Chapter 48

RACE AND GENDER IN THE LABOR MARKET

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Abstract

This chapter summarizes recent research in economics that investigates differentials by race and gender in the labor market. We start with a statistical overview of the trends in labor market outcomes by race, gender and Hispanic origin, including some simple regressions on the determinants of wages and employment. This is followed in Section 3 by an extended review of current theories about discrimination in the labor market, including recent extensions of taste-based theories, theories of occupational exclusion, and theories of statistical discrimination. Section 4 discusses empirical research that provides direct evidence of discrimination in the labor market, beyond "unexplained gaps" in wage or employment regressions. The remainder of the chapter reviews the evidence on race and gender gaps, particularly wage gaps. Section 5 reviews research on the impact of pre-market human capital differences in education and family background that differ by race and gender. Section 6 reviews the impact of differences in both the levels and the returns to experience and seniority, with discussion of the role of training and labor market search and turnover on race and gender differentials. Section 7 reviews the role of job characteristics (particularly occupational characteristics) in the gender wage gap. Section 8 reviews the smaller literature on differences in fringe benefits by gender. Section 9 is an extensive discussion of the empirical work that accounts for changes in the trends in race and gender differentials over time. Of particular interest is the new research literature that investigates the impact of widening wage inequality on race and gender wage gaps. Section 10 reviews research that relates policy changes to race and gender differentials, including anti-discrimination policy. The chapter concludes with comments about a future research agenda. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

Race and gender differentials in the labor market remain stubbornly persistent. Although the black/white wage gap appeared to be converging rapidly during the 1960s and early

1970s, black/white male wages have now stagnated for almost two decades. The black/white female wage gap has actually risen over the past 15 years. The Hispanic/white wage gap has risen among both males and females in recent years. In contrast, the gender wage gap showed no change in the 1960s and 1970s. Not until the late 1970s did it begin to converge steadily (although a significant gender gap still exists). Of course, these wage gaps are only the most visible form of differences in labor market outcomes by race and gender. Substantial differences in labor force participation, unemployment rates, occupational location, non-wage compensation, job characteristics and job mobility all exist by both race and sex.

This chapter is designed to provide an introduction into the literature that analyzes these differences. As we shall show, there are significant differences in the discussion of race versus gender. Where appropriate, we deal with both issues simultaneously, but in many sections we deal with race and gender differences sequentially, both because the literature on the two is quite distinct and because the conceptual models behind race and gender differences are often dissimilar.

It is important to note that our use of the term "race" in this chapter is extremely limited. With only a few exceptions, we discuss black/white differences in labor market outcomes throughout this chapter. This reflects a major lack in the research literature. There is remarkably little empirical work on Hispanic/non-Hispanic white differences or on Hispanic/black differences in labor market outcomes. There is even less empirical work looking at other racial groups, such as Asian Americans or American Indians. In part, this reflects a lack of data on these groups. However, the widespread availability of Census data and an increase in the race/ethnic categories in a host of datasets makes this excuse increasingly inadequate. We strongly hope that future research will remedy this gap, investigating many of the issues that we discuss here for other labor market groups.

The chapter attempts to summarize some of the most important research areas relating to race and gender in the labor market. Of necessity, there are topics which we will cover inadequately or not at all. In Section 2 we provide a statistical overview of the differentials by race and gender in the labor market. Section 3 discusses theories about how race and gender differences in the labor market arise, with particular attention to new theoretical developments integrating costly search into models of discrimination.

In Section 4 we begin our review of the empirical literature by considering recent studies that provide what we consider to be direct evidence on the role of discrimination, a literature that is remarkably small. In Section 5 we examine the role of differences in human capital accumulation prior to labor force entry, touching on the recent literature on the role of race differences in basic skills, and the literature on the role of differences in the type of education that women receive on the gender gap in wages and occupational location. Section 6 considers the contribution of experience, seniority, training, and labor market search to race and gender differentials.

In Section 7 we consider the consequences of different job characteristics for the gender wage gap, including the effects of occupational location, the "feminization" of occupations, and the impact of part-time and temporary jobs. This research is closely related to

the extended and controversial discussion about the extent to which these differences are related to taste differentials versus constraints in the types of jobs available to men and women. While most of the chapter focusses on wage differentials, and to a lesser degree, employment rate differentials, in Section 8 we discuss the much smaller literature on the race and gender differentials in fringe benefits.

Perhaps more high quality research has been devoted to the analysis of changes over time in race and gender differentials than any other topic in this chapter. This has been a very active area over the past 10 years, and the work has been closely connected to more general analyses of changes in wage structure and the rise in inequality. Section 9 begins with a presentation of the standard methodology for decomposing wage changes between groups and then turns to research on the effects of changes in the prices of observed and unobserved skills. Our emphasis is on recent methodological developments.

In Section 10 we consider the effect of labor market policy on labor market outcomes. We summarize the research evaluating the impact of anti-discrimination legislation, and also briefly review two areas where policy has had large impacts on female workers, namely, the impact of maternity leave benefits and the impact of comparable worth legislation. We close with a few comments on a future research agenda in Section 11.

2. An overview of facts about race and gender in the labor market

2.1. Trends and differences in labor market outcomes and background characteristics

Race and gender differentials in the labor market have been persistent over time, although the nature and magnitude of those differences have changed, as this section discusses. We begin with a basic set of facts about gender, race, and Hispanic/white differences in labor market outcomes and in personal characteristics (such as human capital measures) that are likely to be related to labor market outcomes. We then provide some simple estimates of how differences in wages and employment are related to differences in characteristics and differences in labor market treatment given characteristics. One purpose of this analysis is to illustrate with the most recent data the basic regression techniques that have been used in hundreds of labor market studies of race and gender differences. We particularly discuss the difficulties that arise in differentiating between the effects of labor market discrimination and the effects of race and gender differences in preferences and human capital.

Table 1 shows a current set of key labor market outcomes for all workers, for white, black, and Hispanic male workers, and for white, black, and Hispanic female workers. It is based on tabulations of the Current Population Survey (CPS) data from March 1996.

Row 2 of Table 1 indicates that black and Hispanic men as well as white women earn about two-thirds of that earned by white male workers on an hourly basis. Black and Hispanic women earn even less than minority men, only slightly over half of what white males earn. Figs. 1 and 2 show median weekly earnings among full-time male and female

Table 1
Labor market data by race and gender[a]

	All	White males	Black males	Hispanic males	White females	Black females	Hispanic females
All workers (1995)							
(1) Share of all workers	1.000	0.405	0.037	0.073	0.378	0.049	0.059
(2) Hourly wage	14.88	18.96	12.41	12.20	12.25	10.19	10.94
	(59.48)	(69.11)	(33.21)	(69.33)	(29.34)	(21.89)	(67.72)
(3) Annual earnings	26842	36169	23645	20418	20522	17624	15372
	(1197)	(1346)	(1314)	(926)	(990)	(821)	(917)
(4) Weeks worked	37.0	42.3	34.1	38.6	34.4	31.3	26.3
	(31.11)	(28.8)	(35.0)	(28.2)	(31.8)	(34.2)	(29.9)
(5) Hours worked per week	32.0	38.4	30.3	34.4	27.9	26.3	22.2
	(29.4)	(28.3)	(32.44)	(26.1)	(29.1)	(30.8)	(27)
(6) Share part-time	0.221	0.123	0.153	0.149	0.330	0.254	0.314
(7) Share public sector[b]	0.144	0.120	0.157	0.087	0.165	0.231	0.143
Full-time–full year (1995)							
(8) Hourly wage	14.86	17.97	13.00	11.06	12.51	10.72	9.70
	(24.41)	(27.19)	(25.01)	(18.93)	(19.59)	(17.03)	(18.47)
(9) Annual earnings	34265	42742	29651	24884	27583	22871	20695
	(1236)	(1378)	(1373)	(939)	(963)	(796)	(864)
All persons							
(10) Share ever employed, 1995	0.807	0.892	0.756	0.848	0.769	0.701	0.611
(11) Share ever unemployed, 1995	0.086	0.092	0.119	0.132	0.070	0.091	0.078
(12) Unemployment rate, March 1996	0.044	0.043	0.103	0.080	0.028	0.059	0.057
(13) Employment rate, March 1996	0.731	0.820	0.647	0.768	0.695	0.620	0.532

[a] Source: Current Population Survey, March 1996. Weighted estimates, standard deviations are in parentheses.
[b] Share public sector from March 1996.

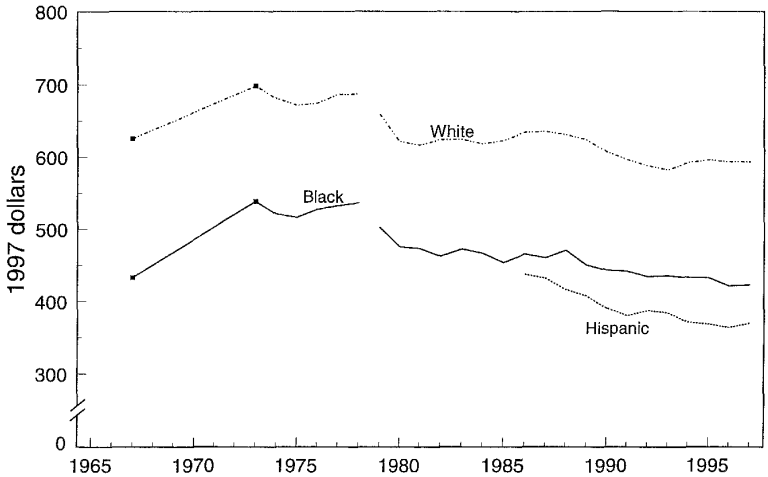

Fig. 1. Median weekly earnings of full-time male workers. Source: Bureau of Labor Statistics.

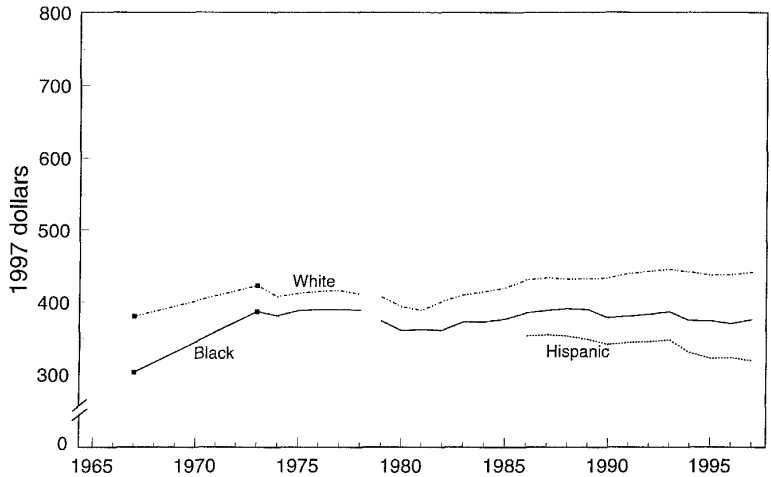

Fig. 2. Median weekly earnings of full-time female workers. Source: Bureau of Labor Statistics.

workers from 1967 to the present for whites and blacks and from 1986 to the present for Hispanics.[1]

The wage trends in these two figures reveal that women, particularly white women, have experienced an increase in their earnings relative to men. But after declining in the 1960s, wage gaps have widened among racial/ethnic groups for both men and women. Although black men's wages rose faster than white men's in the 1960s and early 1970s, there has been little relative improvement (and even some deterioration) in the 25 years since then. Both white and black men show declines in their median weekly earnings over the last decade. Hispanic men show the strongest recent wage declines, but some of this is due to immigration, which has brought an increasing population of less-skilled Hispanic men into the workforce.

Among women, white women's wages have risen steadily since 1980, as Fig. 2 indicates. Black women's wages almost reached parity with white women in the 1970s, but have diverged again in the last 15 years, as black women have experienced little wage growth. Hispanic women, like Hispanic men, are doing relatively worse over the past decade, in part because of shifts in labor force composition due to immigration.

Annual earnings (shown in row 3 of Table 1) show an even larger differential than hourly wages, suggesting that weeks and hours worked are lower among minorities and females. Indeed, rows 4 and 5 confirm that white men not only earn more per hour, they also work more weeks per year and more hours per week. These differences are less among full-time/full-year workers as rows 8 and 9 indicate, but they are still substantial. Row 6 shows that women are particularly likely to be working part-time.

Consistent with the weeks and hours data, rows 10–13 indicate that white men are more likely to ever be employed over the past year and to be employed at any point in time. Unemployment among white women has been as low or lower than among white men since the early 1980s. Blacks have about twice the unemployment rates of whites. Figs. 3 and 4 graph unemployment rates from 1955 to the present among men and women and between whites, blacks and Hispanics. Unemployment rates are quite cyclical among all groups of men, although black male unemployment is more cyclical than white male unemployment. The differential between black, white and Hispanic male unemployment rates is remarkably constant over much of this time period. Women's unemployment has been less cyclical than men's. As has occurred with their wages, the gap between black and Hispanic women's unemployment rates and white women's unemployment rates is higher over the 1980s and early 1990s than it was in the early 1970s.

Wages and unemployment rates are often affected by overall labor force participation rates, which have changed dramatically over time. Labor force participation rates by race and gender are shown in Fig. 5 from 1955 to the present. This chart clearly depicts the convergence in labor force participation among all groups. Men have experienced a steady

[1] Data for Figs. 1–5 are from the Bureau of Labor Statistics, tabulated from the Current Population Survey. Prior to 1972, the data for blacks includes all non-whites. Beginning in 1979, the data in Figs. 1 and 2 are for workers ages 25 and over.

