The Glass Ceiling Effect*

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Abstract

The popular notion of glass ceiling effects implies that gender (or other) disadvantages are stronger at the top of the hierarchy than at lower levels and that these disadvantages become worse later in a person's career. We define four specific criteria that must be met to conclude that a glass ceiling exists. Using random effects models and data from the Panel Study of Income Dynamics, we examine gender and race inequalities at the 25th, 50th, and 75th percentiles of white male earnings. We find evidence of a glass ceiling for women, but racial inequalities among men do not follow a similar pattern. Thus, we should not describe all systems of differential work rewards as "glass ceilings." They appear to be a distinctively gender phenomenon.

In the summer of 1999 two events focused attention on the glass ceiling that women are widely believed to face in the business world. The positive news was that Carleton Fiorina was named the new CEO of Hewlett-Packard, the first female chief executive officer of a Fortune 500 company. Her appointment was heralded as evidence that a glass ceiling no longer exists. She claimed that women face "no limits whatsoever. There is not a glass ceiling" (Meyer 1999: 56). On the other hand, Catalyst, an independent research group, issued a report on corporate women that highlighted the persistence of a glass ceiling, especially for women of color. According to this report, women of color perceive a "concrete ceiling" and not

simply a glass ceiling (Catalyst 1999). These two announcements suggested very different conclusions about the conditions for working women in U.S.

Part of the disagreement results from the lack of a clear definition of what is meant by a glass ceiling. In this article we extract from the recent literature four conditions that should be met in order to define a gender (or other) inequality as a glass ceiling effect. We then propose an empirical test based on these propositions. Applying the test to data from the Panel Study of Income Dynamics, we find the four conditions are met for gender, but not racial, inequality in the U.S.

The Glass Ceiling Concept: A Review and Critique

Not all gender or racial inequalities need to be defined as glass ceilings. If the "glass ceiling" is intended merely as a more colorful phrase to describe what we already mean by gender or racial inequality, then we are proliferating concepts that may ease our communication with the public, but do little to advance our work as analysts of the causes of inequality. Therefore, our first goal is to provide a clear content to the glass ceiling concept, deriving our definition from its usage in recent literature. For us, a glass ceiling is a specific type of gender or racial inequality that can be distinguished from other types of inequality. In defining the glass ceiling more precisely, we are not suggesting that this type of inequality is more unjust or larger than other types of inequality; nor do we believe it is necessarily more deserving of policy interventions than other types of inequality. It is merely different, and because it is different, it requires distinction from other inequalities.

Before outlining the four criteria that might be used to define a glass ceiling effect, it is important to note that we have kept the type of outcome being studied intentionally ambiguous. Some investigations have looked at levels of authority (e.g., Wright, Baxter & Birkelund 1995), others at positions in the corporate hierarchy (e.g., Frankforter 1996), others at earnings (e.g., Duleep & Sanders 1992), and others at occupation (e.g., Fernandez 1998). Each of these employment characteristics can be fruitfully investigated as exhibiting glass ceiling effects, so the criteria below are framed generally in terms of "outcomes" rather than for one specific measure.

CRITERION 1

According to the Federal Glass Ceiling Commission (1995a:iii), the concept *glass ceiling* refers to "artificial barriers to the advancement of women and minorities." These barriers reflect "discrimination . . . a deep line of demarcation between those who prosper and those left behind." The glass ceiling is the "unseen, yet unbreachable barrier that keeps minorities and women from rising to the upper rungs of the corporate ladder, *regardless of their qualifications or achievements*" (Federal Glass Ceiling Commission 1995b:4; emphasis added). This official description

suggests that the definition of a glass ceiling must recognize that it reflects a job inequality that is unexplained by a person's past "qualifications or achievements"; it reflects labor market discrimination, not just labor market inequality. The usual, but imperfect, method for detecting discrimination is to look for inequalities that are unexplained by prior characteristics of the employees. Inequalities that derive from past discrimination in education or training or from choices that people make to pursue nonmarket goals such as family, volunteer work, or leisure are not generally considered as part of a glass ceiling. Therefore, our first criterion for a glass ceiling is that:

A glass ceiling inequality represents a gender or racial difference that is not explained by other job-relevant characteristics of the employee.

In practice, this means that glass ceilings are measured as the residual differences due to race or gender after controlling for education, experience, abilities, motivation, and other job-relevant characteristics.

Several contentious issues have arisen around discrimination research that will also affect glass ceiling research. First, it is impossible to measure and control for all the job-relevant employee characteristics that affect outcomes; some part of the residual difference may reflect true differences in productivity or preferences, not discrimination.

Second, it is possible to control for *too many* job characteristics since some characteristics of past jobs may explain how discrimination happens, so controlling for them masks rather than detects discrimination. For example, Naff and Thomas (1994) control for "support from a mentor" which could as easily be interpreted as one way in which discrimination occurs to create glass ceilings. Similarly, if earnings or authority is the outcome being studied, controlling for occupation would be inappropriate because occupation changes are a primary way in which careers advance. Do teachers become principals; do principals become school superintendents? Do clerical workers become office managers? Do factory line workers become first-line supervisors; do first-line supervisors become plant managers? Controlling for these occupational changes could potentially eliminate a significant portion of the glass ceiling effect.

Finally, there can be reasonable disagreements about what constitutes "job-relevant" characteristics that need to be controlled to establish discrimination. For example, while most would consider family characteristics (e.g., marital status, presence and age of children) illegitimate criteria for promotion and success that should not be controlled in glass ceiling studies, others could argue that these are proxies for a family versus career orientation that affects productivity and are therefore job-relevant characteristics that need to be controlled. This is not an easily resolved empirical issue. We note the problem here, and construct our own empirical analysis around what we see as the predominant position: marriage and family are not factors that should be controlled in studies of discrimination. We

will return to this issue in the discussion when we speculate on reasons for a glass ceiling effect.

CRITERION 2

If labor market discrimination was all that was meant by a glass ceiling effect, it would not be necessary to invent a new concept. A glass ceiling usually implies a particular type of labor market discrimination that is more specific than the general concept of differential returns for equal amounts of human capital. The next criteria attempt to specify those distinctions.

Included in the commission description is the idea that the glass ceiling refers to inequalities at high levels of outcomes ("the upper rungs of the corporate ladder"). Thus, Wright, Baxter and Birkelund (1995:428) argue that "the glass-ceiling hypothesis is not simply a claim about the existence of discrimination within hierarchies; it claims that such discrimination *increases* as one moves up the hierarchy." An Ontario attorney interviewed by Kay and Hagan (1995:304) stated, "at first, I didn't notice any problem, but as I get more senior I constantly feel that I am not treated seriously by male peers. I am paid less in the partnership, my concerns are dismissed as emotional, etc." So, our second criterion states:

> A glass ceiling inequality represents a gender or racial difference that is greater at higher levels of an outcome than at lower levels of an outcome.

