991-1995, male workers had only a 9.2% chance of receiving a promotion each year compared to 11.6% for female workers. This result is different from recent UK firm-level empirical studies [Audas et al. (1997) and Jones and Makepeace (1996)], although it is not inconsistent with the findings in McCue (1996) based upon US representative survey data. McCue has examined the Michigan Panel Study on Income Dynamics and finds that single white women do not have a significantly different hazard rate for promotion than white men, although married women do have a lower hazard rate.

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unpromoted men, while promoted women gained wages only 9.8% higher than unpromoted women. Neither the glass ceilings nor the Lazear and Rosen approach has a ready explanation for why women should not gain the same wage increases as men consequent upon promotion. Indeed, in the Lazear and Rosen model, the average promoted woman is of higher ability than the average promoted man. If workers are paid their marginal products, then the average wage of promoted women exceeds that of promoted men.

In this paper, we present a new 'sticky floors' model of discrimination that is consistent with both of the stylised facts from the BHPS data. We assume that workers can put in additional effort to acquire specific human capital. To induce workers to invest in training, the firm contractually commits to a promotion rule and to a minimum post-promotion wage rate. If a promoted worker has a higher outside offer, the firm can match that offer.[1] We assume that there is discrimination in the sense that women in the post-promotion job are treated as being less productive than men even though, objectively, their productivity is exactly the same. The guaranteed wage increase on promotion provides a comparable incentive to both women and men to train, and therefore there are comparable promotion rates. However, since the firm does not put the same value on women as men in the post-promotion job, it is less likely to match outside wage offers. As a result promoted women receive lower wage increases over time than men. We use the term 'sticky floors' to describe the situation where women are promoted and receive a one-off wage increase, but then find it hard to rise in the wage scales after promotion.

We use our theoretical model to inform the empirical analysis of the data. Using appropriate controls, and correcting for unobserved heterogeneity and for endogeneity of

[1] The importance of outside offers in understanding promotion is emphasised by Bernhardt and Scoones (1993).

promotions, we reach some conclusions about the relationship between promotions, wage rises and gender. These results weaken the raw data calculation that women are more likely to be promoted than men. After allowing for individual specific variables, it is still the case that women are significantly more likely than men to be promoted. However introducing occupation into the analysis leads to an insignificant difference between men and women. The empirical results provide considerable support for the claim that women gain lower wage increases from promotion. We therefore conclude that the British data are consistent with our new sticky floors model of discrimination.

This conclusion has important policy implications. In our model, a discriminating firm has the same promotion rates for men and women, and the same contractual wages are offered. The firm can point to clearly distinguishing features - the outside offers - in explaining why a particular woman of a given grade is paid less than a man of the same grade, or why the average wage of women in a grade is less than the average wage of men of the same grade. Nonetheless, the driving force behind these apparently subtle manifestations of discrimination is a very clear prejudice leading women to be incorrectly perceived as having lower productivity in promoted jobs.

2. The Model

We develop a three period model of specific human capital and promotion. The economy has a large spot labour market. Workers can leave this market to join a 'career' firm offering specific training leading to promotion. Following Landers, Rebitzer and Taylor

(1996), we emphasise the role of effort in determining who is promoted.[2] In our model effort is used in the instantaneous training period (period 0) to acquire specific human capital. Workers are induced to invest in human capital because the firm commits to a contract that governs the likelihood of promotion and the wage rate consequent upon promotion. The simplest form of such a contract guarantees promotion to workers who make the requisite investment and fixes the minimum wage to be paid to promoted workers. Since workers are heterogeneous in their costs of providing effort, a given contract induces only lower effort cost workers to train. At the beginning of period 2, the promoted worker and the firm learn the worker's net opportunity cost to remaining at the firm, the 'outside offer'. Following Bernhardt and Scoones (1993), the firm can decide on whether to match outside offers. With offer-matching, promoted workers end up with different rates of pay in the final period.

This framework allows us to nest the main features of the Lazear and Rosen model and of a model of a taste for discrimination. It is rich enough to allow us to examine the two main stylised facts in the BHPS data. The model shows under differing assumptions how many workers of a given gender are promoted and how those workers fare in consequent pay rises. With Lazear and Rosen assumptions, fewer women than men are promoted but – at least under some distributional assumptions – those that remain with the firm have higher average wages than promoted men. In our model of discrimination, women and men are promoted at the same rate, but promoted and retained women end up with lower average wages than men.

Before turning to the specific assumptions in each period of time, we further clarify the nature of the contract offered to workers joining a 'career' firm. We have in mind

[2] The other frequent determinant of promotion appearing in the literature is ability. Having both factors in our theoretical model would complicate the notation without adding significant results. In any case, the empirical

contracts with wage scales. There are a number of grades in the contract, with movement across grades representing a promotion. Workers within a grade can still be paid different wages depending upon their point in the scale. Lazear and Rosen (1990, page S107) note that such scales are ubiquitous in large establishments throughout the US economy. Booth and Frank (1996) make a similar point for the UK. The firm can pay a promoted worker the bottom point on the scale in the worker's new grade, or it can offer a wage higher on the scale. In our model, the only reason to offer a higher point is to match an outside offer.

Period 0:

We consider an economy with a large spot labour market. All workers in this market have the same productivity S in each of periods 1 and 2, and receive this as their wage. In the initial period 0, workers wishing to leave the spot market and seek promotion join the training programme at the single local 'career firm'. Workers who choose this option instantaneously train in period 0 by providing the effort level E. This investment E in specific human capital raises productivity in periods 1 and 2 to $P = E + S$. Workers have different costs of providing effort, measured by the individual-specific coefficient α, with the resulting effort cost αE. The effort coefficient is distributed by the function $F(\alpha)$ and associated density $f(\alpha)$ over the support $[0,A]$. The number of workers in the given locality is normalised to unity. Training is costless to the firm. It is also instantaneous, so there is no opportunity cost to workers to training; the only cost is the effort cost αE. All trained workers have the same productivity, irrespective of the cost of providing effort.

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analysis controls for observed and unobserved individual heterogeneity.

The worker - but not the firm - knows α before deciding whether or not to train. Workers are induced to train by the contract offered by the firm. This contract is described more fully under Period 1 and Period 2 below. Its basic features are that all trained workers are promoted, are paid a guaranteed wage w_p in period 1, and are then paid in period 2 either w_p or a higher wage matching an outside offer. Since training is instantaneous, trainees are not paid a wage in period 0. Under our assumption that workers can only train at their local career firm, there is no competition in contract terms except that - to attract workers of a given α - the contract must be at least as attractive as remaining in the spot market.