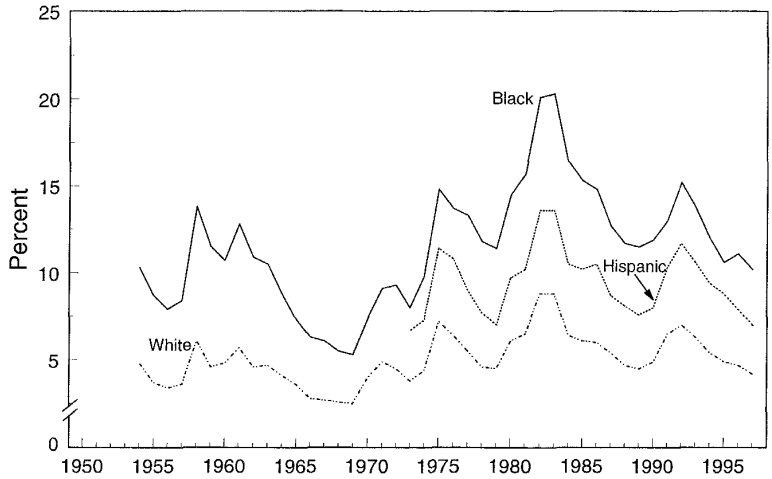

Fig. 3. Male unemployment rates (annual averages). Source: Bureau of Labor Statistics.

decline in their labor force involvement, with the largest declines among black men. Women have shown dramatic increases in labor force participation over these years.

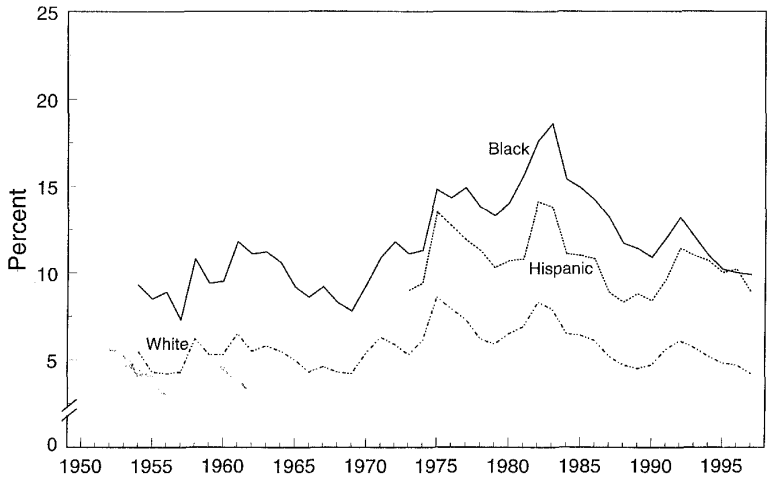

Fig. 4. Female unemployment rates (annual averages). Source: Bureau of Labor Statistics.

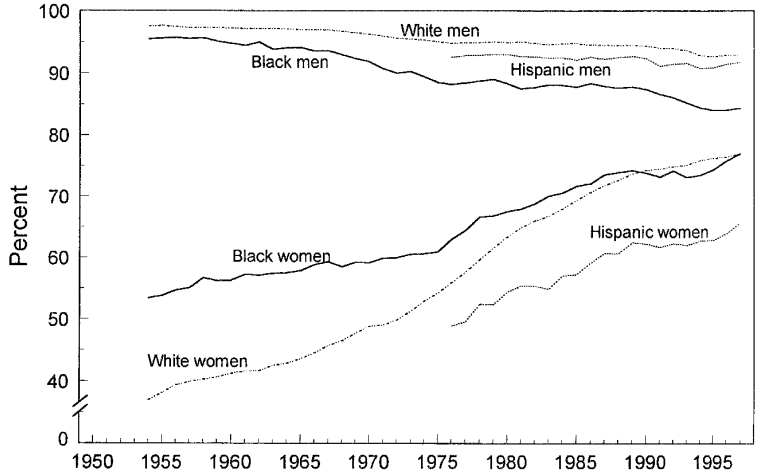

Fig. 5. Labor force participation rates, 25–54-year-olds. Source: Bureau of Labor Statistics.

White women have entered the labor market at a particularly high rate. While their rates of labor force participation used to be far lower than those of black women, they are now at parity. Hispanic women's labor force participation, although rising steadily, is still far below that of black and white women.

In delineating the causes of these labor market differences, labor economists look first at the substantial differences in the attributes that different workers bring with them to the workplace. Table 2 shows a set of key personal characteristics among all persons in 1996, and among the same six race/gender groups observed in Table 1.[2] Educational differences among these groups are large, with race and ethnicity mattering much more than gender. Both male and female Hispanics have particularly low education levels. White women's educational levels are quite similar to white males (this was not true in earlier periods), while blacks have less education than whites but more than Hispanics. These differential investments in education may reflect different preferences and choices, and/or they may reflect "pre-market" discrimination. For instance, there is substantial evidence that blacks have been consistently denied access to suburban housing and crowded into inner city residential neighborhoods with substandard schools. Under these circumstances, blacks will receive a poorer public education and may leave school earlier.

Row 7 of Table 2 shows a "potential experience" calculation, based on calculating (age − years of education − 5) for each individual. This calculation assumes that people are working during all their adult years when they are not in school. Although this variable

[2] The results in Table 2 would not be very different if the tabulations included all workers rather than all persons.

Table 2
Personal characteristics by race and gender, 1996[a]

	All	White males	Black males	Hispanic males	White females	Black females	Hispanic females
(1) Share of all persons	1.000	0.412	0.052	0.055	0.378	0.059	0.039
Education							
(2) Less than high school	0.159	0.118	0.232	0.447	0.105	0.214	0.434
(3) High school	0.331	0.321	0.386	0.275	0.346	0.342	0.275
(4) Some post-HS training	0.281	0.279	0.272	0.192	0.300	0.306	0.215
(5) College degree	0.158	0.184	0.079	0.061	0.177	0.107	0.059
(6) More than college	0.072	0.098	0.030	0.025	0.072	0.031	0.016
(7) Potential experience	23.7	24.1	23.2	22.6	23.8	22.9	22.9
(Age-educ-5)	(23.3)	(23.5)	(25.1)	(21.6)	(23.6)	(23.9)	(21.1)
(8) Share married	0.570	0.605	0.361	0.483	0.624	0.307	0.540
(9) No. children age less than 6	0.24	0.21	0.15	0.29	0.24	0.30	0.41
	(5.07)	(5.02)	(5.03)	(4.99)	(5.07)	(5.69)	(5.19)
(10) Total no. children (age < 18)	0.71	0.63	0.45	0.75	0.73	0.87	1.08
	(7.01)	(6.85)	(7.15)	(6.84)	(6.88)	(7.74)	(6.85)
(11) Share in SMSA[b]	0.489	0.452	0.608	0.655	0.448	0.599	0.658
Region							
(12) New England	0.051	0.060	0.022	0.019	0.059	0.021	0.024
(13) Middle Atlantic	0.145	0.146	0.148	0.125	0.144	0.159	0.146
(14) East-North Central	0.164	0.180	0.149	0.058	0.182	0.149	0.051
(15) West-North Central	0.068	0.082	0.037	0.014	0.081	0.028	0.012
(16) South Atlantic	0.180	0.164	0.324	0.115	0.166	0.332	0.117
(17) East-South Central	0.061	0.060	0.107	0.005	0.062	0.115	0.004
(18) West-South Central	0.109	0.093	0.112	0.213	0.095	0.117	0.212
(19) Mountain	0.060	0.063	0.012	0.095	0.061	0.012	0.093
(20) Pacific	0.161	0.152	0.088	0.357	0.148	0.067	0.340

[a] Source: Current Population Survey, March 1996. Weighted estimates, standard deviations are in parentheses.
[b] Defined as residing in SMSA with at least one million inhabitants.

is commonly used because many datasets lack information on actual experience, it is a particularly poor proxy for experience among women, who are more likely to leave the labor market during their child-bearing years. We return to this point below when we look at alternative data with information on actual experience.

Rows 8–10 of Table 2 indicate that the family and personal commitments of different workers also vary substantially. Whites are much more likely to be married; Hispanics have more children to care for; and black females have greater child care responsibilities than black males. To the extent that family responsibilities influence labor market choices and create labor market constraints, these differences may be important in explaining differences in labor market outcomes.

Rows 11–20 of Table 2 indicate substantial variation in the geographic location of different groups. Blacks are more likely to be in the southern regions and Hispanics are more likely to be in the western regions. Minorities are also far more likely to be in major urban areas (a relatively recent shift for black Americans, who were traditionally more likely to be located in rural areas.) As Bound and Freeman (1992) and Bound and Holzer (1993, 1996) emphasize, to the extent that local labor markets differ and that labor is largely immobile in the short-run,[3] these differences in regional location will also shape labor market outcomes.

Table 3 looks at occupation and industry differences by race and gender. As others have observed, these differences are large. Black and Hispanic men are more likely to be in less skilled jobs. Women are generally more likely to be in clerical and service occupations or in professional services (which includes education). White women and Hispanic men are more likely to be in retail trade; blacks are more likely to be in public administration.

A key question is whether occupational and industry differences represent preferential choices or constraints. If one believes that firms discriminate in their propensity to hire into certain occupations, then occupational location is an outcome of discrimination rather than a choice-based characteristic. We discuss the research literature on this issue below. In the regressions reported in this chapter, we follow standard procedure and report regressions with and without controls for occupation, industry and job characteristics (public sector location or part-time work.) Regressions that do not control for these variables in any way probably underestimate the importance of background and choice-based characteristics on labor market outcomes. Regressions that fully control for these variables probably underestimate the effect of labor market constraints. We allow readers to look at both outcomes.

2.2. Methodologies for decomposing wage changes between groups

One way to explore the wage differential between groups is to decompose it into "explained" and "unexplained" components. Assume that wages for individual i in group 1 at time t can be written as

$$W_{1it} = \beta_{1t} X_{1it} + \mu_{1it} \tag{2.1}$$

[3] Indeed, the more mobile is labor, the less local labor markets will differ.

Table 3
Occupation and industry by race and gender, 1996[a]

	All	White males	Black males	Hispanic males	White females	Black females	Hispanic females
Occupation							
(1) Executive, administrative, and managerial	0.107	0.141	0.051	0.050	0.104	0.064	0.047
(2) Professional specialty	0.114	0.121	0.057	0.044	0.139	0.081	0.049
(3) Technicians	0.024	0.024	0.016	0.015	0.028	0.022	0.018
(4) Sales	0.093	0.107	0.050	0.061	0.095	0.073	0.077
(5) Administrative support	0.116	0.048	0.070	0.053	0.187	0.168	0.130
(6) Private household service	0.005	0.000	0.001	0.002	0.005	0.013	0.027
(7) Protective service	0.013	0.022	0.028	0.017	0.003	0.012	0.004
(8) Other service occupation	0.087	0.049	0.111	0.122	0.102	0.152	0.121
(9) Farming, forestry and fishing	0.085	0.167	0.110	0.161	0.014	0.014	0.016
(10) Precision production, craft and repair	0.053	0.059	0.085	0.101	0.032	0.060	0.067
(11) Machine operators, assemblers, etc.	0.033	0.060	0.071	0.062	0.006	0.009	0.004
(12) Transportation and material moving	0.033	0.044	0.094	0.088	0.011	0.017	0.014
(13) Handlers, equipment cleaners, etc.	0.020	0.030	0.013	0.074	0.008	0.001	0.016

Industry							
(14) Agriculture, forestry and fisheries	0.020	0.028	0.012	0.069	0.012	0.001	0.015
(15) Mining	0.004	0.007	0.003	0.003	0.001	0.000	0.000
(16) Construction	0.052	0.099	0.059	0.106	0.012	0.002	0.004
(17) Manufacturing (durable goods)	0.077	0.122	0.089	0.092	0.043	0.036	0.036
(18) Manufacturing (non-durable goods)	0.053	0.061	0.068	0.081	0.039	0.050	0.053
(19) Transportation and communication	0.054	0.079	0.096	0.060	0.030	0.039	0.024
(20) Wholesale trade	0.030	0.046	0.030	0.039	0.019	0.008	0.017
(21) Retail trade	0.128	0.125	0.117	0.159	0.135	0.101	0.111
(22) Finance, insurance and real estate	0.050	0.046	0.029	0.029	0.063	0.047	0.033
(23) Business and repair services	0.053	0.068	0.073	0.067	0.038	0.040	0.029
(24) Personal services	0.027	0.015	0.023	0.028	0.032	0.047	0.064
(25) Entertainment and recreation	0.013	0.014	0.012	0.018	0.013	0.008	0.010
(26) Professional services	0.186	0.120	0.101	0.074	0.268	0.256	0.173
(27) Public administration	0.035	0.042	0.044	0.023	0.028	0.051	0.020

[a] Source: Current Population Survey, March 1996. Weighted estimates.

and wages for individual j in group 2 at time t can be written as

$$W_{2jt} = \beta_{2t}X_{2jt} + \mu_{2jt}, \tag{2.2}$$

where β_{1t} and β_{2t} are defined so that $E(u_{1jt} \mid X_{1jt}) = 0$ and $E(u_{2jt} \mid X_{2jt}) = 0$.

The difference in mean wages for year t can be written as[4]

$$W_{1t} - W_{2t} = (X_{1t} - X_{2t})\beta_{1t} + (\beta_{1t} - \beta_{2t})X_{2t}, \tag{2.3}$$

where W_{gt} and X_{gt} represent the mean wages and control characteristics for all individuals in group g in year t. The first term in this decomposition represents the "explained" component, that due to average differences in background characteristics (such as education or experience) of workers from groups 1 and 2. It is the predicted gap between groups 1 and 2 using group 1 – typically white men – as the norm. The second term is the "unexplained" component, and represents differences in the estimated coefficients, i.e., differences in the returns to similar characteristics between groups 1 and 2. The share of the total wage differential due to the second component is often referred to as the "share due to discrimination." This is misleading terminology, however, because if any important control variables are omitted that are correlated with the included Xs, then the β coefficients will be affected. The second component therefore captures both the effects of discrimination and unobserved group differences in productivity and tastes. It is also misleading to label only this second component as the result of discrimination, since discriminatory barriers in the labor market and elsewhere in the economy can affect the Xs, the characteristics of individuals in the labor market.