For example, in an organization or industry that has a gendered glass ceiling, the female share of CEOs ought to be lower than the female share of company officers, the female share of officers should be lower than the female share of middle managers, etc. In a typical earnings analysis, the gender effect on the probability of earning over $100,000 ought to be greater than the gender effect on the probability of earning over $20,000. If the gender inequalities are constant throughout the hierarchy, then the gender effect is simply a manifestation of gender inequality, not the more specific inequality of a glass ceiling.

Because this higher levels criterion is implied in most uses of the glass ceiling concept, empirical studies are sometimes limited to professional or managerial samples. Thus, studies of lawyers (Kay & Hagan 1995), physicians (Lorber 1988), engineers (Morgan 1998), scientists (Tang 1997), corporate officers (Frankforter 1996), and federal bureaucrats (Naff & Thomas 1994) have all discussed inequalities in terms of a glass ceiling. Presumably, inequalities at these high status levels represent some upper boundary on advancement.

But gender inequality among professionals and upper-level managers does not represent a *de facto* glass ceiling. If women in nonprofessional and nonmanagerial positions experience the same degree of gender inequality in their work lives as professional and managerial women, then the inequality we see among professionals and managers is not a glass ceiling but rather a common pattern of gender inequality. In other words, if the degree of gender inequality is the same at

elite levels as for the general population, or the same comparing male and female professionals and male and female blue-collar workers, then we have no need for a glass ceiling concept; we are simply observing gender inequality.

Although this criterion of greater inequality at higher levels is common to many usages of the glass ceiling (see also Duleep & Sanders 1992; Frankforter 1996), it is not universal. Reskin and Padavic (1994:82) suggest that "a glass ceiling blocks the on-the-job mobility of women of all classes, as well as minorities of both sexes." They marshal several studies on promotions and authority to support this claim, although none specifically addresses differential authority and promotions by class. Harlan and Berheide (1994) argue the glass ceiling applies to low-wage women workers, even those with very limited job ladders. They suggest these female workers experience limited job advancement as witnessed by lower pay, fewer benefits, etc. Criterion 2 does not rule out glass ceilings for working-class women, but it does require that job limits of women in the middle of a hierarchy should be worse than for job limits at lower levels (and not as bad as job limits even higher in the hierarchy). If the limits on women's advancement are constant throughout the hierarchy, then it is just gender discrimination, not a glass ceiling.

Ferree and Purkayastha (2000) raise an insightful caveat about this criterion of more discrimination at higher levels. They point out that even if women's lower odds of advancement is constant throughout the outcome distribution, if these advancement decisions are made sequentially, then the selection effects increase the difference between women's true abilities and men's abilities at higher levels. Thus, a constant lower chance of advancement represents *more* discrimination at top of the hierarchy where the pool of available women has become superior to the pool of available men because of past discrimination. Wright and Baxter (2000), who initially championed the criterion of increasing odds differentials (see Baxter & Wright 2000), concede this point and back off from their initial insistence on this test of a glass ceiling. We also are persuaded that glass ceilings can exist even if advancement chances do not become worse at higher levels. On the other hand, if advancement chances become worse at higher levels, then we can be even more confident about concluding that glass ceilings exist. Therefore, we recommend maintaining this test for glass ceilings but being cautious about interpreting negative empirical findings.

CRITERION 3

The next two criteria are closely related:

> A glass ceiling inequality represents a gender or racial inequality in the chances of advancement into higher levels, not merely the proportions of each gender or race currently at those higher levels.

Promotions to higher positions and *raises* of income are the proper subject of glass ceiling tests (Naff & Thomas 1994; Reskin & Padavic 1994; Stroh, Brett &

Riley 1996). The glass ceiling ought to be tested in dynamic models that measure change over time (e.g., England et al. 1988; Hannan, Schomann & Blossfeld 1990; Rosenfeld 1980), not just in static comparisons of outcome levels. Of course, more movement into higher positions should, eventually, be associated with greater proportions of women or minorities in higher positions. However, the resulting proportions depend also on (1) entry levels: if men enter at higher levels to begin with, more men will end up at higher levels, even with equal promotions; and (2) exits: if women leave more often, for instance, because of perceived poor chances for promotion (Stroh, Brett & Riley 1996), then that too would contribute to more men ending up in the highest positions.

This promotion and change criterion becomes an especially strong test of a glass ceiling effect in conjunction with the second criterion specifying increased discrimination at higher levels. Together, they restrict a glass ceiling inequality only to situations where inequalities for *promotions* to higher levels are stronger than inequalities for promotions to lower levels. It is possible, perhaps even common, to have stronger gender or racial inequalities for frequencies at the top of a hierarchy than at the bottom without the gender or racial differences in the chances for promotions increasing across levels. If we assume a sequential process with a constant gender disadvantage for promotions at each level (i.e., not satisfying criterion 3 with regard to promotions), those constant promotion disadvantages will accumulate over the hierarchy so that gender gaps will be wider at higher levels than at lower levels (i.e., satisfying criterion 2 with regard to outcome levels).

A concrete example can make this clear. Suppose from a pool of 100 men and 100 women, 20 men and 10 women are promoted to the next level of management, i.e., men have twice the promotion rate of women. If the same ratio applies for promoting these 20 men and 10 women, then 4 men and 1 woman will be promoted to the next level. The ratio of men to women at the top is 4:1 while it is approximately 2:1 at the middle and 1:1 at the bottom. Nevertheless, we are not witnessing a glass ceiling, but a constant promotion disadvantage for women. Our "strong" version of the glass ceiling concept, incorporating both criteria, specifies that not only outcomes but promotions and earnings increases are more gender biased at higher levels. The result is that the gender gap not only grows but accelerates as one moves up the hierarchical order.

Not many studies have actually tested for glass ceilings in promotions or raises since few studies have the necessary longitudinal data. Most research has investigated cross-sectional levels of outcomes, even when glass ceilings were conceptualized as discrimination in promotions or earnings increases.

CRITERION 4

Finally, a few studies explicitly (and others more implicitly) define the glass ceiling as disadvantages that grow over the career (e.g., Morgan 1998). A ceiling implies that some upward movement has been made in the past but that later in one's

career, more severe discrimination sets in to block further progress. This leads to the fourth criterion:

> *A glass ceiling inequality represents a gender or racial inequality that increases over the course of a career.*

Studies that observe career trajectories can test whether a gender gap (in earnings or authority) increases with increasing work experience (Corcoran & Duncan 1979).

Two problems can arise with studies of career trajectories. First, a comparative referent is still needed. If gender or racial gaps increase with more experience for people who start near the bottom as well as for those who start in the middle or near the top, it is not clear we are dealing with a glass ceiling effect or with the simpler idea of differential returns to work experience. The second criterion specifies that the inequality must be greater at the top than at the bottom, so, together with this fourth criterion, a glass ceiling implies that the divergence in career trajectories is greater for chances at high levels of outcomes than for chances at more modest outcome levels. Using gender as an example, career trajectories should be flatter for women than for men under a glass ceiling — but more so for chances to enter top offices or earn very large amounts than for the chances to enter middle management or make a comfortable living.