Period 1:

At the start of period 1, all trained workers are promoted and are identical. Promoted workers are paid the contractual wage w_p in period 1 and produce $P = E + S$. While trained workers have the option of quitting and re-joining the spot market, they will not do so since the contract has a value that is in excess of $2S + \alpha E$ (or they would not have incurred the training costs) and therefore in excess of $2S$.

Period 2:

At the start of period 2, the worker and the firm learn the worker's disutility m of remaining at the contractual firm as opposed to re-entering the spot market. This disutility is distributed over the support $[-M,M]$ by the function $G(m)$ with associated density $g(m)$. Disutility is independent of the effort cost parameter and represents, for example, the disutility to the worker of remaining in the locality instead of moving to a new area. After learning m, the worker has another chance to re-enter the spot market for period 2 work. The

firm is committed to paying at least the contractual wage w_p. If the worker's 'outside offer' inclusive of disutility, $S + m$, exceeds the contractual wage, the firm decides whether or not to raise the worker's wage to $S + m$ in order to 'match the outside offer'. If it does not, the worker will quit to re-enter the spot market. Since there is a distribution of worker disutility, there will be a distribution of wages offered to promoted workers in period 2, depending upon whether or not their 'outside offer' is matched. The firm is effectively facing an upward sloping supply curve for workers for whom $S + m > w_p$ and for these workers the firm can act as a perfectly discriminating monopsonist.

Potential contracts differ by the wage w_p. We solve for the expected wage and promotion rates for a contract with an arbitrary minimum wage $w_p \geq S$, and then turn to the issue of the optimal contractual wage. Since this is an investment problem, solutions must be calculated recursively, beginning in the terminal period.

In period 2, the promoted worker produces P at the firm. If $S + m \leq w_p \leq P$, the worker remains at the firm at the minimum contractual wage and the firm gains the profit $P - w_p \geq 0$. For workers with a higher m such that $S + m > w_p$, the firm can only retain the worker by matching the outside offer $S + m$. It will be profitable to do so for m values such that $P \geq S + m$. If $S + m > P$, then it is not profitable to match the outside offer and the worker separates. Figure 1 shows the optimal matching and retention strategy of the firm.

The expected (across workers with different m values) period 2 wage of retained workers is given by:

$$(1) \qquad \overline{w}_2 = \left[\int_{w_p - S}^{P-S} (S+m)\, g(m)\, dm + \int_{-M}^{w_p - S} w_p\, g(m)\, dm \right] \Big/ G(P\text{-}S)$$

The first term on the right hand side represents the wages of workers with m values such that they are retained by an outside offer matching wage in excess of w_p and the second term is the contractual wage w_p paid to the remaining retained workers. Since matched outside offers do not give the worker a surplus (but only compensate for the disutility of remaining at the firm), the expected second period surplus gained by trained workers is:

$$(2) \qquad \overline{\sigma}_2 = \int_{-M}^{w_p - S} (w_p - S - m)\, g(m)\, dm$$

This is the relevant value (shown in Figure 1) to be used by a worker at time 0 deciding whether or not to train for a career firm job. All trained workers in period 1 gain the same surplus $\sigma_1 = w_p - S$. Adding together period 1 and 2 expected surpluses, the marginal worker who chooses to train is the one with an α value such that:

$$(3) \qquad \alpha E = w_p - S + \int_{-M}^{w_p - S} (w_p - S - m)\, g(m)\, dm$$

Workers with a low effort cost α find it optimal to train and be promoted.

Since our concern is with comparative wage and promotion rates between women and men, the determination of the optimal w_p does not add much to the analysis and we do not solve the optimisation problem explicitly. A low w_p entails from (3) that only those workers with a very low α train at the firm which however gains a high profit per trained worker. On the other high, a high w_p induces many workers to train, but the firm will be committed to paying high wages in periods 1 and 2. The optimal w_p balances out the number of workers

induced to train with the minimum wage that the firm is committed to paying them.

This framework will allow us to consider how wages and promotions differ across gender under alternative assumptions about the economic environment. We assume throughout that equal wage laws mean that women and men must be offered the same explicit contract. However, the law cannot effectively force equal promotion rates in practice, nor does it limit the wage distribution that arises as firms respond to outside offers.

The Lazear and Rosen approach differentiates between men and women on the basis of outside opportunities such as homework. The assumption that women have more favourable outside opportunities can be incorporated into our framework by introducing the shift factor $\omega > 0$ so that the outside opportunity of a female worker in period 2 is given by $S + m + \omega$, as shown in Figure 2.[3] This is equivalent to a rightward shift of the G(m) distribution from the support [-m,m] to the support [-m+ω,m+ω]. As seen from Figure 2, fewer promoted women than men remain at the firm as women leave to take up the favourable outside opportunities. As a result, the expected surplus gained by women is less than for men, and fewer women choose to join the career firms to train for promotion. This can be seen formally by substituting in the appropriate expressions for the period 2 surplus gained by men and women and solving for the marginal α values for men and women, α_w and α_m:

$$\alpha_w E = w_p - S + \int_{-M}^{w_p - S - \omega} (w_p - S - m - \omega)\, g(m)\, dm \qquad (4)$$

[3] An alternative assumption is that women have less favourable outside opportunities since, for example, they may not be able to move away from the family location. Under this assumption, it turns out that women are more likely to be promoted than men, while receiving lower wages upon promotion. This alternative

$$< w_p - S + \int_{-M}^{w_p - S} (w_p - S - m)\, g(m)\, dm \;=\; \alpha_m E$$

From this, $\alpha_w < \alpha_m$ which implies that more men are promoted.

How do expected period 2 wages differ for promoted women and men under Lazear and Rosen assumptions? The difference in expected wages can be written:

$$\overline{w}_w - \overline{w}_m = \int_{w_p - S - \omega}^{P - S - \omega} (S + m + \omega)\, g(m)\, dm \,/\, G(P - S - \omega) \;+\; \int_{-M}^{w_p - S - \omega} w_p\, g(m)\, dm \,/\, G(P - S - \omega)$$

$$- \left[\int_{w_p - S}^{P - S} (S + m)\, g(m)\, dm \,/\, G(P - S) + \int_{-M}^{w_p - S} w_p\, g(m)\, dm \,/\, G(P - S) \right]$$

This expression cannot be signed without some assumption about the distribution of disutilities m. If the distribution is uniform, the expected wage difference equals:

$$\int_{w_p - S - \omega}^{P - S - \omega} (S + m + \omega)\, g(m)\, dm \,/\, G(P\text{-}S\text{-}\omega) \;-\; \int_{w_p - S}^{P - S} (S + m)\, g(m)\, dm \,/\, G(P - S)$$

$$> \int_{w_p - S - \omega}^{P - S - \omega} (S + m)\, g(m)\, dm \,/\, G(P\text{-}S\text{-}\omega) \;-\; \int_{w_p - S}^{P - S} (S + m)\, g(m)\, dm \,/\, G(P - S) \;>\; 0$$

from the uniform distribution and $G(P\text{-}S\text{-}\omega) < G(P\text{-}S)$. With the uniform distribution, the same number of women and men have their outside offers matched with wages higher than w_p. But since fewer women stay at the minimum contractual wage w_p, the average wage paid to retained women is higher than for men. Under the Lazear and Rosen assumptions, fewer women than men are promoted, but promoted and retained women gain higher average wages than men.