2.3. Estimating simple models of wage determination

In this section we explore race and gender gaps in wages through a set of simple models of wage determination. Table 4 shows the differences in race and gender coefficients over time, across specifications and between all workers and full-time/full-year workers. Columns (1) and (4) report regressions of log hourly wages in 1979 and 1995 respectively on dummy variables for black, Hispanic and female, without including any further control variables. Columns (2) and (5) include controls for education, experience and regional location, a minimal set of personal characteristics that an individual brings to a job. Columns (3) and (6) add further controls for occupation, industry and job characteristics.

Part A of Table 4 focuses on all workers. As control variables are added to the model the negative effect of race or gender on hourly wages becomes less significant. In 1995, black males received 21% lower hourly wages than white males if no control variables were included; they received 12% less once education, experience and region were controlled for, and they received 9% less when a full set of control variables were included. Among white women, there is only a small effect of adding controls for education and experience

[4] Alternatively, the average wage difference can be decomposed as Eq. (2.3′): $W_{1t} - W_{2t} = (X_{1t} - X_{2t})\beta_{2t} + (\beta_{1t} - \beta_{2t})X_{1t}$. This alternative decomposition can produce quite different results from the first. Many authors report both results, or (occasionally) the average of the two.

Table 4
Coefficients on race and gender in wage regressions[a]

	1979			1995		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Part (A) all workers						
(1) Black	−0.143	−0.107	−0.061	−0.207	−0.119	−0.089
	(0.010)	(0.010)	(0.010)	(0.012)	(0.011)	(0.011)
(2) Hispanic	−0.152	−0.053	−0.040	−0.379	−0.131	−0.102
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
(3) Female	−0.436	−0.421	−0.348	−0.279	−0.272	−0.221
	(0.006)	(0.005)	(0.006)	(0.007)	(0.006)	(0.007)
Controls						
(4) Education, experience, and region	No	Yes	Yes	No	Yes	Yes
(5) Occupation, industry and job characteristics[b]	No	No	Yes	No	No	Yes
Part (B) full-time-full year workers						
(6) Black	−0.139	−0.115	−0.064	−0.148	−0.102	−0.067
	(0.012)	(0.011)	(0.011)	(0.012)	(0.011)	(0.010)
(7) Hispanic	−0.184	−0.093	−0.076	−0.344	−0.139	−0.101
	(0.012)	(0.012)	(0.011)	(0.010)	(0.010)	(0.010)
(8) Female	−0.421	−0.399	−0.360	−0.265	−0.266	−0.241
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
Controls						
(9) Education, experience, and region	No	Yes	Yes	No	Yes	Yes
(10) Occupation, industry and job characteristics[b]	No	No	Yes	No	No	Yes

[a] Source: Authors' regressions using the Current Population Survey, March 1980 and March 1996. Standard errors are in parentheses.
[b] Job characteristics include public sector and part-time status.

(suggesting that these characteristics among white women and white men are quite similar as Table 2 indicates), but controlling for occupation and industry results in substantially smaller negative effects.

Part *B* of Table 4 looks only at full-time/full-year workers.[5] The results are surprisingly

similar to those for all workers, both in the magnitude of the coefficients within any specification and in the change in coefficients over time and across specifications.

The results in Table 4 show that there are ongoing and significant race and gender differences in the labor market, even after controlling for occupational and industry location. The remaining negative effects faced by minority and female workers indicate that either we are omitting some key variables from this specification that are relevant to labor market productivity, and/or there are substantial "unexplained" constraints in labor market returns among minorities and women.

Table 5 uses the decomposition shown in Eq. (2.3) to decompose changes in log hourly wages in 1979 (part A) and 1995 (part *B*) for three groups: blacks versus whites, Hispanics versus whites, and females versus males. The top row of Table 5 shows the difference in log hourly wages between these three groups in 1979. The second and third rows decompose this into the share due to differences in characteristics and differences in coefficients. In the "Partial" specification, the only control variables are education, experience and region; the "Full" specification also controls for occupation, industry and job characteristics. Rows 4–10 show how much of the total difference in characteristics is due to specific sets of variables; rows 11–18 show how much of the total difference in coefficients can be ascribed to specific sets of coefficients. Part *B* repeats the same analysis for 1995. We report the detailed breakdowns because it is standard in the literature to do so, but it is important to emphasize the decompositions for subgroups of variables and the intercept term are not invariant to the scale of the variables. Variables such as education and experience have a natural scale but occupation and industry do not. For example, changing the omitted category for occupation will change the contribution of differences in the intercept and differences in occupation coefficients, as Oaxaca and Ransom (1999) discuss.

Two patterns are visible for all three groups in the table. First, as one moves from the partial to the full specification, the share of the wage differential explained by characteristics increases substantially. This is expected as we control more completely for job characteristics. Second, as one moves from 1979 to 1995, the share of the differential due to characteristics declines, indicating that over time these groups' characteristics are moving closer to those of white men. The exception to this is the Hispanic versus white comparison. The increasing importance over time of differences in characteristics is consistent with increased in-migration of Hispanics with poorer skill characteristics than native Hispanics.

Looking just at the 1995 results, it is clear that differentials in education and experience continue to negatively affect wages for black workers. The returns to education for blacks are actually stronger than for whites, but the returns to experience are substantially lower, more than offsetting the advantage in educational returns. One sees a similar pattern among Hispanics, although their mean characteristics remain further from those of whites, hence characteristic differences are more important.

[5] Full-time/full-year workers work a minimum of 35 h/week and 48 weeks/year.

Table 5
Decomposition of race and gender wage differentials[a]

Specification	Blacks vs whites		Hispanics vs whites		Females vs males	
	Partial	Full	Partial	Full	Partial	Full
Part (A) 1979						
(1) Log(hourly wage) difference	−0.165		−0.126		−0.457	
Amount due to						
(2) Characteristics	−0.063	−0.108	−0.086	−0.105	−0.026	−0.126
(3) Coefficients	−0.102	−0.061	−0.041	−0.025	−0.432	−0.335
Differences due to characteristics						
(4) Education	−0.023	−0.017	0.002	0.001	0.002	−0.001
(5) Experience	−0.033	−0.022	−0.011	−0.009	−0.024	−0.018
(6) Personal characteristics[b]	−0.030	−0.024	−0.013	−0.010	−0.004	−0.002
(7) City and region	0.026	0.013	0.027	0.039	−0.001	−0.000
(8) Occupation	N/A	−0.049	N/A	−0.025	N/A	−0.028
(9) Industry	N/A	−0.007	N/A	−0.018	N/A	−0.060
(10) Job characteristics[c]	N/A	0.003	N/A	0.003	N/A	−0.018
Differences due to parameters						
(11) Education	0.080	0.045	−0.031	−0.051	0.041	−0.031
(12) Experience	−0.100	0.032	−0.153	−0.111	−0.612	−0.410
(13) Personal characteristics[b]	0.082	0.071	0.074	0.054	0.019	0.014
(14) City and region	0.002	0.036	−0.057	−0.056	−0.039	−0.023
(15) Occupation	N/A	0.025	N/A	0.021	N/A	0.056
(16) Industry	N/A	−0.016	N/A	0.013	N/A	0.046
(17) Job characteristics[c]	N/A	0.008	N/A	0.005	N/A	0.016
(18) Intercept	−0.168	−0.252	0.145	0.122	0.146	−0.009
Part (B) 1995						
(19) Log(hourly wage) difference	−0.211		−0.305		−0.286	
Amount due to						
(20) Characteristics	−0.082	−0.114	−0.193	−0.226	−0.008	−0.076
(21) Coefficients	−0.134	−0.098	−0.112	−0.079	−0.279	−0.211
Differences due to characteristics						
(22) Education	−0.028	−0.013	−0.055	−0.024	0.000	−0.001
(23) Experience	−0.058	−0.048	−0.185	−0.152	−0.005	−0.003
(24) Personal characteristics[b]	−0.025	−0.020	0.010	0.008	−0.002	−0.002
(25) City and region	0.030	0.020	0.038	0.033	−0.001	−0.001
(26) Occupation	N/A	−0.058	N/A	−0.080	N/A	−0.012
(27) Industry	N/A	0.006	N/A	−0.012	N/A	−0.036
(28) Job characteristics[c]	N/A	−0.000	N/A	0.001	N/A	−0.020

Table 5 (*continued*)

Specification	Blacks vs whites		Hispanics vs whites		Females vs males	
	Partial	Full	Partial	Full	Partial	Full
Differences due to parameters						
(29) Education	0.091	0.082	0.022	0.012	−0.003	−0.022
(30) Experience	−0.197	−0.145	−0.208	−0.025	−0.093	−0.023
(31) Personal characteristics[b]	0.055	0.047	0.031	0.025	0.019	0.014
(32) City and region	0.016	0.030	−0.036	−0.032	−0.037	−0.013
(33) Occupation	N/A	−0.005	N/A	−0.058	N/A	0.060
(34) Industry	N/A	0.032	N/A	0.046	N/A	−0.004
(35) Job characteristics[c]	N/A	0.009	N/A	0.033	N/A	0.014
(36) Intercept	−0.100	−0.148	0.079	−0.081	−0.165	−0.237

[a] Source: Authors' regressions using the Current Population Survey, March 1980 and March 1996.
[b] Personal characteristics include sex and race when appropriate.
[c] Job characteristics include public sector and part-time status.

There are fewer differences between males and females in their background characteristics, so that characteristics play only a small role in labor market differentials for women in 1995. The returns to both education and experience are slightly lower for women. A large share of the coefficient effect for women and blacks comes from a lower intercept term. This is typically interpreted as ongoing discriminatory constraints in the labor market for these groups. It should be kept in mind that cohort effects may bias estimates of the return to experience in cross-section regressions of the type we report here. One will get a low return to experience if the recent cohorts have received better schooling or had more full access to labor market opportunities. This might be important for women and blacks.

While the CPS data provides a large national sample of workers, it has serious limits. Most importantly, it lacks any measure of ability, it has inadequate information on past labor market experience, and it is limited in its family background characteristics. To investigate the importance of these limitations, we ran regressions for blacks and women using data from the National Longitudinal Survey of Youth (NLSY) for 1994. The NLSY provides data on a cohort of workers ages 29–37 in 1994, hence it is representative of only a limited age group in the labor market. It is also a much smaller sample, without enough observations on Hispanics to look separately at this group. The NLSY has been collected annually since 1979, however, and has a much richer set of variables than the CPS. It allows us to add three crucial sets of variables to our formal estimates: actual years of past experience in the labor market; the individual's score on the Armed Forces Qualifying Text (AFQT) which is typically used as a measure of ability,[6] and a set of family back-

[6] An extended discussion about the appropriate interpretation of AFQT scores has occurred recently. This is not a measure of innate ability, but is clearly related to years of schooling. With controls for education in the model, one might interpret the AFQT results as a measure of how much an individual has learned, conditional upon years of schooling. Thus, it can represent poor school quality as well as differences in ability. Further discussion of this issue occurs in Section 5.

ground variables including father's and mother's education and father's and mother's employment status when the individual was an adolescent.

Table 6 shows the results of our NLSY regressions for 1994. Models 1 and 5 repeat the partial and full specifications used with CPS data. Models 2 and 6 add AFQT scores and family background. Models 3 and 7 also replace potential experience with actual experience. Models 4 and 8 add family characteristics and (for the regressions in rows 8–11) race or sex dummies where appropriate. Rows 6 and 7 show the coefficients on dummy variables for race and gender in these models. Rows 8–9 and 10–11 are decompositions of wage differentials based on separate male/female regressions and white/black regressions.

For both the partial and the full specification, three patterns are apparent in Table 6. First, the inclusion of AFQT scores eliminates much of the black/white wage differential, as others have noted (Neal and Johnson, 1996). Second, the effect on the female/male wage differential of controlling for actual experience, AFQT scores, and family characteristics is relatively modest, lowering the unexplained wage differential only slightly.[7] Third, the decomposition of results in the NLSY is quite similar to that using CPS data. For women, virtually all of the wage difference is due to coefficient differences in the more complex models. For blacks, a much higher share is due to characteristic differences, particularly as more control variables are added to the model.

The results in Table 6 confirm that an improved specification can reduce the unexplained effects for blacks and for women. In fact, for blacks, the inclusion of the AFQT scores virtually eliminates any remaining black/white differences. For women, however, even with a richer set of control variables in the model, a significant portion of the male/female wage differential remains unexplained.

2.4. Estimating simple models of labor force participation

Not all of the concern about race and gender differences in the labor market revolves around wages. Differentials in labor force participation between these groups are also a concern. This has been particularly true as participation rates among less-skilled black men have declined, and as policy-makers have focused welfare reform efforts on increasing the labor force participation of less-skilled women. Fig. 5 indicates there have been dramatic trends in labor force participation over time.

Table 7 shows the results of estimating separate labor force participation equations for blacks versus whites, Hispanics versus whites, and females versus males in 1979 (part A) and 1995 (part *B*), using data from the CPS. The first row shows relative labor force participation ratios. Rows 2 and 3 decompose a simple labor force participation regression for these groups into the share due to characteristics versus the share due to coefficients. This regression includes controls for education, potential experience, race and gender

[7] Our measure of actual experience is relatively crude. Using more detailed controls for actual experience would probably have a bigger effect on the gender gap. See Section 6.2.1.