A second problem with experience-based tests of a glass ceiling effect is that cross-sectional data potentially conflates experience effects with cohort effects. Since older cohorts have always had larger gender inequalities even at early stages in their work histories, these cohort differences will appear as experience effects in any cross-sectional study (England 1992:26). In any cross-section, the most experienced workers will come from the earliest cohorts so their greater gender inequality will make it appear that inequalities grow with experience. Longitudinal designs are required to disentangle the cohort and experience effects. Morgan (1998) has shown in a sample of engineers that early cohorts had larger gender earnings gaps than later cohorts, but these gaps did not grow between 1982 and 1989 for any of the cohorts. She suggests the constancy in the earnings gaps across time implies the absence of a glass ceiling.

Studying career trajectories has the additional benefit of assisting in the investigation of whether the more stringent dynamic conditions of criterion 3 are met. Plotting career trajectories reveals not only the inequalities in the levels of outcomes but also inequalities in the annual changes in those outcomes. The slopes of those trajectories represent promotions or raises — the changes in hierarchical position or salary increments — that must also be lower for women and minorities than for white men if criterion 3 is to be met.

We illustrate the conditions for a glass ceiling effect in Figures 1A, 1B, and 1C. In these figures we plot the hypothetical chances of men and women attaining a low-level outcome (e.g., $10,000 in earnings or some minimal level of authority) and their chances of attaining a high-level outcome (e.g., $100,000 in earnings or

becoming a CEO). Figure 1A provides evidence of gender inequality, but not of a glass ceiling effect. Assuming the curves are produced from an analysis that controls for education and other job-relevant characteristics, they satisfy criterion 1, but none of the other criteria. The gender difference is equal for both outcomes (not satisfying criterion 2); the annual changes — the slopes of the curves — are equal for men and women at each year of experience (not satisfying criterion 3); and the gender gap fails to grow with work experience (not satisfying criterion 4). This is a case of gender inequality, perhaps even gender discrimination, but not a glass ceiling effect.

Figure 1B shows a gender difference in outcomes that is larger for the low-probability (high status) outcome, thus satisfying criterion 2. However, the male-female gap does not grow with additional work experience, and the annual changes are equivalent for men and women. Hence, Figure 1B also fails to show a strict glass ceiling effect.

Finally, Figure 1C displays a glass ceiling effect. There is a gender difference in outcomes that is greater for the low-probability outcome and also increases with more work experience. The slopes are also steeper for men than women at the higher outcome showing that annual changes are greater for men than women. All four glass ceiling criteria are satisfied.

At present, it is difficult to determine if women and/or minority workers really face a glass ceiling because of the varying definitions in the existing literature. These four conditions are offered as a tool for clarifying the concept of a glass ceiling effect. Agreement on the definition should help comparisons across different data and across different outcomes — unequal authority, earnings, etc. — all of which may indicate a glass ceiling exists.

A Comprehensive Method for Testing Glass Ceiling Effects

In this section, we present a method for measuring glass ceiling effects that incorporates all four criteria outlined above. We do so by laying out our analytic strategy and highlighting the key methodological concerns related to measuring a glass ceiling effect. Our own use of this method focuses on earnings data from the Panel Study of Income Dynamics (PSID) because of the ready availability of longitudinal data on earnings and experience. While our concrete example follows these data, we seek to develop a strategy for investigating glass ceiling effects that might be applied equally as well to authority, grade level, or other outcomes.

The first glass ceiling criterion implies discrimination. We test for this in the usual, if imperfect, way by calculating race and gender effects holding constant other crucial factors. Of course, not all outcome-relevant factors can be controlled so some of the remaining race and gender differences may not reflect discrimination. But we know from past research that education, work experience and tenure explain a significant proportion of the total race and gender differences

(e.g., Corcoran & Duncan 1979; Wellington 1993, 1994). With the fairly recent growth in women's entry into high paying professions such as medicine and law and the increases in women's managerial positions (Jacobs 1992), women's disadvantages at higher earnings levels may simply reflect their lower experience levels. So at the minimum, experience and tenure need to be held constant. In fact, few of the existing glass ceiling studies meet even this minimum test (for exceptions, see Kay & Hagan 1995; Naff & Thomas 1994; Tang 1997).

Second, a glass ceiling effect implies that the gender and race effects are strongest for the chances of advancing to the highest levels of the outcome. Therefore, the outcome scale needs to be divided into partitions, and inequality effects must be calculated separately at each level of the outcome (e.g., none/some/high authority; low/moderate/high earnings). Separate logistic regressions estimate gender and race effects across each partition. If the outcomes are normally distributed and the distribution of female outcomes mirrors the distribution of male outcomes but at a lower level, then the gender coefficient will be constant across all possible partitions. But if women are especially disadvantaged in the upper tail of the outcome distribution, then the coefficients will increase as the partitions get higher.[1]

This strategy extends a growing trend towards investigating inequalities at all levels of the outcome variable (Bernhardt, Morris & Handcock 1995; Cotter, Hermsen & Vanneman 1999). The approach is sensitive to the functional form of the comparisons made at each level of the outcome: simple percentage differences, for instance, will rarely show the same gender gaps at higher levels than in the middle of the distribution. A logistic or probit transformation avoids this problem (Cotter et al. 1997).

In the analyses to follow, we divide the hourly earnings distribution at three points: the 25th, 50th, and 75th percentiles of white male earnings. These cutoffs represent three different thresholds of earnings that an individual may or may not surpass. Larger gender coefficients at the 75th than the 25th percentile indicate gender is more important at the higher threshold in determining earnings chances.

Finally, because glass ceilings reflect chances for advancement that grow more slowly over the career for some individuals, we calculate individual career trajectories over time. These career trajectories implicitly incorporate average annual changes in earnings chances (criterion 3) and enable us to test whether the race and gender differences increase with more work experience (criterion 4). We want to know how the returns to experience vary by race and gender across outcome levels. A glass ceiling implies that women and minorities fall further behind white men as their careers progress and that this growing disadvantage is more noticeable at higher earnings levels than at lower ones.