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assumption is consistent with the raw data, but is less consistent with the empirical results presented later than is our sticky floors discrimination model..

Our proposed alternative model is a sticky floors model of discrimination where it turns out that women and men are just as likely to be promoted, but women find it harder to rise up the wage scale consequent upon promotion. Instead of the Lazear and Rosen outside opportunity differential ω, we introduce a discrimination factor δ such that women are treated as if they have a lower productivity net of δ in the promoted job but are perceived to be of equal productivity in the spot labour market. This is shown in Figure 3.

Provided that δ is not too large ($P - \delta \geq w_P$), discrimination has no effect in period 1. In period 2, however, the firm will now only match outside offers of women up to a wage of $P - \delta$ while they continue to match male outside offers up to P. Since the matching of offers does not increase the worker's surplus, discrimination has no effect on the expected surplus gained by men and women in period 2. Therefore, women and men have the same incentive to train and the same promotion rate. But the greater number of matched outside offers for men means that men end up with a higher expected wage:

$$\overline{w}_m - \overline{w}_w = \left[\int_{w_P - S}^{P-S} (S+m)\, g(m)\, dm / G(P-S) + \int_{-M}^{w_P - S} w_P\, g(m)\, dm / G(P-S) \right]$$

$$- \left[\int_{w_P - S}^{P-\delta-S} (S+m)\, g(m)\, dm / G(P-S-\delta) + \int_{-M}^{w_P - S} w_P\, g(m)\, dm / G(P-S-\delta) \right] > 0$$

The sticky floors discrimination model leads to very different empirical implications from Lazear and Rosen. Under the Lazear and Rosen assumptions, fewer women are promoted but - at least under the uniform distribution of disutilities - those that remain with the firm into period 2 have higher average wages than promoted and retained men. Under the sticky floors model of discrimination, women and men are promoted at the same rate, receive

the same wage upon promotion in period 1, but then in period 2 promoted and retained women have a lower average wage than promoted and retained men. Women are less able to rise through the wage scales. In the remainder of the paper, we will examine how well these two models correspond to the data.

It is important to note that our model of discrimination is not guilty of being 'tortured' or 'strained' in the way that leads Lazear and Rosen to criticise other models of discrimination. They object (1990, page S120) to discrimination models such that "... sex bias take[s] the form of preventing movement across jobs but result[s] in no discrimination within". In our model there is an underlying discrimination factor that can affect both wages within a grade and promotion to the grade.

3. The Data

We examine the relationship between promotion, wages and gender using the first five waves of the British Household Panel Survey (BHPS). This is a nationally representative random sample survey of private households in Britain. Interviews were conducted during the autumn of 1991, and annually thereafter (see Taylor *et al*, 1996). The BHPS provides information on the timing and type of job changes made by a worker, including job changes at the same employer. For all jobs ended during the 12 month period between interview dates, individuals give the reason for stopping the job. One of the reasons on the available list is promotion. We use this as our measure of whether or not an individual is promoted in a given year.[4]

[4] Given the theoretical model, our empirical analysis defines individuals as promoted if they are promoted at their current employer. We do not include individuals who gain a promotion in the process of moving to a new

Our analysis is based on panels of men and women who meet the following criteria: (i) were born after 1935; (ii) have at least two years of labour market data; (iii) provided complete information at each interview date; (iv) were in full-time employment at the time of the survey; and (v) were not self-employed, farmers or in the armed forces. These restrictions were primarily imposed to narrow the sample to those with a reasonably strong attachment to the mainstream labour market. In comparisons between women and men, there are important issues relating to part-time work and to the greater likelihood that women will take career breaks. Our restriction on full-time employment is designed to make the male and female samples as comparable as possible. We tested for sample selection in women's full-time employment and found that such a selection does not explain any variation in wages. [5] Restrictions (i-v) lead to an unbalanced panel comprising 2327 men and 1090 women, with respectively 9456 and 4341 person-year observations. To examine models of wage growth over the full 5 years, we also constructed a balanced panel of 1289 men and 560 women who were in full-time employment each of the 5 years. For wage levels equations, the balanced and unbalanced panel results are similar. We present the unbalanced panel estimates where possible since these are based on a larger sample size and the estimates have greater precision.

Our theory focuses on promotions and wages. Raw data are presented in Table 1, which shows average hourly wage rates and the number of promotions for each year over the period 1991-95, disaggregated by gender.[6] The table also reports the promotion rate and the

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employer. The promotion variable takes on the value unity if an individual has one or more promotions in a given year.

[5] We also performed the entire analysis on samples including part-time workers and found that – although part-timers and full-timers had different wage and promotion rates - our main comparative results were unchanged. Estimates on the sample including part-time workers and on sample selection are not presented in the paper due to space limitations and since they do not contain additional explanatory power.

[6] The log of the hourly wage rate is given by:

wage gain consequent upon promotion (the promotion premium). Without exception, these figures show that the proportion of women being promoted each year is greater than for men.[7] Over the entire period, women in the balanced panel have an average 11.8% chance of being promoted each year, while men only 9.6%. Hourly wage rates are higher for both sexes after promotion, but men gain a higher promotion premium. The promotion wage premium for women averages only 10.5%, but the premium for men is 17.1%.

Table 2 examines whether the gender gaps in wages and promotions are significant. All male-female wage gaps are significant. The gender wage differentials are approximately £1.30-1.40 per hour for the entire population of workers, but widen to £2.10 per hour when considering only promoted workers. The pattern on promotions is less clear. Although the male-female promotion gap is significant over the full sample, for both the balanced and unbalanced panels, this does not hold in every year.

In summary, the raw data provide some support for the predictions of the sticky floors discrimination model over the Lazear and Rosen approach. Women are more likely to be promoted than men, but receive smaller wage gains consequent upon promotion. In the next two sections, we use a number of different estimation methods to see whether these differences remain significant after controlling for other explanatory factors.

$$w = \ln \{PAYGU / [(30/7)(HS + \kappa HOT)]\}$$

where PAYGU is the usual gross pay per month in the current job (deflated by the 1995 Retail Price Index), HS is standard weekly hours, HOT is paid overtime hours per week, and κ is the overtime premium. In the empirical analysis, we set κ at 1.5, the standard overtime rate. We experimented with alternative values of κ, ranging between 1 and 2 and detected no substantial changes in our results.