Table 6
Coefficients and decompositions of race and gender wage differentials[a]

	Occupation, industry, job characteristics excluded				Occupation, industry, job characteristics included			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Controls								
(1) Education, potential experience, and region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(2) Add Family background[b] and AFQT	No	Yes	Yes	Yes	No	Yes	Yes	Yes
(3) Use actual experience	No	No	Yes	Yes	No	No	Yes	Yes
(4) Add personal characteristics[c]	No	No	No	Yes	No	No	No	Yes
(5) Occupation, industry and job characteristics[d]	No	No	No	No	Yes	Yes	Yes	Yes
(A) Combined sample with race and gender dummy variables								
(6) Black	−0.154	−0.060	−0.030	−0.029	−0.139	−0.055	−0.028	−0.027
	(0.028)	(0.032)	(0.031)	(0.031)	(0.028)	(0.031)	(0.031)	(0.031)
(7) Female	−0.244	−0.239	−0.211	−0.214	−0.231	−0.225	−0.196	−0.199
	(0.024)	(0.024)	(0.024)	(0.025)	(0.026)	(0.025)	(0.026)	(0.026)
(B) Decompositions based on group specific regressions								
Amount due to (males vs females)								
(8) Coefficients	−0.057	−0.136	−0.225	−0.243	−0.032	−0.111	−0.177	−0.198
(9) Characteristics[e]	−0.171	−0.121	−0.035	−0.011	−0.192	−0.132	−0.069	−0.044
Amount due to (whites vs blacks)								
(10) Coefficients	−0.150	−0.022	−0.005	−0.009	−0.188	−0.044	−0.032	−0.036
(11) Characteristics[f]	0.081	−0.057	−0.057	−0.056	0.036	−0.105	−0.101	−0.099

[a] Source: Authors' regressions using the National Longitudinal Survey of Youth, 1994. Standard errors are in parentheses.
[b] Family background characteristics include mother's and father's education and employment status in 1978.
[c] Personal characteristics include age of youngest child, total number of children, and sex and race when appropriate.
[d] Job characteristics include public sector and part-time status, 1 digit industry and occupation controls.
[e] Coefficients from regression for males.
[f] Coefficients from regression for whites.

Table 7
Decomposition of race and gender labor force participation differentials[a]

	Blacks vs whites	Hispanics vs whites	Females vs males
Part (A) 1979			
(1) Labor force participation difference	−0.065	−0.047	−0.273
Amount due to			
(2) Characteristics	−0.046	−0.052	−0.005
(3) Coefficients	−0.019	0.006	−0.267
Differences due to characteristics			
(4) Education	−0.011	−0.016	0.001
(5) Experience	−0.014	−0.005	−0.002
(6) Personal Characteristics*	−0.014	−0.025	−0.004
(7) City and Region	−0.007	−0.006	−0.000
Differences due to parameters			
(8) Education	0.042	0.025	0.052
(9) Experience	0.318	−0.041	0.015
(10) Personal characteristics[b]	0.112	−0.017	−0.209
(11) City and region	−0.016	−0.030	−0.014
(12) Intercept	−0.474	0.069	−0.112
Part (B) 1995			
(13) Labor force participation difference	−0.086	−0.081	−0.156
Amount due to			
(14) Characteristics	−0.048	−0.077	−0.008
(15) Coefficients	−0.037	−0.004	−0.148
Differences due to characteristics			
(16) Education	−0.007	−0.021	−0.009
(17) Experience	−0.015	−0.032	−0.003
(18) Personal characteristics[b]	−0.017	−0.015	−0.004
(19) City and region	−0.009	−0.009	−0.003
Differences due to parameters			
(20) Education	0.077	0.046	0.041
(21) Experience	0.189	0.002	0.109
(22) Personal characteristics[b]	0.058	−0.070	−0.121
(23) City and region	0.062	−0.011	−0.007
(24) Intercept	−0.423	0.030	−0.170

[a] Source: Authors' regressions using Current Population Survey, March 1980 and March 1996.

[b] Personal characteristics include marital status, no. of children less than 6, total no. of children, and sex and race when appropriate.

(when appropriate), marital status, total number of children, number of children less than age 6 years, and SMSA and regional location.

Looking at the results for 1995 in Part *B* of Table 7, there are striking differences between blacks and Hispanics on the one hand and males and females on the other hand. Black and Hispanic differences in labor force participation are largely due to group differences in background characteristics. In contrast, male/female differences in labor force participation are entirely due to differences in coefficients. In particular, the coefficients on personal characteristics (children and marital status) are much more negative for women than for men. Women as well as blacks continue to have a large unexplained difference in the intercept term. In contrast, the effect of education and experience on labor force participation is actually higher for women than for men and for blacks and Hispanics than for whites.

The results in this section only briefly summarize some of the key differences in outcomes and background characteristics between female, black, Hispanic, white, and male workers. Among the key conclusions in this section: There are substantial differences between male/female differentials in the labor market and black/white or Hispanic/white differentials. Male/female wage differentials remain greater than those of minority men versus white men and the decomposition of those differentials is different. There are fewer differences between blacks and Hispanics, although the aggregate category "Hispanic" includes workers from a very diverse set of backgrounds. Even controlling for occupation, industry, and job characteristics, there remain significant differentials between white males and other workers. Some of this may be due to incompletely specified models, as the inclusion of the AFQT scores for black men indicates. Some of it almost surely represents ongoing constraints in the labor market for women and minorities. Over time, minorities and women have acquired more education and experience than before, hence their human capital characteristics are less important in explaining their wage differentials in 1995 than 15 years earlier. But there remain significant unexplained differences in the coefficients that determine the returns to worker and job characteristics among black, Hispanic, and women workers. Below, we discuss research that investigates more causally complex questions about these differences.

3. Theories of race and gender differences in labor market outcomes

In this section we discuss theoretical research on the sources of race and gender differences in labor market outcomes. We begin in Section 3.1 by reviewing the hypothesis that group differences in wages, occupations, and employment patterns are the consequence of preference and skill differences rather than discrimination. This "preferences/human capital" hypothesis is the null hypothesis underlying most of the empirical research on race and gender differences. In this case, discrimination is assumed to be the residual difference that exists in labor market outcomes that cannot be explained by these factors. However,

the implications of this hypothesis are straightforward, and there have been few theoretical developments in recent years. Consequently, despite its importance in the literature, we will provide only a brief verbal summary of the preferences/human capital explanations for group differences.

In Section 3.2 we provide an overview of theories of discrimination. In Section 3.3 we consider theories that treat discrimination as prejudice ("taste") on the part of employers, employees, or consumers, with an emphasis on recent work that integrates labor market search into taste-based models of discrimination. In Section 3.4 we consider theories of occupational exclusion and crowding based on employer discrimination, social norms or institutional constraints. In Section 3.5 we consider models of statistical discrimination and the feedback effects of employer behavior on the behavioral incentives of minority groups, including the effects of affirmative action policy on worker incentives to invest in training.

3.1. The impact of group differences in preferences and skills

3.1.1. Differences in preferences

The role of group differences in preferences is emphasized primarily in discussions of gender differences rather than race or ethnic differences. People differ in their preferences for market versus non-market work or leisure and for particular types of work, such as manual labor versus office work or work in the non-profit versus the private sector. The distribution of preferences for particular job characteristics across groups and the value to employers of offering jobs with particular characteristics will determine the occupational wage distribution as well as the occupational distribution of particular groups.[8] For instance, the theory of compensating differentials predicts that if unskilled workers who are tolerant of dirty, dangerous jobs are scarce, then such jobs will offer a wage premium. If workers with these preferences are also predominantly male, then such jobs will be largely filled by men.

A major issue, of course, is the source of gender differences in preferences. Closely related to this is the question of how and why preferences might evolve over time, a topic on which there is little direct evidence. Pre-market gender discrimination in child-rearing practices or in the educational system may be one source of differences in preferences. Of course, the differential treatment of boys versus girls may be a rational response by parents to market discrimination. For example, altruistic parents who know that their female children will face discrimination in traditionally male occupations may endeavor to shape the preferences of their children so that they will be comfortable in traditional roles. However, regardless of the source, it is easy to show that in a competitive labor market group differences in the preferences individuals bring to the labor market can lead to group differences in labor force participation, in occupational location, and in wages.

[8] Classic references are Thaler and Rosen (1975), and Rosen's (1986) survey.

3.1.2. Differences in comparative advantage

The second key element in a competitive theory of group differences is differences in comparative advantage. In a competitive economy differences in comparative advantage will influence the allocation of time across occupations and between market and non-market work. Becker, Mincer, and other researchers analyzing the economics of the family have pointed to biologically based differences in gender roles in reproduction as a basis for women's comparative advantage in home production. Historically, differences in physical strength may also have given men an advantage in certain labor market tasks. Becker (1991) argues that this comparative advantage is amplified by parental investments in the skills (and preferences) of daughters, in part because women's home production skills will be rewarded in a marriage market populated by men who have prepared for the labor market.

Almost any model of human capital investment says that investment in valuable marketplace skills will be lower among those who expect to spend less time in the marketplace. The implication is that women who expect to devote many years to child-bearing and child-rearing will be less likely to train in law, medicine, accounting, engineering, and other areas that primarily have value in the labor market. Similarly, they are less likely to attend college or graduate school.[9]

This line of reasoning suggests that as birth rates, marriage rates and marital stability have declined, gains from specialization between men and women should have fallen and the labor market consequences of any biologically based comparative advantage should have declined. Over a longer period of time, the declining importance of physical strength and the growing importance of cognitive skill and interpersonal skill should have further reduced gender differences in comparative advantage. The clear implication is that the education choices and career patterns of women should have become more similar to those for men, and that is what we have observed over the past 30 years.

It is important to stress that the discussion of comparative advantage in the above paragraph is largely a gender story, although a strong intergenerational correlation in occupational choices occurs not just within gender groups, but within race and ethnic groups as well. However, if the family plays an important role in the transmission of preferences for particular types of work and in the acquisition of occupation-specific human capital, then historically determined group differences in comparative advantage may persist for some time.

3.1.3. Differences in human capital investment

Closely related to comparative advantage are group differences in human capital investments. As noted above, the return to general skills acquired through education and training depends on expected labor force participation if these skills raise market productivity more than non-market productivity. The return to many types of human capital investment is

[9] Polachek (1978) argues that depreciation rates are higher in technical occupations such as science and engineering than in the humanities or education, giving women a comparative advantage in these latter fields.

higher for persons who expect to work full-time for most of their adult lives. The return to investments in firm-specific human capital and to labor market search is higher for persons who work full-time and who do not expect to leave their firms to engage in non-market work or to accommodate a spouse who is transferred to another part of the country. Given changes in family size and marital patterns, the theory of demand for human capital would predict the increase in the education of women relative to men during the postwar period, as well as the shift in women's fields of study and job choices. Again, this is largely a gender story.

Pre-labor market discrimination may also have reduced women's human capital investments by affecting their quality of schooling, fields of study, and access to higher education. Some recent research, especially outside the US, has emphasized parental discrimination in favor of boys as a source of the gender gap in human capital attainment (Thomas, 1990). Historical restrictions on the admission of women to colleges or training programs made it difficult in the past for women to pursue certain career options.

While racial and ethnic group differences in preferences are unlikely to be exogenous, racial and ethnic differences in the level of human capital acquired prior to labor force entry, or group differences in home environment, communities, and schools may lead to substantial differences in comparative advantage and human capital investment. There is a huge literature documenting the importance of family background for educational attainment and labor market success. Parental education is often an important variable in these studies. The effects of past discrimination on the resources available to parents may lead to large differences across race and ethnic groups in the skills that individuals bring to the labor market. For instance, to the extent that parents in particular occupations provide children with a comparative advantage in those occupations, below average representation of minority groups in managerial jobs may lower the probability that minority youths obtain the skills required to hold these jobs in the future.

Neighborhoods and schools may also matter, particularly given racial and economic segregation in housing markets. School quality has historically been lower for African Americans and Hispanics than for whites. A substantial body of recent research suggests that growing up in a deprived neighborhoods hurts one's economic prospects (Aaronson, 1998). In short, differences in home and neighborhood environment may lead minority groups to have less human capital on average, with obvious implications for their wage levels and occupational location. These differences in pre-market human capital accumulation are almost certainly responsible for part of the earnings gap between whites and blacks.

It important to stress that theories that emphasize differences in group preferences, comparative advantage, and pre-market human capital accumulation may complement the theories of discrimination discussed below. Discrimination can influence human capital investment decisions both before and after an individual enters the labor market, as the model by Coate and Loury (1993b) that we discuss below indicates, and it can also influence the behavior of parents and teachers. Hence, it is difficult to separate the effects

of labor market discrimination from truly exogenous pre-labor market factors that may result in group differences.

3.2. An introduction to theories of discrimination

3.2.1. Overview

Economic models of discrimination may be divided into two main classes – competitive models in which agents act individually and collective models in which one group acts collectively against another. Almost all of the theoretical work by economists has been within a competitive framework. These models emphasize two broad types of discrimination. The first is prejudice, which Gary Becker formalizes as a "taste" by at least some members of the majority group against interacting with members of the minority group. The second is statistical discrimination by employers in the presence of imperfect information about the skills or behavior of members of the minority group. Collective models, which are more prominent outside of "mainstream" labor economics, are often informal and emphasize the consequences of collective action of one group against another, often using the legal system or the threat of violence as an enforcement mechanism.

Over the past 15 years the theoretical work on discrimination has particularly emphasized the role of imperfect information about worker attributes, and we devote much of our discussion to models that reflect this concern. Particularly intriguing is the introduction of imperfect information into taste-based theories of discrimination. One attraction of models that emphasize informational problems is that they are consistent with long run equilibria in which group differentials persist, while simpler models of taste-based discrimination often predict the elimination of discrimination through competition or segregation. Recent work by Borjas and Bronars (1989), and subsequent papers by Black (1995), and Bowlus and Eckstein (1998) point out that imperfect information about the locations and preferences of customers, employees, and employers will limit the ability of competition and segregation to eliminate the effects of prejudice on labor market outcomes. These papers merge ideas from search models of the labor market with Becker-style models of taste discrimination and obtain a number of important results.