The PSID provides longitudinal data that allow us to calculate career trajectories for each individual (holding constant the controls enumerated below) and compare these career trajectories across race and gender. This design avoids the conflation

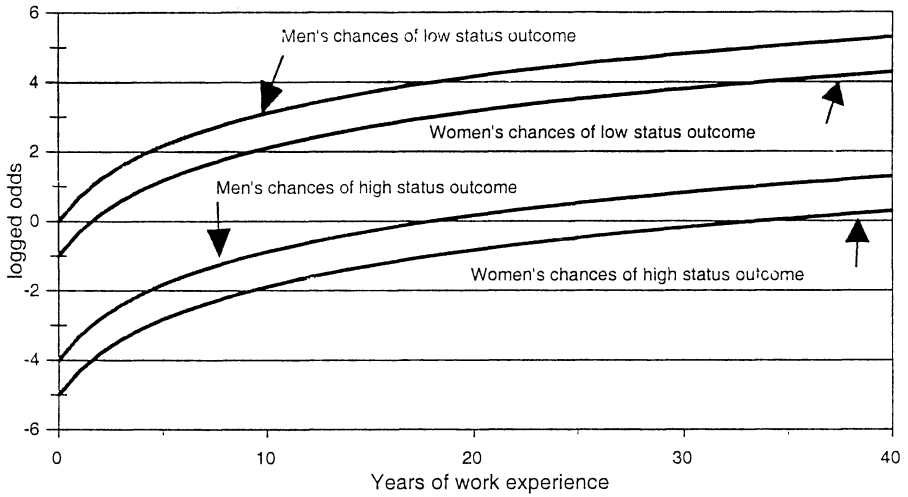FIGURE 1A: Gender Inequality Only

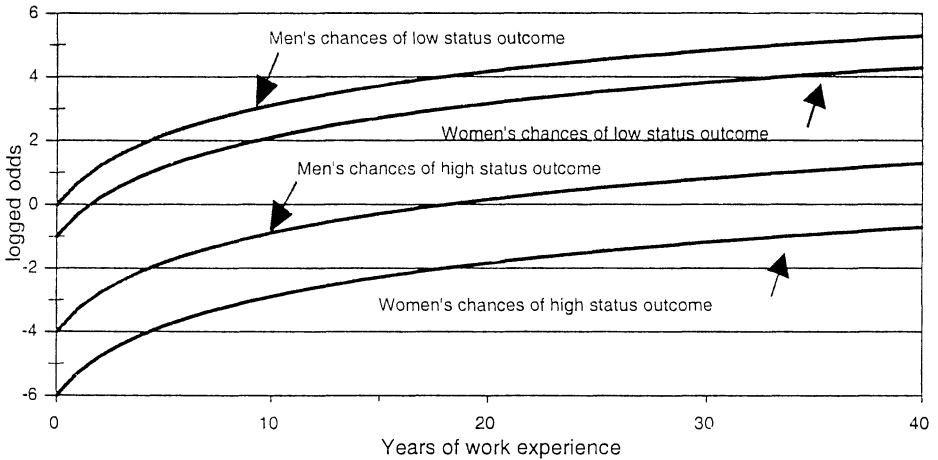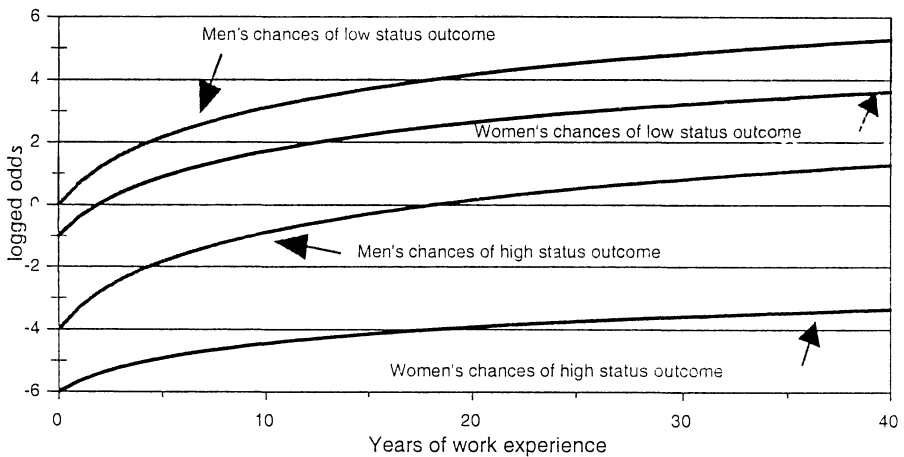FIGURE 1B: Gender Inequality Greater for High-Status Outcome

FIGURE 1C: Gender Inequality Growing Over Career, More for High Status

Men's chances of low status outcome

Women's chances of low status outcome

Men's chances of high status outcome

Women's chances of high status outcome

logged odds

Years of work experience

of experience and cohort effects that Morgan (1998) warns against since we calculate the experience effects separately for each individual. In addition, we include direct controls for cohort. More importantly, studying career trajectories enables tests for the race and gender effects on the *rate of change* in the outcome over the career. We employ random effects models to examine the determinants of work experience effects, allowing the experience coefficient to vary across individuals. Random effects models are equivalent to multilevel methods in which work years are nested within individuals (Bryk & Raudenbush 1992).

It is convenient to express the strength of the work experience effect as a single coefficient so that we can have a simple test whether that coefficient is stronger among white men than among women or minorities. Work experience effects are generally not linear: income and promotions increase rapidly in the early career and then level off. This can be seen, for example, in the curves of Figure 2, which uses the PSID data to plot the chances of exceeding low, middle, and high levels of hourly earnings at each year of work experience in the data file. These are simple cross-tabulations, uncontrolled for other factors that also determine earnings, but the curvilinearity of the experience effects is obvious. We capture this curvilinearity in a logarithmic function that, in results not reported here, fits these curves better than alternatives such as a linear, square root, or quadratic function.

Methods

Sample

This study uses data from the 1976-93 waves of the PSID to construct a person-year file. We restrict the sample to men and women ages 25-59 in the civilian labor force who worked at least 250 hours during the year. The age restrictions minimize the problems of sample selection introduced by college attendance in younger ages and retirement in older ages. We include part-time and part-year workers, who are disproportionately women and who may have flatter career trajectories because of their part-time status, so the analysis includes controls for hours worked and a dummy variable indicating part-time status (less than 1500 hours worked that year). Further, we include only respondents who are PSID sample members, not spouses who marry into the PSID sample, in order to ensure a representative sample of the U.S. population. The number of cases each person can contribute depends upon the number of years the individual is in the PSID sample and employed. The person year file includes 39,051 cases for 4,278 persons.

Partitions of Earnings Outcomes

We use hourly earnings as the basis for constructing the dependent variables in this study. We construct three dummy variables for each person within each year to indicate whether the respondents' hourly earnings surpassed the white male 25th, 50th, and 75th earnings percentiles. A person who is above the 75th earnings percentile will have a value of 1 for all three percentile dummy variables. The white male earnings threshold for each percentile is calculated for each year using the sample data.

Gender and Racial/Ethnic Gaps

We construct four dummy variables for white men, white women, African American men, and African American women. Members of other racial/ethnic categories were excluded from the sample due to sample size limitations and concerns about complexity of the models. We omit the white men dummy variable from the models so they serve as the comparison group.

Work Experience

The primary independent variable of interest is work experience, operationalized as the natural logarithm of cumulative work experience since age 18.[2] A glass ceiling effect would be observed if gender (or race) has an effect on the log experience coefficient that is increasingly negative as the level of outcome increases.