[7] The study by Groot and van den Brink (1996), based upon the first two waves of BHPS data, shows raw data where men are more likely to be promoted than women (10.4% of men and 7.3% of women). Their sample differs from ours in two major ways: they eliminate workers who change employers and also they include part-time workers. Eliminating workers who change employers and including part-timers, our sample (based upon a later release of the data) for 1992 shows 9.8% of men and 7.4% of women are promoted. Eliminating part-timers, 9.9% of men and 9.52% of women are promoted. We have retained in our sample workers who later

4. Who Gets Promoted?

The sticky floors model outlined in Section 2 predicts that women and men are just as likely to be promoted. We test this hypothesis in a multivariate framework using probit regressions. Table 3 presents our estimates of the determinants of the promotion probability, estimated using the unbalanced panel of full-time workers, for the pooled sample of all workers and from the separate samples of men and women.[8] From the pooled sample of men and women, gender has no significant effect (t-ratio=0.66) on the probability of promotion once we control for effort (by using various proxies), individual characteristics, and employment-related characteristics. Full definitions of variables used in the analysis are provided in Table A1 in the Appendix.

Our model of promotions emphasises the role of effort in acquiring specific human capital. Following Landers, Rebitzer and Taylor (1996), we use overtime hours worked as an important proxy for effort. This is significant in the pooled and gender-specific estimates.[9] Variables for the number of dependent children by age group and the presence of a partner are included since these are likely to affect the distribution of effort between home and market activities. Interestingly, these effects are similar for both men and women; in particular, the presence of a partner raises promotion rates for both genders.

Turning to individual and employment characteristics, non-whites are less likely to be promoted, and in this sense any appropriate model of ethnic discrimination differs from the

change employers (perhaps because they were not promoted) to avoid sample selection biases. We also feel that restricting attention to full-time workers provides a better comparison across gender.

[8] The coefficients in Table 3 are marginal effects, calculated as the derivative of the conditional expectation of the observed dependent variable evaluated at the sample means.

one we have developed for gender. Education variables have little effect. The worker's occupation and cohort (measured by the decade of labour market entry), along with the size of establishment, have significant effects on promotion rates. Professional, managerial and skilled non-manual workers are more likely to be promoted, as are newer cohorts in the labour market (entrants in the 1980s and 1990s). Workers in smaller firms are less likely to be promoted. The effects of various experiments on changing variable values, compared to the baseline promotion rate, are shown in Table 4.

Since the raw data show that women are more likely to be promoted than men (with a gender gap of 2.46% for the unbalanced panel over the entire sample period), while the pooled estimation shows no significant gender effect, it is interesting to ask which variables explain the apparent difference. One way of looking at this is to see when the gender dummy ceases to 'explain' the observed variations in the promotion probability for the pooled sample of men and women workers. We first perform a probit regression whose only regressor is the gender dummy, and check its significance. Then we sequentially add individual characteristics, variables proxying effort and different combinations of the employment-related variables, stopping when significance of the gender gap disappears. The results of this exercise are summarised in the first column of Table 5. The gender gap (women are more likely to be promoted than men) is 2.46 and significantly measured when gender is the only explanatory variable (row i). The significance of the gender gap does not disappear after including incrementally in the next regressions: individual characteristics (race, disability, and educational qualifications - row ii); variables proxying effort (overtime, number of children by age, and living with a partner - row iii); and the variables for experience and

[9] To gain an idea of the magnitude of the effect, an increase of 5 hours of overtime work per week increases the pooled promotion probability from 8.1 to 8.7% *ceteris paribus*.

tenure, union coverage, and the U/V ratio (row iv). In this last case, the magnitude of the gender gap is reduced to 1.52 percent, but the *t*-statistic is 2.77. Addition of the dummies for establishment size, type of employing organisation, region of residence, and labour market entry cohort lowers the gender gap to 0.98 percent but it remains significant at any confidence level above 7.9 percent (row ix). Gender differences cease to explain variations in the promotion probability only when we also control for either current occupation, occupation of origin or industry of employment.

The second column in Table 5 represents a further check on our results. The model in Section 2 has effort and promotion being simultaneously determined. Since effort therefore may be viewed as an endogenous variable, we repeat the exercise excluding the variables proxying the worker's effort. As seen from the Table, our conclusions – that there is a gender gap that becomes insignificant once we account for occupation – are robust to this change in specification.[10]

5. Who Gets Higher Wages After Promotion?

We now consider the impact of promotion on wages. The sticky floors discrimination model in Section 2 predicts that, while promoted women may at first gain the same wage increase as promoted men, they do not continue to benefit from wage increases to the same extent as men. In contrast, the Lazear and Rosen assumptions imply that promoted women are likely to gain higher average wage increases than men. We examine wages in Table 6 using a wage levels approach, and in Table 7 using a wages growth approach. The wage

[10] We also estimated all the models on occupational sub-samples that might be viewed as representing occupational segregation by gender. These are (i) a predominantly male classification, comprising only

levels estimates gain from the larger sample size, while the wage growth estimates allow us to examine lagged effects over the sample period. This is important because, in the model in Section 2, the differential wage effects across gender occur with a lag in the second period.

Table 6 reports the estimated coefficients from a number of different specifications of the natural logarithm of the real (1995 pounds) hourly wage rate. The first three columns report the wage estimates when promotion is treated as exogenous. We use three estimation methods for each sample (all workers, men, and women). In the 'pooled' model, all the observations are treated as if from a single cross section. The second and third estimation methods - the random-effects (RE) and the fixed-effects (FE) models - exploit the longitudinal nature of the data, and assume that the error term in the wage equation comprises both a time-invariant individual-specific unobservable component and pure noise.[11] The last three columns report the estimates when promotion is treated as endogenous, using a standard two-step Heckman (1979) procedure. The reason for treating promotion as endogenous is that individuals may be selected (or select themselves) into promotion on the basis of characteristics that are unobservable to the econometrician.[12] From Columns 4 to 6, it can be seen that the estimated coefficient of the selectivity term is always significant and we cannot reject the hypothesis that promotion is endogenous to wages. We find, however, that the magnitude of the differences between the endogenous and exogenous promotion estimates for the variables of interest (i.e., gender, promotion, and gender-promotion interaction) is generally small.

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managers and professionals, and (ii) a predominantly female occupational classification comprising only clerical and secretarial workers. Our broad findings are unaltered.

[11] Both RE and FE models recognise that differences in lifetime work patterns between men and women may arise from factors that are difficult to measure directly, such as motivational differences discussed in Weiss and Gronau (1981). Failure to account for such differences would lead to biased estimates of the unexplained wage gap, because they are likely to pick up differences in motivation [Polacheck and Kim (1994)].