In the remainder of this section we provide a brief discussion of the definition of discrimination. In Sections 3.3–3.5 we discuss various models of discrimination and the implications of these models for the effects of policy.

3.2.2. Defining discrimination

We define labor market discrimination as a situation in which persons who provide labor market services and who are equally productive in a physical or material sense are treated unequally in a way that is related to an observable characteristic such as race, ethnicity, or gender. By "unequal" we mean these persons receive different wages or face different demands for their services at a given wage.

Following Cain (1986), let the wage Y equal

$$Y = X\beta + \alpha Z + e, \tag{3.1}$$

where X is a vector of productivity characteristics that determine productivity, are observable by firms, and are exogenous to the process under study; β is the vector of related coefficients. Z is a discrete variable equal to 1 if the individual is a member of a minority group. The group is discriminated against if $\alpha < 0$.

As Cain discusses in some detail, there are problems with defining "equally productive". For example, in the entertainment industry (and, according to Hamermesh and Biddle (1994), in the economy more generally) physical beauty is rewarded. Should a consumer preference for watching handsome newscasters be treated as a legitimate difference in productivity or as source of labor market discrimination against less handsome people? How does such a preference differ from preferences that are based on race or sex? There is also the issue of whether the technology that determines β is exogenous. For example, changes in technology in the fire fighting industry and in the military have altered the effects of physical strength on productivity and increased the average productivity of women relative to men.

Finally, it is standard to distinguish between "current labor market discrimination" given a set of predetermined observed characteristics of the worker and the effects of prior discrimination on those characteristics. For example, discrimination in housing or in educational access among an earlier generation may lower current education levels of the minority group. We refer to this as the effect of pre-labor market discrimination. Differences in the productivity characteristics (the Xs) among the minority group may arise in part from such pre-labor market discrimination. However, it is important to emphasize that current labor market discrimination may also influence X. If women believe they will have difficulty being accepted in a particular profession, they are less likely to invest in the skills necessary for that profession.

In short, it is hard to distinguish between the effects of past discrimination versus current discrimination on productivity-based characteristics. Recent work by Durlauf (1992, 1994), Benabou (1993, 1994, 1997), and Lundberg and Startz (1998) builds upon earlier work by Loury (1977, 1981) and emphasizes that past labor market and pre-labor market discrimination against a group has feedback effects on the human capital of future generations and may lead to persistent group differences in skills.[10]

[10] Lundberg and Startz (1996) provide a good non-technical survey of this literature.

3.3. Taste-based discrimination

3.3.1. Becker's analysis of employer, employee, and consumer discrimination

3.3.1.1. Employer discrimination Becker (1971) modeled prejudice as a "taste" for discrimination. He defined employer discrimination as a situation in which some employers were prejudiced against members of group B, the minority group. (Throughout the chapter we will use the subscript B to denote the group that suffers discrimination and A to denote the group that discriminates.) Employers maximize a utility function that is the sum of profits plus the monetary value of utility from employing members of particular groups. Let d be the taste parameter of the firm, which Becker called the "coefficient of discrimination". To be specific, firms maximize

$$U = pF(N_b + N_a) - \omega_a N_a - \omega_b N_b - dN_b, \tag{3.2}$$

where p is the price level, F is the production function, N_g is employment of members of group g ($g = A,B$), and ω_g is the wage paid to members of group g. Employers for whom $d > 0$ are prejudiced and act as if the price of hiring a B worker is $\omega_b + d$. If the utility function is of the form given above, then the firm hires workers from group B only if $\omega_a - \omega_b \geq d$.

Let $G(d;\bar{d})$ denote the CDF of the prejudice parameter d in the population of employers, where the mean $\bar{d}$ summarizes the location of the distribution. The fraction of firms that hire B workers is $G(\omega_a - \omega_b; \bar{d})$. The optimal number of workers hired is determined by the solution to

$$pF'(N_a) = \omega_a \tag{3.3a}$$

for firms that hire A workers, and

$$pF'(N_b) = \omega_b + d \tag{3.3b}$$

for firms that hire B workers. The number of workers hired is decreasing in ω_a for firms that employ A workers and decreasing in $\omega_b + d$ for firms that hire B workers. Treating p as fixed and aggregating across firms in the economy leads to the market demand function $N_b^{\mathrm{d}}(\omega_a, \omega_b; \bar{d})$ for B workers and $N_a^{\mathrm{d}}(\omega_a, \omega_b; \bar{d})$ for A workers. The wages for the two groups are determined by the solution to the two equations

$$N_a^d(\omega_a, \omega_b; \bar{d}) = N_a^s(\omega_a), \tag{3.4a}$$

$$N_b^d(\omega_a, \omega_b; \bar{d}) = N_b^s(\omega_b), \tag{3.4b}$$

where $N_g^s(\omega_g)$ is the supply function of group g workers.

A wage differential will arise if $\bar{d}$ is sufficiently large that the demand for B workers when $\omega_b = \omega_a$ is less than the supply. The greater the number of prejudiced employers and the stronger the intensity of their preferences (a higher $\bar{d}$), the greater the wage gap between A and B workers. Becker's model is formally equivalent to a hedonic model

where a market premium is paid for a worker attribute. The price on the attribute is determined by the preferences of the least prejudiced employer who hires *B* workers. The model implies that *B* workers are employed by the least prejudiced firms and that *A* and *B* workers will be segregated in the labor market.

One may easily extend this framework to incorporate the possibility that the disutility of the employer depends upon the type of job filled by *B* workers. This can lead to a theory of occupational segregation, as we discuss below in Section 3.4. Below we also discuss Coate and Loury's (1993a) model in which all employers have the same preferences and the disutility is for hiring *B* workers into skilled jobs and is increasing in the ratio of *B* to *A* workers employed.

Becker and many others have discussed the fact that his model implies that discriminating employers earn lower profits than non-discriminators, since the non-discriminators will pay less for their labor by hiring *B* workers. As Becker points out, if there is free entry and/or constant returns to scale, then in the long run non-discriminating employers will increase to the point that it is no longer necessary for *B* workers to work for prejudiced employers. This will eliminate the wage gap. In contrast to the long run predictions of the model, a wage gap between white males and other groups in the labor market has persisted over long periods of time. One is left to conclude that either there is no discrimination and other factors are responsible for these gaps, employer discrimination is not the primary form of discrimination in the labor market, all potential employers are discriminators, and/or other factors interfere with the expansion of non-discriminating firms, such as search frictions or collective action.

3.3.1.2. Employee discrimination Becker also discusses the consequences of employee discrimination and consumer discrimination. The basic idea of employee discrimination is that some members of the majority group *A* are prejudiced against group *B* members and do not like to work with members of the minority group. Suppose there are two types of workers, skilled and unskilled, and two types of jobs, skilled and unskilled. All workers are equally productive in the unskilled task, but only skilled workers can do the skilled job. Production must be done in teams of one skilled worker and one unskilled worker. Employee discrimination would not lead to a wage gap if there were no search costs and the distribution of qualifications and preferences for particular types of jobs were the same across groups. In this case, firms could form teams consisting of all *B* workers, or all *A* workers. However, if there are too few skilled *B* workers and most skilled *A* workers are prejudiced, then some unskilled *B* workers will have to work with prejudiced skilled *A* workers, who will require a wage premium. In equilibrium, unskilled *B* workers will earn less than unskilled *A* workers. (Skilled *B* workers will earn more than skilled *A* workers who work with unskilled *A* workers.) However, the return to acquiring skill will be greater for *B* than for *A* workers, and so in the absence of barriers to skill acquisition the skill distributions in the two populations should tend to equalize over time, leading to segregated work forces but eliminating group wage differentials.

3.3.1.3. Consumer discrimination Finally, Becker also presents a model of consumer discrimination. In this model, prejudiced consumers in group A get less utility if they purchase from a group B member than from a group A member. Consequently, they will only purchase from B members if the asking price is reduced, lowering the labor market payoff for group B members to working in occupations with customer contact. The effect of such discrimination on wages is reduced to the extent that B members can serve only B customers and unprejudiced A's, or to the extent that Bs can work in occupations without customer contact.

3.3.2. Taste-based discrimination when search is costly

As Becker and others have noted, the impact of taste-based discrimination on wages is reduced when segregation is costless. However, if there is imperfect information about the location of vacancies, workers, and customers or about the type of agents and whether or not they are prejudiced, this will interfere with segregation. The importance of search costs is amplified by the fact that most workers go through a series a jobs within a firm in which they work and a series of occupations over their working life. These many jobs involve contact with many different employees and different levels of customer exposure.

Borjas and Bronars (1989) and subsequent papers by Black (1995) and Bowlus and Eckstein (1998) have analyzed the effects of customer and employer prejudice in the presence of search, with many interesting results. First, in these models the whole distribution of prejudicial tastes matters, not simply the prejudice of the marginal firm (or customer) who employs a member of group B. Second, B workers are at a disadvantage even when their numbers are small relative to the number of non-discriminating customers. Third, discrimination is unlikely to be eliminated by entry of new firms or changes in human capital investments by B workers.

The recognition that sorting is expensive because of search costs overcomes some of the main objections to competitive models in which prejudice on the part of employers, employees, and consumers plays a key role. Both theoretical and empirical work exploring these models deserve a high research priority. In this section we summarize some of this work using Black's model of employer discrimination as the basis for much of the presentation.

3.3.2.1. Employer discrimination with costly search Black assumes that a fraction γ of workers are type B and a fraction $(1 - \gamma)$ are type A. All workers are equally productive. Workers have the same leisure preferences and direct costs of search; they may search for a job at a cost c per period. There are two types of employers, p and u. Type p employers constitute θ of the firms and are so prejudiced against B workers that they will only hire A workers, paying a wage w_{pa}. Type u employers are unprejudiced and simply maximize profits. They hire type A workers at the wage w_{ua} and type B workers at the wage w_{ub}.

The utility that a worker gets from a job each period is the sum of the wage and a match specific job satisfaction component α. The worker learns the value of α prior to accepting or rejecting an offer, but the employer knows only the distribution of this component. Workers meet one firm per period. Type A workers receive an offer of w_{pa} from a preju-

diced firm with probability θ and or an offer of w_{ua} from an unprejudiced firm with probability $(1-\theta)$. Given the arrival probabilities of the two offers an A worker formulates a reservation utility level to accept a job, u^a, where

$$u^a = f^a(\overset{-}{c}, \overset{?}{\theta}, \overset{+}{w_{pa}}, \overset{+}{w_{ua}}, \beta_\alpha) \tag{3.5}$$

where β_α is the parameter vector of the distribution of α. As in conventional search models, reservation utility is decreasing in search costs c and increasing in the wage offers. The sign of $\mathrm{d}u^a/\mathrm{d}\theta$ is the same as the sign of $w_{pa} - w_{ua}$. Type A workers accept an offer if $w_{ja} + \alpha > u^a$, $(j = u, p)$.

Type B workers face the same optimization problem, but they only receive an offer when (with probability $1-\theta$) they encounter a type u firm. Their reservation utility level u^b is determined by

$$u^b = f^b(\overset{-}{c}, \overset{-}{\theta}, \overset{+}{w_{ub}}, \beta_\alpha). \tag{3.6}$$

The reservation utility of a B worker is decreasing in the probability that the worker will encounter a prejudiced firm and thus fail to receive an offer. Type B workers accept a job if they encounter a type u firm and if the utility from the offer exceeds the reservation value u^b, that is, when $w_{ub} + \alpha > u^b$. It follows almost immediately that if $w_{pa} \geq w_{ua} \geq w_{ub}$ then $u^b < u^a$. Type B workers are less choosy in utility terms than type A workers because they only receive offers from $(1-\theta)$ of the employers.

We now turn to the firm's wage decision. In Black's basic model firms face a fixed selling price and have a linear technology. Thus they choose wages to maximize profits net of disutility per applicant. Type p firms are so prejudiced that they do not make offers to B workers. Both firm types choose wages to trade off the marginal product V if a worker accepts the offer against the wage costs. The optimal wage offer to members of group g is determined by the function

$$w_g = f^w(\overset{+}{V}, \overset{+}{u^g}; \beta_\alpha) \tag{3.7}$$

for both firm types. Wages are increasing in V and increasing in u^g provided that the distribution of α is log concave. Since the wage depends on the worker type but not the firm type, $w_{pa} = w_{ua}$.

As we noted above, the solution to the worker's search problem implies that $u^b < u^a$ when $w_{pa} = w_{ua}$ if $w_{ua} = w_{ub}$. Other aspects of the problem rule out $w_{ub} > w_{ua}$. Consequently,

$$w_{ub} = f^w(V, u^b; \beta_\alpha) < f^w(V, u^a; \beta_\alpha) = w_{ua}. \tag{3.8}$$

The "unprejudiced" firms exploit the fact that type B workers have higher search costs because they waste time contacting type p firms. This allows them to offer B workers lower

wages. Since u_b is decreasing in the fraction θ of prejudiced firms, the wage gap declines to 0 as θ falls to 0. However, even if the fraction of B workers is small relative to the fraction of unprejudiced firms, they will face wage discrimination. In contrast to Becker's original model of employer discrimination, search costs prevent the market from segregating into unprejudiced firms that hire type B (and perhaps type A) workers and prejudiced firms that hire only A workers. This is true even if the total labor demand of unprejudiced firms is larger than the number of B workers.

Will entry into the market or expansion among unprejudiced employers drive the share of prejudiced employers to 0? Prejudiced employers earn lower profits in Black's basic model. If entrepreneurial talent is abundant, then prejudiced employers will be driven from the market. To investigate the issue of entry, Black considers a version of the model in which there is a fixed number of entrepreneurs (potential employers), of which a fraction ρ are type p and will not hire B workers. There is a distribution of entrepreneurial ability that influences the fixed cost of operating. He shows that the fraction of type p firms in the market is less than the fraction of prejudiced entrepreneurs ($\theta < \rho$), that is, the competitive market limits the entry of prejudiced entrepreneurs. The reservation level of entrepreneurial talent required to enter is higher for type p firms, and these firms are smaller on average than type u firms. In equilibrium, wages are higher for A workers than B workers. Increases in ρ increase the wage gap between A and B workers.