FIGURE 2:   Earnings Chances by Work Experience
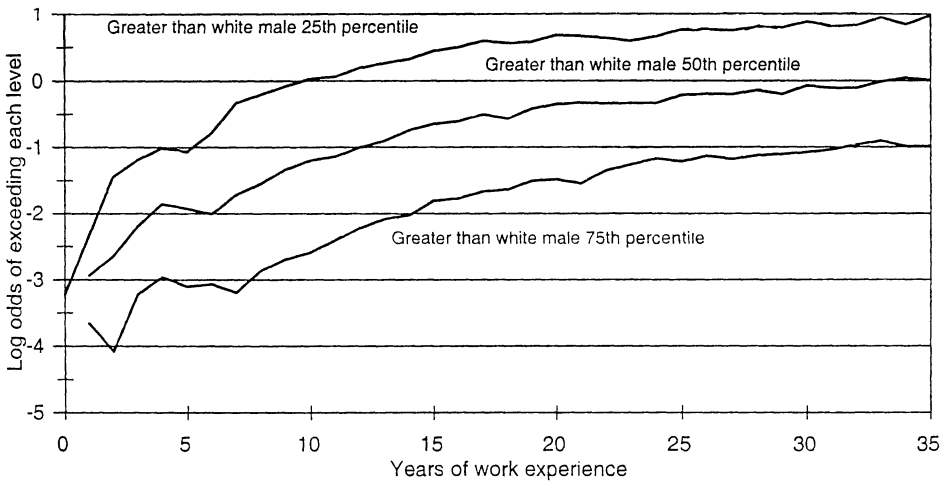
Source: 1975-93 PSID

CONTROL VARIABLES

We control for total hours worked during the year, a dummy variable for working less than 1500 hours, a dummy variable for self-employment, a measure of unemployment during the year, an urbanization scale,[3] a South/non-South dummy variable, whether the job is covered by a union, and a measure of tenure with the current employer. These controls are all time-varying. In addition, we control for years of completed education,[4] birth cohort, and average levels of the time-varying controls for the across-person model.

SELECTION BIAS CORRECTION

An individual can encounter a glass ceiling only if he or she is currently employed. Heckman (1979) has argued that failure to account for selection into an employed sample may produce inconsistent results in studies of labor market inequality. We test for sample selection bias in the usual two-step procedure. First, we estimate a probit model with employment for 250 hours as a function of marital status, presence and age of children in the household, age, education, experience, nonwage income, region, county unemployment rate, urban residence, and year for the full sample. We then use the probit equation to calculate a selection bias term, the

inverse Mills ratio, that is then incorporated as a variable in the glass ceiling analyses for those who are currently employed.

MULTILEVEL MODEL ESTIMATION

We use hierarchical nonlinear modeling to test the effects of gender and race on the chances of exceeding each earnings level and on the work experience slopes of those chances. We seek to trace here the average career earnings trajectories for each of the four gender-race subsamples at each of the three earnings percentiles.

The full multilevel model is (1a, 1b, 1c, and 1d):

$$\ln \frac{p_{iy}}{(1-p_{iy})} = \beta_{0i} + \beta_{1i} * \ln(1 + EXPER_{iy}) + \sum_{j=2}^{Nj} \beta_{ji} * (X_{jiy} - \overline{X_{j..}}) + r_{iy}$$

$$\beta_{0i} = \gamma_{00} + \gamma_{01} * WFEM_i + \gamma_{02} * BMAL_i + \gamma_{03} * BFEM_i + \sum_{k=4}^{Nk} \gamma_{0k} * (Z_{ki} - \overline{Z_{k.}}) + u_{0i}$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11} * WFEM_i + \gamma_{12} * BMAL_i + \gamma_{13} * BFEM_i + \sum_{k=4}^{Nk} \gamma_{1k} * (Z_{ki} - \overline{Z_{k.}}) + u_{1i}$$

$$\beta_{ji} = \gamma_{j0}$$

where

$ln\ (p_{iy}\ /[1-p_{iy}])$ = the log odds of exceeding the p*th* percentile for individual i in year y;

β_{0i} = the intercept for individual i (at experience = 0);

β_{1i} = the experience coefficient for individual i;

$EXPER_{iy}$ = years of work experience for individual i at year y;

β_{ji} = the coefficient for time-varying variable j for individual i;

X_{jiy} = a vector of j time-varying variables (e.g., hours worked) describing individual i in year y;

$\overline{X_{j..}}$ = a vector of j grand means of the time-varying variables;

r_{iy} = the time-varying error term for year y for individual i;

γ_{00} = the intercept of the equation for the individual intercept, the log odds for the average white male in the first year of work;

γ_{01} = the difference between the average white woman and the average white man on the log odds of exceeding percentile p during the first year of work and at average values of all time-varying variables; γ_{02} for the African American woman's difference; and γ_{03} for the average African American man's difference;

$WFEM_i$ = a dummy variable for individual i where white females = 1;

$BMAL_i$ = a dummy variable for individual i where African American males = 1;

$BFEM_i$ = a dummy variable for individual i where African American females = 1;

γ_{0k} = a vector of k person-level coefficients for the effects of Z_{ki} on the coefficients β_{0i};

Z_{ki} = a vector of k person-level time-invariant variables (e.g., education) describing individual i;

$\overline{Z_{k.}}$ = a vector of k grand means of the person-level variables;

u_{0i} = the person-level error term for coefficient β_{0i} for individual i;

γ_{10} = the intercept of the equation for individual's experience effect; = the experience effect for the average white male;

γ_{11} = the difference between the experience effect of the average white woman and of the average white man; γ_{12} for the average African American women; and γ_{13} for the average African American man;

γ_{1k} = a vector of k person-level coefficients for the effects of Z_{ki} on the experience coefficients β_{1i};

u_{1i} = the person-level error term for experience coefficient β_{1i} for individual i;

γ_{j0} = the (fixed across all persons) coefficients for time-varying variables X_{jiy}.

    The critical coefficients for a glass ceiling test are the g_{11}, g_{12}, and g_{13} that test the gender and race differences in the experience slopes (criteria 3 and 4) and, together with g_{01}, g_{02}, and g_{03}, test the gender and race differences in the chances of each earnings level (criteria 1 and 2).

Results

We present the full multilevel results in Appendix B but focus primarily on the experience-earnings curves produced by these results. Table 1 reports the differences among the race-gender groups in the returns to experience at each earnings level. These career trajectories are the crucial statistics for a glass ceiling test. These slopes can be best understood in Figures 3A, 3B, and 3C, which show the logged odds of members of each race-gender group exceeding the three percentile levels at each year of experience across a career, net of the control variables.

    The figures show that at each earnings percentile, women (and African American men) have lower chances of exceeding the earnings threshold than do white men, the first piece of evidence to support a glass ceiling. Each of their curves in the figures are below white men's curves at all points. That is, *at each year of work experience,* holding constant the other variables in the models, women and African Americans have lower earnings chances than white men.