The figures reported in Tables 1 and 2 show that male workers (both promoted and unpromoted) earn about 20 percent more than all female workers (£8.0 per hours versus £6.7 per hour for the whole sample period 1991-95). Table 6, controlling for individual and employment characteristics, confirms that finding. From the estimates on the full sample, the coefficient on 'female' shows that women have approximately 17-18 percent lower wages than men, regardless of the estimation method. Men and women gain wage increases between 2 and 8 percent from promotion, depending on the estimation method.[13] Although the estimated return to women from promotion seems generally less than that for men, these differences are not significant. This is seen most clearly from the estimates on the full (men and women) sample, where the interaction of the gender dummy with promotion has an insignificant coefficient. We also compare the estimated coefficient on promotion in the separate male and female equations. There is no significant difference except for the pooled estimation with endogenous promotion.[14] From these estimates, therefore, there is no evidence that promotion either increases or diminishes the gender wage gap.

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[12] Identifying restrictions are listed in Note (ii) at the bottom of Table 6. The *t*-statistics of the estimates reported in Tables 6 and 7 are computed using robust (Huber-White) standard errors.

[13] Bound et al. (1995) has suggested new tests on instrument validity. We performed two tests on the validity of the instruments used in the promotion equation to identify the effect of promotion on wages. The test of the joint statistical significance of the excluded instruments (the proxy variables for effort) is accepted, confirming our hypothesis that the effort variables are good predictors of the promotion probability. In addition, all male wage regressions pass the over-identification test (with respect to there being low explanatory power for the excluded instruments in the wage equation); for women, this is true in the fixed and random effects models, but not in the pooled wage regressions. The reason is that female wages are negatively associated with the presence of children.

[14] The test statistic is given by:

$$(\beta_m - \beta_w) / \sqrt{\sigma_m^2 + \sigma_w^2}$$

where σ_j^2 is the standard error of β_j for j = m,w. The calculated gender differences and t-statistics are:

Exogenous promotions			Endogenous Promotions		
Pooled	RE	FE	Pooled	RE	FE
.0322	.0102	-.0052	.0500	.0142	-.0059
(1.423)	(0.440)	(0.222)	(2.201)	(0.612)	(0.251)

We now further explore the relationship between promotion and wages by estimating real wage growth equations, for the period between the first (1991) and the fifth (1995) waves of the BHPS. The theoretical model suggests that both men and women might be given the minimum contractual wage payable upon promotion, but that men might gain from further outside offer matching wage increases over time. The wage growth equations allow us to examine this hypothesis. This analysis necessitates the use of a balanced panel of labour market participants over the whole period, and our estimating sub-sample now consists of 1289 men and 560 women. The results are reported in Table 7.

Model 1 in Table 7 looks at the lagged effects of promotions on wage growth. Column 1 shows that, after controlling for individual and establishment effects, as well as promotions, women have lower wage growth over time. Looking at the separate male and female estimates (Columns 2 and 3) of the impact on wages of lagged promotions, we detect an important difference. Men continue to gain wage increases from promotions that occurred 3 to 5 years before, while women do not. This effect is cumulative so a man promoted each year will get a boost to his wage growth of about 38% between 1991 and 1995, while an otherwise identical woman will get only a 21% increase.[15] If men and women are promoted at roughly the same rate (as suggested by the empirical analysis in Section 4), the dynamic effect of promotions on the growth of wages is likely to exacerbate the already large gender gap in wages.

Model 2 in Table 7 looks at the gender comparison from another perspective, the return to the number of promotions over the 5 year period. We find that men gain a constant rate of return from promotion of about 11 percent (with the quadratic term being negative but insignificantly different from zero). Women gain from promotions at a decreasing rate.

Consider a male worker and a female worker over the 1991-95 period. If both experienced three promotions the gender difference would be sizeable: the man would have gained a real wage growth of almost 32% from the three promotions while the woman would have gained only 7%.

6. Conclusions

The use of individual panel data, such as the BHPS, provides a new perspective on previously accepted stylised facts about the gender gap in promotions and wages. Our results suggest that women are at least as likely as men to be promoted. They either gain the same wage increase consequent on promotion, or a smaller one. It is clear from the raw data and the estimates that the promotion process does not systematically mitigate the general disadvantage women face in the labour market. It may very well increase the disadvantage, not through a lower promotion probability, but through a lower wage reward over time to promotion.

These results clearly require a new way of looking at the issue of promotion and gender. The glass ceilings model of discrimination claims that women are less likely than men to be promoted. The alternative model in Lazear and Rosen (1990), emphasising the non-market outside opportunities for women, comes to the same conclusion. Our new model has as its driving force the discriminatory treatment of women as though they had a lower productivity in the promoted jobs, even though their actual productivity is the same as that of men. Nonetheless, the employment contract provides the same incentive to men and women to acquire the specific human capital needed for promotion, and they are promoted at the

[15] This calculation uses all the coefficients, both significant and insignificant.

same rate. The difference is that promoted men gain a higher wage over time than promoted women, as the firm chooses whether or not to respond to outside offers. Even though women get the same outside offers as men, the firm responds disproportionately to male outside offers, since it views promoted men as being more productive than promoted women.

To a certain extent, the theoretical predictions depend upon equal wage and other anti-discrimination laws. We have assumed that the firm must offer the same explicit contract to both men and women, and that its promotions and wage policy requires that any differential treatment of individuals must be justified by a very concrete explanatory factor – either specific human capital acquisition or an outside offer. In this sense, our model shows how more subtle forms of discrimination can manifest themselves even under these forms of legislative control.

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Table 1: Raw Data: Mean Promotion and Hourly Wages

	BHPS YEAR															
	1991		1992		1993		1994		1995		All					
	£	N	£	N	£	N	£	N	£	N	£	N				
BALANCED PANEL																
Men																
With no promotion	6.9	1173	7.7	1144	7.9	1142	8.8	1188	9.5	1179	8.2	5826				
With promotion	8.3	116	8.7	145	10.1	147	10.2	101	11.1	110	9.6	619				
Promotion rate	.090		.112		.114		.078		.08		.096					
Promotion premium	.203		.123		.278		.159		.16		.171					
Women																
With no promotion	5.7	507	6.3	481	6.7	490	7.4	504	8.1	488	6.8	2470				
With promotion	6.4	53	6.8	79	7.5	70	8.1	56	9.0	72	7.6	330				
Promotion rate	.095		.141		.125		.100		.12		.118					
Promotion premium	.123		.079		.119		.095		.11		.105					
UNBALANCED PANEL																
Men																
With no promotion	6.8	1765	7.3	1814	7.7	1677	8.4	1710	9.1	1623	7.8[a]	8589				
With promotion	8.1	151	8.7	203	9.5	202	10.4	150	10.6	161	9.4[a]	867				
Promotion rate	.079		.101		.108		.081		.09		.092					
Promotion premium	.191		.192		.234		.238		.16		.204					
Women																
With no promotion	5.5	795	6.1	816	6.5	753	7.2	785	7.9	687	6.6[a]	3836				
With promotion	6.0	76	6.8	118	7.2	119	8.0	91	8.4	101	7.3[a]	505				
Promotion rate	.087		.126		.136		.104		.12		.116					
Promotion premium	.091		.115		.108		.111		.06		.098					

Note: Wages are in constant (1995) pounds. N is number of individuals (full-time workers). Promotion rate is number of individuals promoted divided by total number of individuals. Promotion premium is the difference between wage after promotion and wage with no promotion divided by the wage with no promotion.
Figures over the entire period are weighted averages (superscript α denotes an unweighted average) of each year figures, and the weight for each year is the number of individuals in that year over person-year observations.