Interestingly, an increase in the fraction of type B workers may lead to an increase in the wage for type B workers. This is because the increase in the fraction of B workers leads to a decline in profits among prejudiced firms and a smaller fraction of prejudiced employers in the market. This result contrasts sharply with the standard result in a Becker-type taste discrimination model, where an increase in the relative supply of B workers harms their labor market opportunities.

Bowlus and Eckstein (1998) develop and estimate a model that is similar in spirit to Black's, but where firms rather than workers are engaging in search. They assume that γ of the workers are type B and $(1 - \gamma)$ are type A. They also allow for the possibility that type B workers are less productive than type A, but assume that within a group all workers are equally productive, and, in contrast to Black's model with entry, all firms have the same productivity. A fraction $(1 - \theta)$ of the employers care only about profits (type u), while θ of the firms are prejudiced (type p) and care about profits minus disutility d from hiring type B workers. Both firm types search less intensely for B workers if they are less productive, but in addition, prejudiced firms search less intensively for B workers than A workers. The search intensity parameters are exogenous to the model. Firms search for both employed and unemployed workers but cannot condition offers on whether the worker is employed or on the wage of an employed worker. It follows almost immediately from these assumptions that type B workers receive fewer offers. Bowlus and Eckstein work out the optimal search strategy and the optimal wage offers of the two firm types and show that even if A and B workers are equally productive, (1) type B workers receive lower wage offers from both types of firms and (2) type B workers will have higher unemployment rates. Bowlus and Eckstein provide an interesting empirical analysis of their model although it should be

regarded as preliminary as it is based on a number of unattractive assumptions, including the assumption that all type A and type B workers have the same productivity.

If firms have control over where they can search, then presumably the unprejudiced firms will focus their search effort on B workers (who are less expensive), and the p firms will focus on A workers. The market will segregate, as in a Becker-type model with search unemployment. However, it may not be possible for firms to fully target their efforts, particularly given equal opportunity laws governing hiring practices.

Even when type u firms search more intensively for B workers and the type p firms search more intensively for A workers, some of Bowlus and Eckstein's qualitative results concerning wage differentials will probably go through as the authors speculate. This is because some B workers will still contact type p firms and receive lower offers, and this will lower their reservation wage for accepting employment at type u firms. As a result, they will receive lower wage offers from both types of firms. It is less clear, however, that the unemployment differentials will remain under targeted search because the probability of receiving an offer could be higher for a type B.

The basic approach taken in these papers is promising and usefully extends the earlier models of taste discrimination by employers. As the authors of these papers note, their theoretical results are far more consistent with the observed facts about wage differentials between black and white workers than are the predictions of taste discrimination models without search.

3.3.2.2. Consumer discrimination with costly search In the paper which started the literature on taste discrimination with costly search, Borjas and Bronars (1989) consider consumer discrimination. Borjas and Bronars' (1989) analysis of consumer discrimination and self employment has the flavor of the model sketched below. Their aim is to explain why blacks are under-represented among the self-employed, as well as to examine how consumer discrimination in the market served by the self-employed affects the ability distribution of self-employed workers from group A and group B.

It is easy to recast Black's framework as a consumer discrimination model. Reinterpret θ as the fraction of consumers who are type p (prejudiced) and $(1 - \theta)$ as the fraction who are type u (unprejudiced). Consumers have heterogeneous reservation prices α. However, type p consumers will not buy from type B sales persons regardless of price. Sales persons can visit one consumer per period at a cost c. They earn profits $p - V$ when they make a sale, where p is the price they charge and V is the cost of producing the product. Sales persons do not know what type of consumer they have encountered and in any case are constrained to charge the same price to all consumers. Sales persons choose a price that maximizes expected profits per consumer visit. They trade off profits in the event of a sale, $p - V$, against the fact that higher prices lower the probability that the consumer will buy. Type A and type B sales persons will set the same price, but the earnings of a type B seller will be only $(1 - \theta)$ of the earnings of a type A seller.

Alternatively, one may assume that there is a distribution of prejudice in the population. As in Becker's formulation of consumer discrimination, the reservation price to buy from

a type B salesperson is $\alpha - d$, where $d \geq 0$ and defines the degree to which a person is prejudiced against type B workers. In this circumstance, under plausible assumptions about the distribution of α and d, type B sales persons not only make fewer sales than type A but will also sell at a lower price. Consequently, they will have lower earnings. (If company policy constrains type A and type B sales persons to charge the same price, then the type Bs will simply make fewer sales.) If type Bs have an alternative occupation in which they are insulated from customer contact and thus not affected by consumer prejudice, then they are likely to be under represented in sales jobs.

3.3.2.3. Employee discrimination and costly search Thus far, no one has presented a model of employee discrimination that incorporates search costs. The informational assumptions needed to incorporate search costs into employee discrimination models may be somewhat more heroic than in employer or consumer discrimination models. There are a number of ways that one could develop such a model, however. If search costs for workers are substantial and employers do not know the group membership of potential employees prior to contacting them or do not know the degree of prejudice among group A members in the particular firm, then it will be difficult for firms to avoid employee prejudice by hiring a segregated work force consisting of either all A workers or all B and unprejudiced A workers. If there are more A workers than B workers, B workers will be less valuable to firms because employing B workers raises the costs of hiring and retaining a work force. This is true even if the skill composition of the A and B work forces are the same, a case in which segregation would eliminate the wage differential in the long run in the absence of search costs.

3.4. Discrimination and occupational exclusion

A vast literature has emerged in sociology and economics that is concerned with the fact that men and women and whites and blacks tend to work in different occupations. Occupational segregation can arise for many reasons. One possibility is more severe employer discrimination in one occupation than in another, as we noted above. A second possibility is that members of different groups select into different occupations, either because social norms regarding appropriate occupations may differ between groups or because legal and institutional constraints may limit access of certain groups to some occupations. This possibility recognizes that collective action may play a role in enforcing discriminatory outcomes, while the models of taste-based discrimination discussed above or the models of statistical discrimination discussed below are competitive models. A third possibility is that group differences in pre-labor market human capital investment and in non-labor market activities may lead to differences in comparative advantage across occupations, as we discussed in Section 3.1. We also note that preferences for the characteristics of occupations may differ between groups, particularly men and women, although such preference differences may be endogenously related to all three of the above-listed causes of occupational segregation.

How do these different mechanisms lead to occupational segregation and what are the

effects of such segregation on the relative wages of different groups? The consequences of public policies such as affirmative action and comparable worth depend critically on the answer. Bergmann's (1974) influential paper provided an initial analysis of the consequences of "occupational exclusion", in which one group is crowded into a subset of the occupations in the labor market. Johnson and Stafford (1997) extend this analysis and provide a simple framework with which to analyze the role of employer discrimination, preferences, human capital, and social pressure (whether due to institutional restrictions or social norms) on occupational exclusion. We follow their analysis closely in what follows.

Suppose that there is one good in the economy, and it is produced using workers in two occupations. For concreteness, we will focus on the case of gender segregation and define occupation 1 as the "men's job" and occupation 2 as the "women's job" (indexed by $j = 1, 2$). The number of workers of each gender in each job is denoted by L_{gj}, where $(g = m, f)$ for males and females. The ratio of the productivity of women to men in job j is denoted by λ_j. The flow of labor services is

$$N_j = L_{mj} + \lambda_j L_{fj}, \qquad j = 1, 2. \tag{3.9}$$

The marginal product of an extra unit of labor input in job 1 or job 2 depends on N_1 and N_2 and is denoted by $G_1(N_1,N_2)$ and $G_2(N_1,N_2)$, respectively.

Johnson and Stafford model employer discrimination along the lines of Becker, but assume that all potential employers have identical preferences. This simplifies the analysis and permits them to side-step the important issue of whether prejudiced employers can survive in the long run. The effect of hiring an additional worker on the utility of the firm is equal to the difference between his or her marginal product and the wage plus the psychic disutility (in monetary units) that the firm associates with employing that particular type of worker in the particular occupation. Define this as the disutility, d_1 or d_2, associated with hiring women into the two occupations. An employer hires men up to the point where wages (W_{gj}) equal marginal product:

$$W_{m1} = G_1, \qquad W_{m2} = G_2, \tag{3.10}$$

and hires women up to the point where

$$W_{f1} = (1 - d_1)\lambda_1 G_1, \qquad W_{f2} = (1 - d_2)\lambda_2 G_2. \tag{3.11}$$

To close the model it is necessary to specify the effects of wages on the supply of men and women to the two occupations (L_{gj}). Johnson and Stafford make the simplifying assumptions that the aggregate labor supply of the two groups is inelastic and that the labor market clears.[11] In this case

$$L_g = L_{g1} + L_{g2}. \tag{3.12}$$

[11] To the extent that the absolute level of labor supply of women to the two occupations responds to W_{f1} and W_{f2} (rather than simply to the relative labor supply in the two occupations), then the effects of the employer discrimination parameters d_1 and d_2 will be more likely to show up in a gender difference in employment rates rather than wage rates. Alternatively, one can re-interpret the "woman's occupation" to include the "non-market production" tasks that have traditionally been done by women.

In the absence of institutional constraints, the desired supply of labor in job 1 relative to job 2 depends on the relative wages and on the distribution of preferences for the two jobs given job characteristics such as hours flexibility, job security, and working conditions. The *desired* relative labor supply of group g is given by

$$\frac{L_{g1}^s}{L_{g2}^s} = \theta_g \psi_g\left(\frac{W_{g1}}{W_{g2}}\right), \tag{3.13}$$

where θ_g is a taste parameter and $\psi'(\cdot) > 0$. The *actual* relative supply is equal to the product of the desired relative labor supply and X_g, where X_g captures the effects of social pressure and/or institutional constraints on the costs and benefits that a person of type g derives from working in occupation 1:

$$\frac{L_{g1}}{L_{g2}} = X_g \frac{L_{g1}^s}{L_{g2}^s} = X_g \theta_g \psi_g\left(\frac{W_{g1}}{W_{g2}}\right), \qquad g = m,f. \tag{3.14}$$

For example, if women are legally prohibited from working in occupation 1, then X_f is 0 and $L_{f1}/L_{f2} = 0$. If there is social pressure for women to work in occupation 2 and for men to work in occupation 1, then $X_f < 1$ and $X_m > 1$. Eqs. (3.9) and (3.14), together with the assumption that the aggregate labor supply of the two groups is inelastic, give equations for N_1 and N_2 in terms of W_{g1}/W_{g2}, $g = m,f$. These equations and the labor demand condition

$$\frac{W_{m1}}{W_{m2}} = \frac{G_1(N_1,N_2)}{G_2(N_1,N_2)}, \qquad \frac{W_{f1}}{W_{f2}} = \frac{(1-d_1)\lambda_1 G_1(N_1,N_2)}{(1-d_2)\lambda_2 G_2(N_1,N_2)} \tag{3.15}$$

implied by labor demand conditions (3.10) and (3.11) determine L_{g1}/L_{g2} and W_{g1}/W_{g2} as well as the wage levels. Johnson and Stafford note that W_{g1}/W_{g2}, the group specific ratio of the wage in the man's job relative to the female job, is greater for men than women. This is due to a comparative advantage of women in job 2 ($\lambda_2 > \lambda_1$) and/or greater employer discrimination against women in job 1 than job 2 ($d_1 > d_2$).

The fraction of group g workers in occupation 1 is given by

$$P_{g1} = \frac{L_{g1}}{L_g} = \frac{X_g \theta_g \psi_g\left(\frac{W_{g1}}{W_{g2}}\right)}{1 + X_g \theta_g \psi_g\left(\frac{W_{g1}}{W_{g2}}\right)}. \tag{3.16}$$

Let D denote the gender difference $P_{m1} - P_{f1}$ in the distribution of workers in occupation 1. D is decreasing in λ_1/λ_2, the comparative advantage of women in occupation 1, and in $(1-d_1)/(1-d_2)$, which is inversely related to degree of employer prejudice faced by women in occupation 1 relative to occupation 2. Increases in these variables raise W_{f1}/W_{f2} relative to W_{m1}/W_{m2}, inducing an increase in the relative supply of women to the "men's occupation". D is decreasing in θ_f/θ_m, the relative tastes of women for occupation 1

compared to the relative tastes of men. Finally, D is decreasing in X_f/X_m, which increases as the gender differences in social norms and institutional constraints decline.

One may easily use this framework to analyze the effects on the wages of men and women of an increase in X_f, which represents a decline in occupational exclusion due to institutional constraints or social norms. This would induce a shift in the supply of women from occupation 2 to occupation 1. The case in which there is no employer discrimination ($d_1 = d_2 = 0$) provides an easy benchmark case to analyze. In this case

$$W_m = G_1 \frac{L_{m1}}{L_m} + G_2 \frac{L_{m2}}{L_m} \tag{3.17}$$

and

$$W_f = \lambda_1 G_1 \frac{L_{f1}}{L_f} + \lambda_2 G_2 \frac{L_{f2}}{L_f}. \tag{3.18}$$

where W_m and W_f are the average wage for men and for women respectively. These equations imply that the wage changes resulting from the shift of one woman from occupation 2 to occupation 1 are

$$\Delta W_m = -\frac{s_2 - s_1}{\sigma L_m}\Big[(1-\beta)W_{f1} + \beta W_{f2}\Big] \tag{3.19}$$

and

$$\Delta W_f = \frac{W_{f1} - W_{f2}}{L_f} + \frac{s_2 - s_1}{\sigma L_f}\Big[(1-\beta)W_{f1} + \beta W_{f2}\Big] \tag{3.20}$$

where $s_1 = \lambda_1 L_{f1}/N_1$ and $s_2 = \lambda_2 L_{f2}/N_2$ are the shares of female labor input supplied to the two occupations, β is the share of job 1 in the total wage bill, and σ is the elasticity of substitution between the two occupations. Since $s_2 - s_1 > 0$ the wages of men fall as a result of this shift. Rents collected by workers in occupation 1 decline as result of the relative supply shift. On the other hand, W_f rises. The first term in Eq. (3.20) captures the direct gain to women's wages of someone shifting from the low to the high wage occupation and the second term captures the effect of the increase in the occupation 2 wage that results from fewer women in occupation 2.