    More importantly for a glass ceiling test, the *annual changes* in high earnings chances (i.e., the slope of the odds of advancing beyond the white men's 75th

percentile) are smaller for women than for men, so that the career trajectories *diverge* for women and men at high earnings levels. At the 75th percentile, the return to an additional (log) year of work experience for white men is .753, while the return for white women is only .512 (.753 – .241). For African American women, the logged odds of achieving the 75th percentile only increases by .159 with each additional (log) year of experience.[5] The curves for the 75th percentile resemble Figure 1C, which was the hypothetical representation of the glass ceiling effect incorporating all four criteria. Although throughout their work lives, women have steadily improving chances of reaching the white men's 75th earnings percentile, those chances fail to improve as quickly as white men's. With each year of experience, they fall further behind.

The career trajectories at lower levels of earnings do not show the same divergence in earnings chances for women as are observed at higher levels. In Figure 3A, we can see that even though women start with a small chance of achieving the 25th earnings level early in their careers, this gap progressively *narrows* as experience increases, especially for white women. This can also be understood from Table 1. While white men's logged odds of achieving the 25th percentile increase by .721 with each log year of experience, the increase for white women is 1.074 (.721 + .353). Since white women's chances of achieving the 25th earnings percentile increase over time faster than men's chances, increasing experience leads to convergence. For African American women, the annual return to log experience is .804 (.721 + .083), which is not significantly different from white men's returns. In neither case is gender divergence over the career observed for women in lower income brackets.

At the 50th earning percentile level, there is neither gender convergence nor divergence for white women. It can be seen in Figure 3B that white men's and white women's experience trajectories are essentially parallel and in Table 1, white women's coefficients are not significantly different from white men's. Each year of experience results in an equal improvement in earnings chances for both white women and white men; at no point in their careers do women's chances for a raise beyond the 50th percentile begin falling further behind white men. For African American women however, even at this lower level, their career chances are diverging from white men's. The returns to a year of experience for African American women is .366 (.755 – .389), which is significantly lower than for white men (.755). This can also be seen in Figure 3B where the white men's and African American women's curves diverge so that the gap between them is much greater at the end of their careers than at the beginning.

While both white and African American women face a glass ceiling, African American men do not satisfy the criteria listed above. The differences between the returns to experience for white men and African American men are nonsignificant at all levels (Table 1). Thus, while African American men have lower chances than white men of achieving each of the earnings levels throughout their careers (Figures 3A, 3B, and 3C), their disadvantage is not a glass ceiling: their chances for surpassing

each of the earnings levels increase each year in parallel with white men's. At no point in their careers do they face a growing gap of advancement chances. There is a consistent race penalty, but it is found at all income levels and at all levels of work experience. While the results support a finding of discrimination, there is no evidence this is a glass ceiling effect.

Discussion

Varying techniques in prior empirical research and the widespread use of the term in the mass media have led to a proliferation of different understandings of what constitutes a glass ceiling. In this article, we suggest four criteria that characterize glass ceilings as a form of disadvantage that is distinct from other forms of discrimination in the work place. The essence of a glass ceiling effect is the greater disadvantages for moving into higher outcome (e.g., earnings, authority) levels at later stages in one's work life. If we partition the earnings distribution or other outcome hierarchy into separate benchmarks and observe the inequalities in the chances of advancing beyond each of these benchmarks, a glass ceiling effect is evident if the magnitude of the inequality not only increases, but accelerates, as one moves up the hierarchy.

We find exactly that pattern of results for gender inequalities. Both white and African American women face a glass ceiling in earnings over the course of their careers. At high earnings levels, defined in this research as white men's 75th percentile, the gap between white men's chances and women's chances grows larger over the career. This gap grows only at the higher level of earnings, not at moderate or low levels. In contrast, we do not find evidence of a glass ceiling for African American men. While African American men are less likely than white men to achieve each of the earnings benchmarks, the gap does not grow larger later in their careers, nor is it especially stronger at high earnings levels than at low earnings levels. Thus, the racial pattern of economic disadvantage does not fulfill two of the four criteria that we have specified as constituting a glass ceiling. Although these are the more controversial criteria (2 and 4), glass ceilings appear to be a phenomenon of gender stratification.

Our results differ from the *lack* of a gender differential in experience curves that Corcoran and Duncan (1979) and Wellington (1993) found. Their analyses used least squares regressions that focus on mean earnings. Our results at the white men's 50th percentile are quite similar to theirs. But at the 25th percentile, white women's experience curves converge with white men's; at the 75th percentile, they diverge. Least squares statistics average both of these results together and find no difference. Our results demonstrate once again the hazards of drawing conclusions about the full range of the earnings spectrum based only on measures of central tendency. In this case, those statistics will overstate the disadvantages that lower earning women face and understate the disadvantages at higher earnings levels.

TABLE 1: Work Experience Coefficients by Race and Gender at Three Earnings Levels

| | Models at Each White Male Earnings Level | | |
	25th Percentile	50th Percentile	75th Percentile
Experience trajectories			
Intercept (white men)	.721***	.755***	.753***
White women [a]	.353***	−.028	−.241**
African American men [a]	−.070	.025	.226
African American women [a]	.083	−.389**	−.594***

Note: Models includes controls for union coverage, tenure with employer, education, cohort, residence in the South, metropolitan area, self employment, unemployment during the year, part-time status, and hours worked (see Appendix B).
[a] Coefficients represent differences in experience slopes from white men's.

* p < .05   ** p < .01   *** p < .001

The delineation of criteria for a glass ceiling and the empirical test with earnings are important steps in clarifying the glass ceiling concept and documenting the existence of this type of inequality. However, there are several limitations to the current study. Although we find strong support for a glass ceiling in earnings, this is not the only work-related outcome that may reflect a glass ceiling. For example, gender and racial differences in authority and promotions are two outcomes that are frequently described as demonstrating a glass ceiling. We do not test for glass ceiling effects on these outcomes in this analysis. Thus, our results cannot speak to the extent of glass ceiling effects across multiple outcomes. Future research is needed to test whether glass ceilings do exist in terms of authority and promotions. The model that we have outlined and employed in this article provides a guide as to how these parallel tests could be designed.

Furthermore, the analyses focus only on gender and race with particular attention to the glass ceilings that women and African Americans may encounter. We are not able to confirm or challenge the existence of glass ceilings for other groups. It is certainly the case that other groups may face a glass ceiling, and research is needed to determine if this is so. For example, we know little about the workplace experience of gays and lesbians, including whether they encounter glass ceilings in earnings, authority, and promotions. Though we know a bit more about the work outcomes of the disabled, glass ceilings remain an unexplored area. Although we find no glass ceiling in earnings for African American men, we still need to investigate the existence of glass ceilings for other ethnic groups, especially Asian Americans, for whom glass ceilings have been widely hypothesized (Cheng 1997; Duleep & Sanders 1992; Fernandez 1998).