Table 2: Gender Gap in Promotion and Hourly Wages: Is It Significant?

	BHPS Year					
	1991	1992	1993	1994	1995	All
			BALANCED PANEL			
Promotion (%)	-0.47	-2.86	-1.10	-2.16	-4.32	-2.18
t-stat	0.319	1.731	0.672	1.534	2.872	3.177
p-value	0.7500	0.0836	0.5014	0.1251	0.0041	0.0015
Hourly Wages (£)						
With no promotion	1.26	1.38	1.30	1.42	1.43	1.37
t-stat	5.811	5.905	5.156	4.589	4.137	10.928
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
With promotion	1.94	1.89	2.57	2.18	2.12	2.06
t-stat	2.985	3.053	3.566	2.862	2.641	6.361
p-value	0.0033	0.0025	0.0004	0.0048	0.0090	0.0000
All (promoted and unpromoted)	1.32	1.43	1.43	1.47	1.45	1.42
t-stat	6.383	6.512	5.989	5.048	4.534	12.092
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
			UNBALANCED PANEL			
Promotion (%)	-0.84	-2.57	-2.90	-2.32	-3.79	-2.46
t-stat	0.755	2.086	2.203	2.002	2.935	4.495
p-value	0.4501	0.0371	0.0277	0.0454	0.0034	0.0000
Hourly Wages (£)						
With no promotion	1.25	1.25	1.23	1.20	1.22	1.24
t-stat	7.252	6.859	6.233	5.141	4.428	12.904
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
With promotion	2.11	1.91	2.32	2.36	2.27	2.14
t-stat	3.958	3.873	4.309	2.523	3.363	7.415
p-value	0.0001	0.0001	0.0000	0.0123	0.0009	0.0000
All (promoted and unpromoted)	1.31	1.30	1.33	1.27	1.29	1.31
t-stat	7.984	7.576	7.132	5.554	5.050	14.272
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: Gender gap in promotion is (percentage) difference of average male promotion rate and average female promotion rate. Gender gap in wages is the (monetary) difference of average male and female hourly wages.

TABLE 3: The Determinants of the Promotion Probability, 1991-95 (Unbalanced panel, Full-time workers) Marginal Effects

Variables	All			Men			Women		
	coeff	t-stat	mean	Coeff	t-stat	Mean	coeff	t-stat	mean
Variables proxying effort									
Overtime hours worked	.001	3.39	4.306	.001	2.72	4.983	.002	2.24	3.119
Overtime paid	.005	0.84	0.258	.002	0.28	0.295	.007	0.55	0.177
Number of children<3 years	-.018	2.12	0.079	-.019	2.22	0.100	-.0001	0.00	0.034
Number of children 3-4	-.004	0.47	0.080	.001	0.10	0.104	-.029	1.01	0.028
Number of children 5-11	-.015	3.49	0.268	-.013	2.81	0.337	-.018	1.51	0.120
Number of children 12-15	-.0002	0.03	0.165	-.008	1.25	0.188	.029	2.34	0.114
Number of children 16-18	-.030	1.89	0.028	-.024	1.39	0.030	.051	1.43	0.021
Partner present	.043	8.01	0.744	.036	5.66	0.778	.052	5.27	0.669
Individual characteristics									
Female	-.004	0.66	0.315	-			-		
Non-white	-.027	2.17	0.033	-.021	1.45	0.033	-.043	1.71	0.035
Disabled	-.007	0.33	0.012	-.0004	0.01	0.012	-.019	0.43	0.011
O-level	-.012	1.50	0.359	-.001	0.09	0.329	-.031	2.03	0.425
A-level	.001	0.14	0.217	.007	0.66	0.235	-.013	0.72	0.177
Higher qualification	-.004	0.44	0.205	.006	0.51	0.207	-.023	1.24	0.201
Employment-related characteristics									
Experience	-.003	1.84	17.70	-.002	1.20	19.06	-.004	1.39	14.75
Experience-squared	.00004	1.29	430.1	.00004	1.16	486.4	.00004	0.52	307.4
Tenure	.002	1.37	5.676	.0001	0.10	6.069	.008	2.64	4.820
Tenure-squared	-.0001	2.52	68.61	-.0001	1.23	77.24	-.0004	2.69	49.82
Union coverage	.0002	0.04	0.544	.005	0.76	0.550	-.013	1.18	0.532
Size10	-.068	9.57	0.225	-.070	8.65	0.252	-.066	4.68	0.166
Size50	-.024	3.59	0.243	-.027	3.54	0.234	-.021	1.58	0.261
Size100	-.012	1.58	0.113	-.0004	0.05	0.109	-.042	2.85	0.125
Size500	-.009	1.45	0.241	-.008	1.05	0.234	-.019	1.47	0.257
Public sector	.012	1.28	0.220	.013	1.18	0.178	.015	0.82	0.312
Charity sector	.038	1.91	0.018	.060	2.33	0.014	.009	0.27	0.025
Professional occupation	.060	3.64	0.074	.060	3.41	0.089	.056	1.40	0.043
Managerial occupation	.109	7.83	0.179	.096	6.52	0.187	.151	4.31	0.160
skilled non-manual	.048	4.23	0.299	.045	3.48	0.189	.052	2.14	0.538
skilled manual	.016	1.63	0.327	.018	1.74	0.390	.011	0.40	0.191
U/V ratio	.0002	1.02	19.70	.0005	1.83	19.63	-.0005	0.99	19.86
1960s labour market entry	.024	1.92	0.243	.016	1.16	0.239	.059	2.14	0.250
1970s labour market entry	.029	1.89	0.301	.030	1.61	0.339	.046	1.44	0.217
1980s labour market entry	.071	3.91	0.271	.078	3.42	0.238	.081	2.37	0.344
1990s labour market entry	.097	4.06	0.078	.107	3.56	0.068	.114	2.45	0.102
Log likelihood		-4111			-2641			-1431	
Person-year observations		13797			9456			4341	

Note: (i) Other controls included in the estimation but not reported in the table are ten region of residence dummies, nine industry dummies, and four 'starting occupation' dummies. Size refers to the number of employees in the establishment [Size10: less than 10 workers; Size50: 10-49 workers; Size100: 50-99 workers; Size 500: 100-499 workers].