Johnson and Stafford (1995) use a version of this model to simulate the effects of reductions in occupational exclusion on the male/female wage rate for the year 1989. They conclude that gender wage equality in 1989 would have required (1) equal productivity and no discrimination ($\lambda_j = 1$, $d_j = 0$; $j = 1, 2$) and (2) a substantial shift in women's occupational distribution, with the size of the shift depending on the assumptions about some of the parameters of the model.

Johnson and Stafford also utilize the model to analyze the effects of an increase in the labor market productivity of women in occupation 1. Such an increase might arise from a reduction in the gender gap in education or on the job training. As women get better at men's jobs ($\Delta\lambda_1 > 0$), W_{f1} rises, L_{f1} rises, and the average male wage falls. As women get

better at women's jobs, both men and women gain. Men can gain more than women if the elasticity of substitution between the two occupations is low.

This analysis shows the consequences of institutional constraints, social norms, or employer discrimination that "crowd" a group into particular occupations. But a major weakness of the theoretical literature continues to be a lack of formal models that analyze the mechanisms through which social norms or institutional constraints arise and are sustained. For example, Donohue and Heckman (1991) argue informally that civil rights legislation played an important role in breaking down social barriers to the hiring of blacks in the South and allowed large numbers of employers who had long wished to integrate their workforces to do so. It would be useful to have models that predict when such barriers are likely to arise, how they evolve over time, and when they are likely to break down. With the rapid development of game theory over the past 15 years, such models might now be feasible to develop.[12]

3.5. Statistical discrimination, worker incentives, and the consequences of affirmative action

3.5.1. Overview

Since the pioneering papers by Phelps (1972) and Arrow (1973), most theoretical research on discrimination has focussed on the consequences of statistical discrimination by employers on the basis of race or sex. The basic premise of this literature is that firms have limited information about the skills and turnover propensity of applicants, particularly young workers with little labor market history. In this situation, firms have an incentive to use easily observable characteristics such as race or gender to "statistically discriminate" among workers if these characteristics are correlated with performance (after controlling for all other information that the firms have available). The idea that firms face a great deal of uncertainty about the productivity of their workers rings true to us and is consistent with recent evidence in Farber and Gibbons (1996) and Altonji and Pierret (1997). It is illegal to make hiring, pay, or promotion decisions based on predictions about worker behavior by race and gender (productivity, absenteeism, turnover, etc.), even if such predictions are statistically rational forecasts given the information set available to the employer. But such behavior would be hard to detect in many circumstances.

There are two main strands to the statistical discrimination literature. The first investigates how prior beliefs about the productivity of group members can influence hiring and pay decisions. One important issue is whether biased racial and gender stereotypes might be self confirming when the payoff for hard-to-observe worker investments depends on employer beliefs. This issue was addressed by Arrow (1973) and analyzed most comprehensively in recent work by Coate and Loury (1993b) that we consider in detail in Section 3.5.2 below. Coate and Loury show that discriminatory equilibria are possible in which racial and gender stereotypes are

[12] Akerlof (1976, 1980) provides a starting point.

self confirming. They also show that affirmative action policies may make the situation either better or worse.

The second strand of literature concerns the consequences of group differences in the *precision* of the information that employers have about individual productivity. This issue is addressed by Aigner and Cain (1977) with subsequent papers by Lundberg and Startz (1983) and Lundberg (1991). Suppose that the true productivity of a specified group of workers is difficult for firms to discern, perhaps because of cultural differences. This difference in information quality has three main implications. First, to the extent that productivity depends on the quality of the match between the skills of the worker and the requirements of the job, expected productivity will be lower for groups about whom the firm is more uncertain, a point emphasized many years ago by Aigner and Cain. Second, a recent paper by Oettinger (1996) points out that differences in the precision of the employer's information may also lead to differences across groups in the return to job matching. Third, the wages of group B workers may be less responsive to performance because firms have difficulty "seeing" their productivity. This would weaken the incentives of group B members to invest in skills and can lead to an equilibrium in which group B members are less productive on average than group A members even if the two groups have the same distributions of innate ability. Section 3.5.3 discusses these models in more detail.

3.5.2. Statistical discrimination: the role of stereotypes

We begin this section by using the Coate and Loury (1993b) (hereafter CL) model to show that differences in the prior beliefs of firms about the skills of different groups of workers can lead to equilibria in which groups that have the same innate ability end up with different levels of skill. We then discuss the implications of this model, as well as Coate and Loury's (1993a) model of taste-based discrimination, regarding the effects of affirmative action on labor market outcomes. In particular, we ask whether affirmative action policies will eliminate negative stereotypes and improve group outcomes. We point out that CL's results are likely to be sensitive to their assumption that jobs are discrete. These models provide a useful framework for analyzing these issues and this approach deserves further attention.

Coate and Loury (1993b) assume employers are randomly matched to a pool of workers. Workers belong to an identifiable group g, where ($g = A, B$) and A represents the majority workers while B represents the minority workers. Each firm has two jobs. Task 0 is unskilled and can be performed satisfactorily by any worker. Task 1 can only be performed by a qualified worker. Firms pay a wage premium of w to workers who do task 1. The net return to the firm of assigning a worker to task 1 is x_q if the worker is qualified and $-x_u$ if the worker is unqualified.

Employers observe group membership and a noisy signal T about a worker's qualifications. The distribution of T depends upon whether the worker is qualified or not. In deciding whether to assign a worker to the skilled or the unskilled job the firm forms a posterior probability that the worker is qualified based upon the signal observed and a prior

belief π_g that a member of this group is qualified. The firm assigns all workers above a critical value of the posterior probability to the skilled job, where the critical value depends on x_q and x_u. Since the posterior probability depends upon the prior beliefs and the signal, this means that the firm assigns all persons in group g with a signal T greater than the critical value

$$s_g = s^*(\pi_g)$$

to the skilled job. The larger π, the lower the critical value. The locus of s, π points forms the curve EE in Fig. 6 (which is based upon Fig. 2 from CL).

All workers have the same basic skills, but only those who choose to invest in training become qualified for task 1. Training costs c have a distribution $G(c)$ in the workforce. Workers decide to invest if the value of the change in the probability of being assigned to job 1 exceeds the cost of training, or if

$$w[F_q(s) - F_u(s)] > c,$$

where w is the net gain from being placed in job 1, $F_q(s)$ and $F_u(s)$ are the respective probabilities that the signal of a qualified worker and an unqualified worker will exceed the hiring threshold s, and $F_q(s) - F_u(s)$ is the net effect of becoming skilled on the probability that the worker's signal will exceed s and the worker will be assigned to job 1. *A* fraction

$$\pi^* = G(w[F_q(s) - F_u(s)]) \tag{3.21}$$

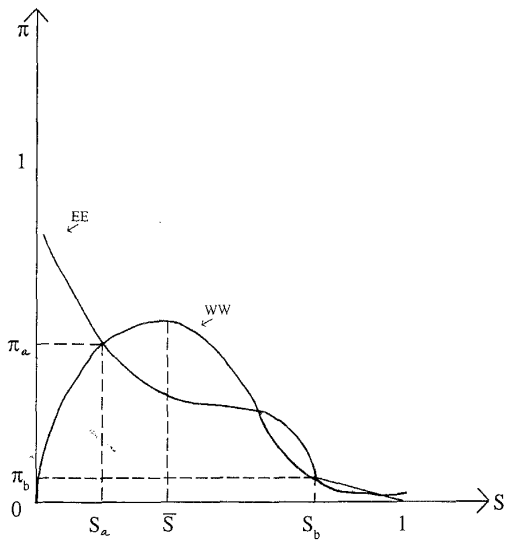

Fig. 6. An equilibrium with negative stereotypes against *B*s. Based on Coate and Loury (1993b, Fig. 2).

find it profitable to train. The curve WW in Fig. 6 is the locus of points π^* and s. For standard distributions, $F_q(s) - F_u(s)$ is initially increasing in s and then decreasing in s.

The equilibrium priors of the firm solves the two equations

$$\pi_g = G(w[F_q(s^*(\pi_g)) - F_u(s^*(\pi_g))]), \qquad g = A, B. \tag{3.22}$$

A discriminatory equilibrium can occur if these two equations have different solutions. The points of intersection between WW and EE are the equilibrium points.

In Fig. 6, both π_b and π_a are equilibria, with $\pi_b < \pi_a$. This indicates that if firms initially think that fewer group B members are qualified than group A, this will influence the investment decisions of group B in a way that may confirm the firms' priors. If firms update their priors using the mechanism that π_g in $(t + 1)$ is equal to the fraction of group g that was qualified for the high skilled job in period t, then both points are locally stable.[13] The important point is that even if firms update priors in a sensible way and As and Bs have identical skills and the same training cost distribution, then stereotypes that are initially negative may become self-confirming.

3.5.2.1. Affirmative action and worker incentives There is little theoretical work on the effects of affirmative action and a major aim of Coate and Loury (1993b) is to ask whether affirmative action policy over time can eliminate negative stereotypes. If not, then it would be necessary to continue affirmative action indefinitely to maintain the position of B. CL define the situation before the implementation of affirmative action policy in a natural way, as the case in which $\pi_b < \pi_a$. They assume that the policy requires that workers from each group be assigned to skilled jobs in proportion to their representation in the labor pool of the firm, where λ is the fraction of type B workers. In this model, the workers' choice of training in response to the assignment standard (s) set by the firm is still summarized by the WW curve in Fig. 6. However, firms know that they must assign λ type B workers for every $(1 - \lambda)$ type A workers they assign to task 1. A firm knows that the probability $\rho(s, \pi)$ that it will assign a worker to a skilled job depends upon the assignment cutoff value, the distribution of the signal for qualified workers and for unqualified workers, and the firm's prior belief π, with

$$\rho(s, \pi) \equiv \pi[1 - F_q(s)] + (1 - \pi)[1 - F_u(s)]. \tag{3.23}$$

Expected profit from hiring a worker when the standard is s and the prior is π is

$$P(s, \pi) \equiv \pi[1 - F_q(s)]x_q + (1 - \pi)[1 - F_u(s)](-x_u), \tag{3.24}$$

where we recall that $-x_u$ is the productivity of an unskilled worker in the skilled job.

Given beliefs π_a and π_b the firm chooses standards (s_a, s_b) that maximize profits subject to the constraint of satisfying (in an expected value sense) the affirmative action goal of proportionate representation in job 1. That is, the firm picks (s_a, s_b) to solve

$$\max[\lambda P(s_b, \pi_b) + (1 - \lambda)P(s_a, \pi_a)],$$

[13] The point $\pi = 0$ is also a locally stable equilibrium. In this situation no members of group g will seek training because the posterior probability of getting assigned to job 1 will be 0 regardless of the signal.

subject to

$$\rho(s_b, \pi_b) = \rho(s_a, \pi_a). \tag{3.25}$$

An equilibrium consists of the values of s_a and s_b that solve (3.25) given the equilibrium values of π_b and π_a.

CL show that for some functional forms the only equilibria under affirmative action is one in which firms hold the same beliefs for the two groups ($\pi_a = \pi_b$), resulting in equal labor market outcomes. This outcome is, of course, the goal of affirmative action. However, CL also show that there are "patronizing equilibria" in which employers hold negative stereotypes about B workers and where these stereotypes are worsened by affirmative action. The intuition is as follows. Because firms must satisfy the affirmative action goal and believe (correctly given the initial equilibrium) that the B workers are less productive, they set a lower standard s_b. Under reasonable assumptions about F_u and F_q, reducing s_b will reduce $F_q(s_b) - F_u(s_b)$ and lower the payoff for B workers to becoming qualified. As a result, some B workers with relatively high training costs no longer seek training. In the words of Coate and Loury (1993a), "if the policy forces firms to 'patronize' some workers by setting lower standards for them, then the workers may be persuaded that they can get desired jobs without making costly investments and skills. However, if fewer members of some group acquire skills, firms will be forced to continue patronizing them in order to achieve parity. Thus, skill disparities might persist, or even worsen, under such policies." Coate and Loury (1993b) show that a patronizing equilibrium is most likely to exist when Bs are relatively rare in the population. In this case firms will meet the affirmative action standard by making it easier for B workers to qualify rather than by raising the standard for A workers.

3.5.2.2. Taste-based discrimination and affirmative action Coate and Loury (1993a) also analyze the consequences of affirmative action using a model of taste-based employer discrimination. Their analysis illustrates how prejudice on the part of employers that is increasing in the skill requirements of the job can undermine the incentives of the minority group to invest in skills. It also shows, as in the statistical discrimination case, that the effect of affirmative action is ambiguous.

Assume firms are taste-based discriminators in the sense of Becker (1971) and experience a psychic cost $0.5\gamma r z_b$ for hiring z_b members of group B, where γ is the coefficient of discrimination ($\gamma > 0$) and r is the ratio z_b/z_a of B workers to A workers hired. Hence, the psychic cost is larger the larger is r, the ratio of Bs to As among the pool of acceptees. As in Coate and Loury (1993b) workers are either qualified or unqualified. They become qualified by making investments at a cost c, where $G(c)$ is the fraction of workers in each group that has a cost less than c. In contrast to the model above, firms can perfectly observe workers' qualifications before hiring them, so the employers' prior beliefs about the average qualifications of a group do not play a role and there is no statistical discrimination, although the model is similar in structure to Coate and Loury (1993b). Workers who are hired receive a net return of w. A firm's return to hiring a qualified B and an unqualified

B are $(x_q - \gamma r)$ and $(-x_u - \gamma r)$ respectively, where γr is the derivative of psychic costs with respect to z_b. The payoff for hiring a qualified A is $(x_q + 0.5\gamma r^2)$ and the payoff for an unqualified A is $(-x_u + 0.5\gamma r^2)$, where $0.5\gamma r^2$ is the effect of z_a on psychic costs. The costs of rejecting a worker are zero, all parameters are taken to be exogenous, and the law requires firms to pay all workers in the job the same wage.