While the data that we use from the PSID are the best available longitudinal survey of income and work-related items, there are some limitations to the data. Because we can follow the career trajectories of individuals for at most 17 years, we assess only partial careers and estimate full career trajectories by patching together cohorts. Despite controls in the model for cohort membership, late career patterns still must reflect the experience of older cohorts and the early career patterns are determined more by recent cohorts. Whether recent cohorts will follow the same diverging chances at higher earnings levels can only be known after time passes. There is no immediate solution to this problem as it is tied directly to a lack of appropriate longitudinal data. When more waves of the PSID are available, there will be an opportunity to model full career trajectories, including glass ceiling effects.[6]

In addition, our data on education is somewhat more limited than we would desire. We are forced to topcode the educational achievement measure at 16 years (college graduate), which compresses the high end of the education distribution. In addition, we would prefer to have controls for types of education (tracking at the high school level, major at the college and graduate levels) to better control for educational effects. It is possible that the flatter career trajectories of women for entry into the higher earnings percentile could be explained by differences in graduate education (e.g., fewer physicians, lawyers, and MBAs) or in college majors (fewer engineering degrees and more education degrees). However, this information is not available for all respondents in the PSID.

In this article, our goals were primarily descriptive: to define the glass ceiling criteria and to determine whether gender and race glass ceilings exist. We have made no attempt to explain why glass ceilings exist or how they are produced in the workplace. A partial list of factors that may contribute to a glass ceiling includes job ladders, personnel policies, limited enforcement of employment laws, and employer discrimination. Women CEOs emphasize the role of networks and social interests as barriers to top positions (Davies-Netzley 1998). Kay and Hagan (1995) show that women are segregated into lower-paying firms and specializations within elite occupations. Some critics blame women's own low aspirations (Lynch & Post 1996), and conflicts between work and family responsibilities remain a common explanation (e.g., Naff & Thomas 1994). More informal recruitment practices are more likely to disadvantage women (Reskin & McBrier 2000), and it may be that recruitment to higher positions more often uses these informal mechanisms than do promotions or raises at lower levels. Finally, the flatter trajectories at higher earnings levels may be as much a function of women's occupations as of the women themselves (i.e., they may be true for both men and women in predominantly female occupations and not true for women in predominantly male occupations).

Additional research is needed to determine which factors account for the glass ceiling effect. A few of the above factors might be tested with the PSID data. For example, if the glass ceiling effect is greater for married women with children than

FIGURE 3A: Estimated Chances of Exceeding the White Male 25th Percentile by Years of Work Experience for White and African American Men and Women

FIGURE 3B: Estimated Chances of Exceeding the White Male 50th Percentile by Years of Work Experience for White and African American Men and Women
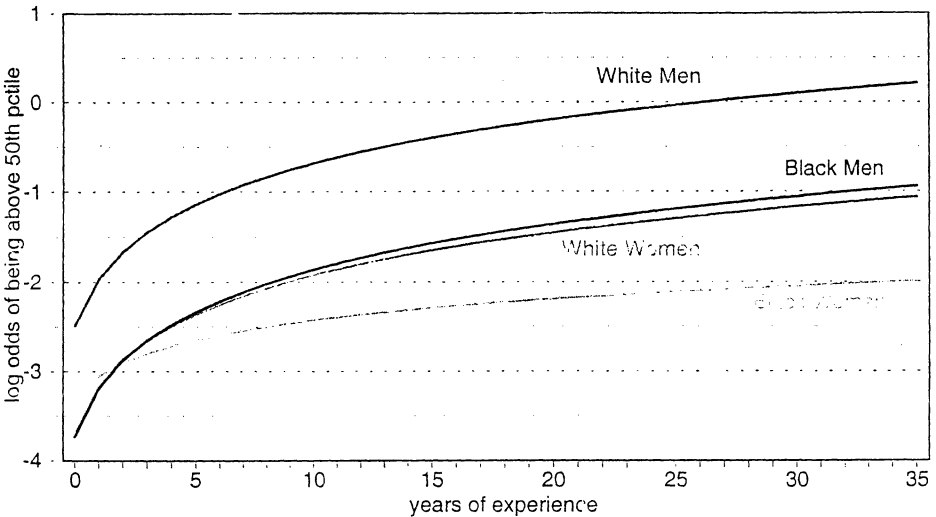
FIGURE 3C: Estimated Chances of Exceeding the White Male 75th Percentile
            by Years of Work Experience for White and African American
            Men and Women

for single women, that would make a work-family conflict explanation more
plausible. Controls for gender composition of the occupation would help sort out
whether it is women who are limited by glass ceilings or whether it is workers in
typically female occupations. Unfortunately, many of the factors most often
mentioned by women themselves, such as "old-boy networks," are rarely measured
in data collections.

The framework outlined in this article provides some guidelines for research
on the mechanisms of glass ceiling discrimination. For instance, research needs to
establish that the causal factors are *more* important for explaining gender inequalities
at top positions and later in the career. All gender labor market inequality is not
the same; inequality at the top of the earnings hierarchy is different from that at
the bottom and thus, the mechanisms, including discrimination, may operate
differently. The factors mentioned above may also play a role at lower levels in the
hierarchy and early in women's careers. Plausible arguments could be made that
job ladders, discrimination, networks, etc. have larger effects at the top than in the
middle or at the bottom, but glass ceiling theories need to make these arguments
more clearly. Duleep and Sanders (1992), for example, begin from a Becker
framework and argue that considerations of social distance should make employers'
tastes for discrimination more evident at higher levels (i.e., where employees are

closer to the actual employer). In addition, those interested in exploring why a glass ceiling exists in earnings are reminded that we find a gender glass ceiling, and not a race glass ceiling. Thus, further theorizing on how the glass ceiling develops should speak to its unique gender dimension.

In conclusion, we offer a set of criteria that can be used to assess the existence of glass ceilings across multiple work outcomes. By doing so, we clarify an important concept that is used often in both scholarly research and mass media. We demonstrate that a glass ceiling does exist as a form of gender inequality over and above that which we typically think of as gender inequality and that there is indeed a need for this distinct concept.

Notes

1. An alternative approach is to use a multinomial logistic model to simultaneously estimate the odds of being in each category. Each approach has its merits and costs. The separate logistic regressions have the disadvantage that the tests are not independent of each other. For example, if the lowest group is racially or gender distinct, it will influence all the regressions and would make it more difficult to detect a glass ceiling effect that requires different results at different levels. The multinomial logit test avoids this dependence but is more sensitive to the cutoff points chosen for the partitions. For example, the results for the top group would look quite different depending on whether they are compared to a group representing the middle two thirds of the distribution or a group representing only the second decile. Since the choice of these partitions is arbitrary for many outcomes, the multinomial strategy may be less robust. We advocate using both methods to uncover any conflicting results. Thus, we have also computed the multinomial logistic model using cutpoints that were identical to those used in the logistic regressions. The conclusions drawn from the multinomial model were nearly identical to the logistic results reported here. Results of the multinomial model are available from the authors upon request.

2. As has been noted before (Brown & Light 1992) tenure and work experience are reported inconsistently in the PSID. Thus it is possible, and not uncommon, for a respondent to report fewer years of work experience or tenure in later surveys. We follow the suggestion of Brown and Light by taking the first report of work experience (and for tenure each time the reported employer tenure is less than the number of months since last interview) and compute years of work experience and months of tenure from that base point by adding years and months in subsequent surveys.