(ii) The base person is not married or cohabiting, without children, has educational qualifications below 'O'-level, is white, lives in the north of England, works in agriculture, forestry or fishing, is manual semi-skilled or unskilled, was manual semi-skilled or unskilled in first job, is employed in the private sector, works no overtime hours, entered the labour market prior to the 1960s, is not disabled, is not covered by a trade union, and works in an establishment of 500 + workers.

Table 4: Predicted Probability of Promotion, by Gender - Selected Variables

	All	Men	Women
Baseline	0.0808	0.0716	0.0959
Overtime hours worked + 5 (per week)	0.0869***	0.0767***	0.1055***
Number of children <3 years +1	0.0640**	0.0541**	0.0958
Number of children 5-11 +1	0.0769***	0.0598***	0.0787
Tenure + 1 year	0.0808**	0.0708	0.0993***
Size 10 + 10%	0.0789***	0.0694***	0.0945***
Charity + 10%	0.0809*	0.0716**	0.0959
Managerial + 10%	0.0923***	0.0730***	0.0977***
Non-manual + 10%	0.0821***	0.0723***	0.0989***

Note: Obtained from estimates of Table 3. Baseline probabilities are computed at mean values of all variables used in estimation for each of the three samples.
***, **, * denotes significance at 1, 5 and 10 percent level.

Table 5: Gender Gap in Promotion Rate from Multivariate Analysis: Is It Still Significant?

Specification	Controlling for effort [Column 1]		No controls for effort [Column 2]	
	Coeff	*t*-stat	Coeff	*t*-stat
(i) gender only	.0246	4.46	.0246	4.46
(ii) gender plus race, disability, education	.0258	4.71	.0258	4.71
(iii) (ii) plus variables that proxy effort	.0264	4.66		
(iv) (iii) plus experience, experience squared, tenure, tenure squared, union, U/V ratio	.0152	2.77	.0160	2.95
(v) (iv) plus establishment size	.0099	1.83	.0118	2.25
(vi) (iv) plus sector (charity and public)	.0129	2.27	.0137	2.50
(vii) (iv) plus regional dummies	.0156	2.76	0.163	2.99
(viii) (iv) plus labour market entry cohorts	.0156	2.75	0.151	2.73
(ix) All variables (i) to (viii)	.0098	1.76	.0104	1.92
(x) (iv) plus current occupation	.0022	0.39	.0012	0.21
(xi) (iv) plus occupation of origin	.0053	0.90	.0049	0.86
(xii) (iv) plus industry dummies	.0054	0.96	.0062	1.11

TABLE 6: Ln Hourly Wage Levels 1991-95
(Unbalanced panel, Full-time workers Panel)

Variables	Exogenous promotion						Endogenous Promotion					
	Column 1 Pooled		Column 2 RE		Column 3 FE		Column 4 Pooled		Column 5 RE		Column 6 FE	
	coeff	t-stat	coeff	t-stat	coeff	t-stat	Coeff	t-stat	coeff	t-stat	coeff	t-stat
All (N=13797)												
Female	-.180	16.36	-.166	9.82			-.179	16.26	-.165	9.81		
promotion *t*	.055	3.91	.036	2.41	.022	1.84	.060	4.28	.037	2.49	.024	1.99
female*promotion	-.009	0.38	-.005	0.19			-.011	0.50	-.005	0.21		
promotion selection	-		-		-		.173	4.97	.072	1.84	.230	4.46
Adjusted R-squared	.354		.339		.109		.355		.340		.110	
Men (N=9456)												
promotion *t*	.067	4.78	.039	2.47	.020	1.28	.076	5.33	.041	2.61	.022	1.36
promotion selection	-		-		-		.271	6.94	.124	2.80	.159	2.55
Adjusted R-squared	.337		.326		.092		.341		.329		.093	
Women (N=4341)												
promotion *t*	.035	1.97	.028	1.66	.026	1.51	.026	1.47	.027	1.56	.028	1.62
promotion selection	-		-		-		-.239	5.29	-.100	1.87	.183	2.88
Adjusted R-squared	.417		.388		.173		.420		.391		.175	

Notes: (i) N is number of person-year observations. There are 2327 men and 1090 women. t-statistics are unweighted. Other controls included in the estimation but not reported in the table are highest educational qualifications, experience, tenure, married/cohabiting, ethnicity, disabled, union coverage, U/V ratio, establishment size dummies, regional and industry dummies, sector, occupational dummies, any work-related training in the last 12 months of the current job, and coverage by performance-related pay.

(ii) Variables included in the promotion probit but excluded from the wages equations are number of children variables, total hours worked, and whether or not overtime hours are paid. The industrial classification and region of residence dummies were included in the promotion equation at a greater degree of disaggregation than in the wages equation (see also footnotes 11 and 12). Variables included in the wages equations but excluded from the promotion probit include performance-related pay and any work-related training in the last 12 months of the current job. Both are omitted on grounds of endogeneity.

TABLE 7: Growth of Hourly Wages, 1991-95 (Balanced panel, Full-time workers)

Variables	Column 1 All (N=1849) coeff.	t-stat	Column 2 Men (N=1289) coeff.	t-stat	Column 3 Women (N=560) Coeff.	t-stat
Model 1						
Female	-.109	3.96	-		-	
Promotion *t*	.052	2.07	.058	1.77	.070	1.38
Promotion *t-1*	.049	1.63	.052	1.41	.034	0.67
Promotion *t-2*	.077	2.43	.076	1.76	.089	2.10
Promotion *t-3*	.073	3.07	.103	3.18	.019	0.47
Promotion *t-4*	.061	2.07	.087	2.27	-.004	0.09
Adjusted R-squared	0.249		0.258		0.303	
Model 2						
Female	-.110	3.83	-		-	
Female*promotion	-.010	0.23	-		-	
No. of promotions	.114	4.38	.105	3.29	.138	3.35
No. of promotions squared	-.020	2.63	-.012	1.21	-.038	3.36
Adjusted R-squared	0.250		0.258		0.307	

Notes:(i) Other controls included in both models but not reported in the table are highest educational qualifications, experience, tenure, married/cohabiting, ethnicity, disabled, union coverage, U/V ratio, establishment size dummies, regional dummies, industry dummies, sector, occupational dummies, changes in these variables across the period, mean tenure in each job between promotions over the period 1991-95, and initial (1991) wage level.
(ii) N is the number of workers.

TABLE A1: Definition of variables

Variable	Definition
Variables proxying effort:	
Overtime hours worked	Number of overtime hours usually worked in a normal week
Overtime paid	Takes value one if overtime paid
Number of children<3 years	Number of children <3 years old in the household
Number of children 3-4	Number of children 3-4 years old in the household
Number of children 5-11	Number of children 5-11 years old in the household
Number of children 12-15	Number of children 12-15 years old in the household
Number of children 16-18	Number of children 16-18 years old in the household
Partner present	Married or cohabiting at interview date
Highest qualification:	
O-level	Highest educational qualification is one or more 'Ordinary'-level qualifications (later replaced by GCSE), usually taken at the end of compulsory schooling at age 16 years
A-level	Highest educational qualification is one or more 'Advanced'-level qualifications, representing university entrance-level qualification typically taken at age 18 years
Higher qualification	University degree or equivalent qualification or above
Other attributes:	
Female	Female
Non-white	Non-white ethnic origin
Experience	Experience (years) in employment since labour market entry
Experience-squared	
Tenure	Tenure (years) in current job. (For people who have been promoted, this will differ from tenure with the employer.)
Tenure-squared	
Union coverage	Recognised trade union or similar organisation for negotiating pay and other similar conditions in the workplace
Disabled	Registered as disabled either with social services or a green card
Size10	Fewer than 10 employees at the establishment
Size50	10-49 employees at the establishment
Size100	50-99 employees at the establishment
Size500	100-499 employees at the establishment
Public sector	Works in public sector
Charity	Works in non-profit making organisation (charities, co-operatives etc.)
Occupation[16]	
Professional	Professional occupation, calculated from the standard occupational classification
Managerial	Managerial occupation
Non-manual	Skilled non-manual occupation
Skilled manual	Skilled non-manual occupation
Base	Semi-skilled and unskilled manual occupations
Date of labour market entry:	
1960s cohort	Entered the labour market 1961-1970
1970s cohort	Entered the labour market 1971-1980
1980s cohort	Entered the labour market 1981-1990
1990s cohort	Entered the labour market 1991 onwards
Labour market tightness (inverse measure)	Ratio of local unemployment to vacancies stock. The geographic unit is 306 matched job centres. This information was obtained from the National On-line Manpower Information Service.
Regional variables	Eleven regional dummies representing region of residence: London, South East, South West, East Anglia, East Midlands, West Midlands, North West (incl. Manchester), Yorkshire, Wales, and Scotland. The base is the rest of the North of England. In the wage regressions, we distinguish only three main regions: London, South East and the rest (chosen after preliminary estimation with more disaggregated measures).
Industrial dummy variables	Ten one-digit Standard Industrial Classification dummy variables. (Only 4 industrial dummies are used in the wage regressions: energy, extraction, metal goods and other manufacturing industries in the first category; banking, finance, insurance and business services in the second category; construction, distribution, transport and other services in the third category; agriculture, forestry and fishing in the base category. The base for the promotion probits is also agriculture, forestry and fishing.)

[16] Occupation of origin categories are the same as for current occupation. We identify occupation of origin with the first full-time job after leaving full-time education using the retrospective work history information collected in the third wave (1993) of the BHPS.

Figure 1: Surplus and Wages Gained by Workers in Period 2

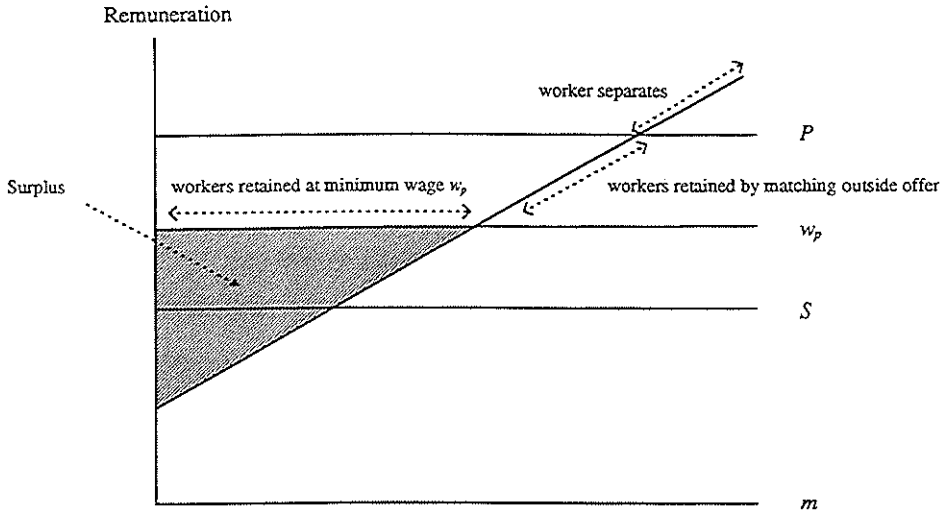

Figure 2: Surplus and Wages Gained in Period 2 by Men and Women in the Lazear and Rosen Model

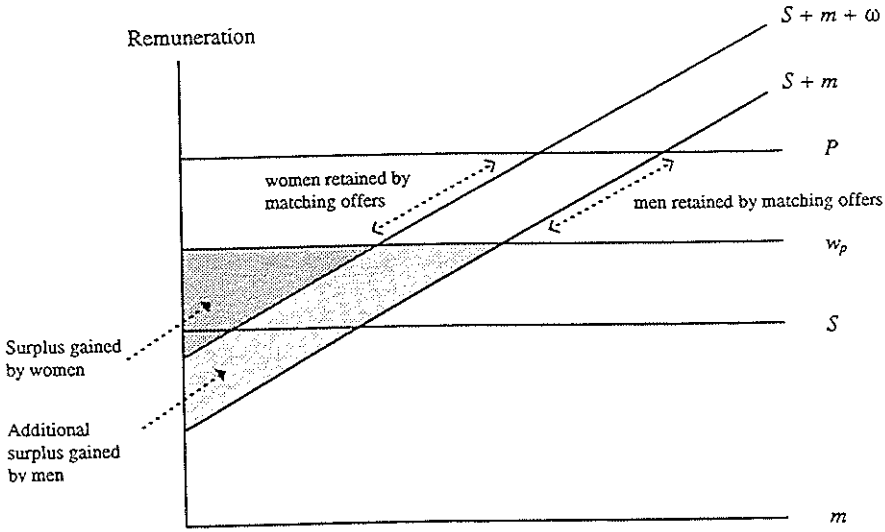

Figure 3: Surplus and Wages Gained in Period 2 by Men and Women in the Sticky Floors Discrimination Model