3. The six category urbanism scale is an ordinal variable. For simplicity we include it as a single variable rather than dividing it into five dummy variables. In fact, the six scores are quite close to the logs of the midpoints of the population ranges.

4. While years of education are reported annually, the variation across years appears to be more a function of inconsistent reporting than changing education levels. There are almost as many cases of declines over time as increases, and the increases generally do not proceed in annual increments. For this reason, we chose the modal education response as a fixed characteristic of the individual. The education variable was top-coded

at 16 years for the earlier years of the study, which prevents the identification of postgraduate education in earlier waves and forces us to impose a topcode of 16 years on later years, as well.

5. To interpret these numbers in terms of the annual increase in odds of achieving the 75th percentile, the slope of the experience curve is equal to $\exp(b/[x+1])$ where x is the number of years of experience. For example, white men's odds of exceeding the 75th percentile are increasing at about 4.1% a year at the mean level of experience (17.6 years). White women's odds are increasing only at 2.8% a year and African American women's odds are increasing at 0.9% a year.

6. The same is true for the National Longitudinal Survey of Youth (NLSY). The National Longitudinal Survey of Young Women includes thirty years of data; however, data collection with the comparable National Longitudinal Survey of Young Men ceased in the early 1980s. Thus, these data do not provide the longitudinal scope to assess a *gender* glass ceiling effect.

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APPENDIX A: Means, Standard Deviations, Minima, and Maxima of
Variables Used in the Analyses

	Mean	Std. Dev.	Minimum	Maximum
White male percentile cutoffs (1993 $)				
25th percentile	9.34	1.40	7.00	12.07
50th percentile	13.17	1.77	10.83	16.21
75th percentile	18.45	1.45	15.86	20.48
White male percentile means				
25th percentile[a]	.60	.49	.00	1.00
50th percentile[a]	.35	.48	.00	1.00
75th percentile[a]	.16	.37	.00	1.00
Person-year measures (time-varying)				
Years of work experience (years)[b]	19.03	9.68	.00	41.00
Ln work experience (years + 1)	2.87	.53	.00	3.71
Tenure with current employer (years)[b]	7.78	7.55	.00	41.83
Ln tenure (months + 1)	3.86	1.50	.00	6.22
Hours worked during year (1000s)	1.98	7.02	.25	5.84
Part-time (< 1500 hours)	.19	.39	.00	1.00
Self-employment	.11	.32	.00	1.00
Unemployment	.06	.24	.00	1.00
Metropolitan area	3.29	1.76	1.00	6.00
Union coverage	.19	.39	.00	1.00
South	.31	.46	.00	1.00
Inverse Mills ratio	.22	.23	.01	3.09
Person measures (time-invariant)				
White men	.47	.50	.00	1.00
White women	.44	.50	.00	1.00
African American men	.04	.19	.00	1.00
African American women	.05	.22	.00	1.00
Education (years)	13.12	2.26	2.00	16.00
Cohort: born before 1936	.27	.44	.00	1.00
Cohort: born 1936-45	.17	.37	.00	1.00
Cohort: born 1946-55	.28	.45	.00	1.00
Cohort: born 1956 and after	.28	.45	.00	1.00
Part-time (mean)	.25	.33	.00	1.00
Union coverage (mean)	.17	.33	.00	1.00
South (mean)	.32	.45	.00	1.00
Metropolitan area (mean)	3.28	1.63	1.00	6.00
Self-employment (mean)	.10	.25	.00	1.00
Unemployment (mean)	.09	.20	.00	1.00
Hours worked (1000s, mean)	1.90	.60	.28	4.50
Inverse Mills ratio (mean)	.27	.27	.03	2.55

[a] Percentile measure includes all individuals above the cutoff.
[b] Experience is measured in the data as total years since age 18, while tenure is measured as total years at any age. Therefore, tenure can potentially exceed experience.

APPENDIX B: Logistic Regression Coefficients Based on Multilevel Analyses

	25th Percentile	50th Percentile	75th Percentile
Intercept (at experience = 0)[a]			
Intercept (white men)	−1.120***	−2.489***	−3.679***
White women	−2.080***	−1.173***	−.449*
African American men	−.734	−1.242*	−1.452**
African American women	−2.232***	−.814*	.072
Education	.355***	.009	.044
Cohort: born before 1936	−.503	.846*	.345
Cohort: born 1946-55	−.509	−.236	−1.430***
Cohort: born 1956 and after	−.715*	−.195	−1.352***
Union coverage [c]	1.215***	1.408***	1.993***
South[c]	−.106	−.151	.009
Metropolitan area[c]	−.062	.122	.126*
Self employment[c]	1.064*	2.288***	1.942***
Unemployment[c]	1.102*	1.049*	2.888***
Part-time employment[c]	.451	1.221*	1.064*
Hours worked (1000s)[c]	−.677*	−.312	.304
Inverse Mills ratio[c]	.786***	.307*	.334*
Experience slope[b]			
Intercept (white men)	.721***	.755***	.753***
White women	.353***	−.028	−.241**
African American men	−.070	.025	.226
African American women	.083	−.389**	−.594***
Education	−.009	.114***	.084***
Cohort: born before 1936	.041	−.296*	−.076
Cohort: born 1946-55	.226*	.102	.450***
Cohort: born 1956 and after	.437**	.176	.473***
Union coverage[c]	−.178	−.238*	−.596***
South[c]	.094	.112	−.061
Metropolitan area[c]	−.039	−.096***	−.108***
Self employment[c]	−.446**	−.760***	−.569***
Unemployment[c]	−.751***	−.689**	−1.190***
Part-time employment[c]	−.516**	−.647**	−.417*
Hours worked (1000s)[c]	.316**	.218	.103

(Continued)

APPENDIX B: Logistic Regression Coefficients Based on Multilevel Analyses

Other time varying measures[a]			
Hours worked (1000s)	−.706***	−.724***	−.773***
Self employment	-1.060***	−.763***	−.353***
Unemployment	.131*	.195**	−.079
Metropolitan area	−.040**	−.045**	−.012
Union coverage	−.369***	−.074	.113*
Part-time employment	.523***	.311***	.151**
South	−.193	−.164	.061
Tenure (log [x+1])	.272***	.268***	.169***
Inverse Mills ratio	−.482**	−.226	−.409**

[a] All variables in the model (except the race-gender dummies and years of experience) are cen-
tered at their means, so the intercept reflects the effects of each time-invariant and time-varying
variable on the earnings chances of white men with no work experience and with average
education, hours worked, etc.

[b] Experience is defined as the log of years of work experience since age 18. A higher coefficient
(and thus positive effects of the time invariant variables on that coefficient) reflects a steeper
career trajectory.

[c] At the person level, this measure is the average across all years in which the person was in the
sample.

$* p < .05$ $** p < .01$ $*** p < .001$

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