Timing in the model is as follows. First, individual workers decide to invest based upon their costs c and the probability of being hired. They then randomly apply to firms. Firms observe the qualifications of their pool of applicants and decide who to hire.

In the absence of constraints imposed by affirmative action, firms will never hire an unqualified B worker and never reject a qualified A. They hire qualified B workers from their pool of qualified Bs up the point that $z_b/z_w = r^*$, where r^* is the value at which the marginal benefit x_q is equal to the marginal disutility the firm associates with an additional B worker, i.e., $x_q = \gamma r^*$. Let π_a and π_b be the fraction of A and B workers who invest in training and let $\bar{r}$ be the ratio of Bs to As in the population. Since firms only hire B workers up to the point where the ratio of B to A employees is r^*, the probability δ that a qualified B is hired is

$$\delta(\pi_b, \pi_a) = \begin{cases} 1, & \text{if } \bar{r}(\pi_b/\pi_a) \leq r^* \\ (\pi_a r^*)/(\pi_b \bar{r}), & \text{otherwise.} \end{cases} \tag{3.26}$$

B workers realize this and choose to train based upon whether $w\delta(\pi_b, \pi_a) < c$. Consequently, $\pi_b = G(w\delta(\pi_b, \pi_a))$ and $\pi_a = G(w)$.

The equilibrium acceptance probability for qualified Bs, δ^*, solves

$$\delta = \min[G(w)r^*/G(\delta w)\bar{r}, 1]. \tag{3.27}$$

Under certain assumptions about the strength of the firm's taste for discrimination, CL show that $r^* < \bar{r}$, and $0 < \delta(\pi_a, \pi_b) < 1$. This implies that $\pi_b < \pi_a$ in equilibrium. That is, the prejudice of the firms leads some firms to reject qualified Bs while accepting all qualified As. This lowers the incentive for Bs to invest and results in an equilibrium in which a lower fraction of Bs than As are qualified. Thus, Coate and Loury (1993a) show that reduced opportunities resulting from prejudice may feed back into reduced investments in skill on the part of B workers, leading to ex post differences in the average skill levels of the groups.

The authors introduce affirmative action by assuming that the law requires firms to achieve a ratio of at least $\hat{r} > r^*$. This means that the law is binding on the firms. They show that if the unconstrained equilibrium r^* is only slightly below $\hat{r}$, so that the firms can achieve $\hat{r}$ by hiring more of the qualified B workers, then the return to becoming qualified will rise for B workers. As a result, the gap between π_b and π_a will narrow. However, they also show that if $\hat{r}$ exceeds r^* by an amount that is large enough to induce firms to hire unqualified B workers, then the return to becoming qualified may fall. In this case, affirmative action may actually widen the skill gap between A and B workers.

3.5.2.3. The case of continuous skill types and job types The point made in the Coate and Loury (1993a,b) papers – that affirmative action, by lowering the hiring standard for B workers, may reduce incentives for these workers to invest– is an important contribution to the literature. However, we believe that this possibility is less likely than the analyses may seem to imply. Both papers simplify the analysis to focus upon "qualified" and "unqualified" workers. The labor market is better described as a continuum of jobs and a continuum of skill levels. A worker with a given set of skills may be well qualified for one job, slightly less well qualified for another one and so on. Furthermore, the investment opportunities open to workers are more continuous. Why might continuity in job types and investment opportunities matter? Because in such a world the payoff to investment in skill is continuous. An affirmative action policy that lowers the skill required to obtain a given job may put higher level jobs within reach of a worker willing to make an investment. Consequently, affirmative action may leave the return to investment unchanged or raise the return for many workers.

Consider the following scenario. There is a continuum of jobs indexed by j, where a higher j is associated with a more skilled job. The expected productivity of a worker in job j depends on the firm's belief, $\hat{e}$, about the skill of the worker whose true skill is e. Firms do not observe e but as in Coate and Loury (1993b), observe group membership and a productivity signal θ. Their estimate of the productivity of a given worker is the mean of the posterior distribution of $\hat{e}$, conditional on group membership and θ. Since the distribution of θ depends on e, the expected value of this estimate for a worker from group g who expends training effort e is

$$\hat{e}(e,g) = \mathrm{E}[\hat{e}(\theta,g) \mid e,g], \qquad g = A,B. \tag{3.28}$$

Assume that because of the Equal Pay Act of 1963 firms pay all workers in the same job the same wage. For simplicity, we assume that expected productivity in job j, $Q_j(\hat{e})$ has the form

$$Q_j(\hat{e}) = \begin{cases} 0, & \text{if } \hat{e} < q_j \\ Q_j(q_j), & \text{otherwise,} \end{cases}$$

where q_j is a technology parameter for job j. Given the indexing of jobs, $q_{j'} > q_j$ if $j' > j$ and

$$Q_{j'}(q_{j'}) > Q_j(q_{j'}) = Q_j(q_j), \qquad \text{if } j' > j.$$

Firms only care about profits, as in Coate and Loury (1993b). This means that if wages are increasing in $\hat{e}$, the firm will choose workers with $\hat{e} = q_j$.[14] Competition among firms will force $w(q_j) = Q_j(q_j)$.

[14] There is a fudge here in that $Q_j(\hat{e})$ should be a more smooth function of $\hat{e}$ if actual productivity has the form $Q_j{}^*(e) = 0$ if $e < q_j$ and $Q^*{}_j(e) = Q^*{}_j(q_j)$ if $e \geq q_j$. More generally, firms choose the skill type to hire so as to maximize $Q_j(\hat{e}) - w(\hat{e})$. A condition for type j firms to choose workers with $\hat{e} = q_j$ is that the second derivative of $Q_j(\hat{e})$ with respect to $\hat{e}$ is large and negative when $\hat{e}$ is near q_j while the second derivative of $w(\hat{e})$ is small. In this case, $\partial Q_j(\hat{e})/\partial\hat{e} = \partial w(\hat{e})/\partial\hat{e}$ near q_j.

Let $\bar{r}$ be the ratio of B to A workers in the workforce and let $f(q_j)$ be the ratio of the densities of $\hat{e}$ among B and A workers evaluated at q_j. In equilibrium the ratio of B workers to A workers in job j will be $\bar{r}f(q_j)$.

Workers choose skill levels to maximize expected income given training costs. We normalize skill and effort spent on training so that skill is equal to training effort. Assume training costs are equal to

$$C(e;c) = ce + he^2, \qquad c > 0, h > 0, \tag{3.29}$$

where h is a constant but c has a CDF $G(c)$ in the B and A population, as in the CL models. As in Coate and Loury (1993b), firms do not observe the skills of the worker directly or the training input. Consequently, workers choose skill to solve the first order condition

$$w'(\hat{e}(e,g))\partial\hat{e}(e,g)/\partial e = c + 2he, \qquad g = A, B. \tag{3.30}$$

We assume that the parameter values are such that the first order condition has an interior solution over the support of c. If (1) $\hat{e}(e,g)$ does not depend on g and (2) $\partial\hat{e}(e,g)/\partial e)$ does not depend on g, then the distribution of e will be the same for B and A. However, suppose that the economy is in an initial equilibrium

$$\hat{e}(e,B) = \hat{e}(e,A) - \phi, \tag{3.31}$$

and furthermore assume that

$$\theta = e + u, \tag{3.32}$$

where u is noise that is assumed to have the same distribution for A and B workers (in contrast to the Aigner and Cain and Lundberg and Startz models we turn to momentarily.) Assume firms use the linear least squares predictor

$$\mathrm{E}(e \mid \theta, A) = (1 - \beta)\mathrm{E}(e \mid A) + \beta\theta. \tag{3.33}$$

to form their beliefs about workers who are members of group A and have signal θ. Then since $E(\theta \mid e, A) = e$,

$$\hat{e}(e,A) = \mathrm{E}[\mathrm{E}(e \mid \theta, A) \mid e, A] = (1 - \beta)\mathrm{E}(e \mid A) + \beta e. \tag{3.34}$$

Assume that the technology and distribution of job types is such that the equilibrium wage function $w(\hat{e}(e,g))$ is approximately quadratic, with

$$w(\hat{e}(e,g)) = b_1\hat{e}(e,g) + 0.5b_2\hat{e}(e,g)^2, \qquad g = A, B. \tag{3.35}$$

and $b_2 > 0$. Then some algebra establishes that the skill level $e(c,B)$ chosen by a member of group B with cost c is

$$e(c,B) = e(c,A) + \frac{\beta b_2 \phi}{\beta^2 b_2 - 2h}. \tag{3.36}$$

where $e(c,A)$ is the skill level chosen by group A members with training cost c. The second order condition for the worker's optimal choice of e is $(\beta^2 b_2 - 2h) < 0$, so the denomi-

nator in this expression is negative. This means that the gap in firm beliefs will induce group B members to invest

$$\frac{\beta b_2 \phi}{\beta^2 b_2 - 2h}$$

less than A members for each value of c, and leaves them with less training. If $\beta b_2 = -(\beta^2 b_2 - 2h)$, then the beliefs of firms are consistent with an equilibrium in which Bs are $-\phi$ less productive than As. This result is analogous to Coate and Loury's (1993b) result with two types of jobs and two skill types. The intuition is that the firm's prior beliefs place the B workers in a range in which the effect of training on productivity is lower, given that b_2 is greater than 0. Consequently, they choose less training.[15]

Now suppose that an affirmative action program is instituted that requires firms to hire Bs in each job j at least in proportion to their fraction $\bar{r}$ in the population. Assume that $\bar{r}$ is small, so that there is no adjustment in the employment of As. Then the Bs move up the job hierarchy in accordance with the value of $\hat{e}(e,B)$ for the particular worker. Since the density of $\hat{e}(e,B)$ is equal to the density of $\hat{e}(e,A) - \phi$, a B worker who chooses e and receives the job will receive $Q_j(\hat{e}(e,B) + \phi) = Q_j(\hat{e}(e,A))$ in the new equilibrium. This fact and the fact that $d\hat{e}(e,k)/de$ is a constant (β) means that after the affirmative action program is instituted B and A workers have the same incentive to invest. Consequently, in equilibrium B and A workers with a given c will choose the same e.

Obviously, the above discussion assumes that the behavior of the A workers does not change after the affirmative action policy is implemented. Affirmative action might actually give some B workers an incentive to invest more than an A worker with the same c, and the effects need not be uniform over the distribution of c. There are certain situations in which mobility costs across firms or across positions within a firm are so high that workers may face a discrete set of choices rather than a continuum. But for the most part skills are continuous and there is a continuum of jobs. In such a world the adverse incentive affects highlighted by CL do not seem likely to be as important.

3.5.3. Statistical discrimination: group differences in the quality of employer's information

We now turn to models of the consequences of group differences in the quality of signals received by firms from workers (as opposed to differences in the prior beliefs of firms). As we will see, such differential information affects ex post outcomes as well as the impact of equal pay or affirmative action legislation. We also discuss an extension of Lundberg's (1991) analysis of affirmative action in which firms *choose* how much to invest in information about workers. Firms do not internalize the social benefits that may arise when their investments in information affect the decisions of workers to invest in training. As a result, firms may gather less information than is socially optimal. Affirmative action may

[15] If b_2 was less than 0, they would choose more training.

lead to greater investments in information by firms and greater investments in training by workers.

Lundberg (1991) uses a model of statistical discrimination developed by Aigner and Cain (1977) and extended in Lundberg and Startz (1983) that has been quite influential. The key assumption of the model is that the accuracy of the information that firms have about the productivity of individuals differs across groups. They show that this can lead to an equilibrium in which firms statistically discriminate on the basis of group membership and groups differ ex post in productivity even though the mean of innate ability is the same for all groups.

The Lundberg and Startz model is as follows. The marginal product MP of worker i is

$$MP_i = a_i + e_i, \tag{3.37}$$

where a_i is innate ability and e_i is acquired human capital, which we normalize to affect MP with a coefficient of 1. Workers choose e_i to equate the marginal cost of skill investment to the marginal increment in wages, which is increasing in e_i. The marginal cost is

$$C'(e_i) = ce_i, \tag{3.38}$$

where c is a scalar. In contrast to CL, c is the same for all workers.

As in Coate and Loury (1993b) and the model sketched above, firms observe only group membership in A or B and an indicator of productivity θ_i. The productivity indicator is determined by

$$\theta_i = MP_i + \varepsilon_i. \tag{3.39}$$

Firms pay $w_i = \mathrm{E}(w_i|\theta_i)$, which if the errors are jointly normal and independent implies

$$w_i = \overline{MP} + \beta(\theta_i - \overline{\theta}), \tag{3.40}$$

where $\beta = \sigma^2/(\sigma_\varepsilon^2 + \sigma^2)$ is the variance of MP, and σ_ε^2 is the variance of the random component of the noisy signal θ. For an individual the response of wages to human capital investment is β. To see how statistical discrimination may lead to group differences in the mean of w_i, suppose that the training cost parameter c and the mean of innate ability a_i is the same for the groups A and B, but θ is less informative for group B than A, with $\beta_B < \beta_A$. In this situation, firms that are permitted to "statistically discriminate" will use separate wage equations for the two groups. The return to human capital investment will be lower for group B than group A members. In equilibrium, this will lead group B members to invest β_B/c, which is less than the amount β_A/c group A members will invest. A wage gap between the groups will develop.

Lundberg and Startz show that forbidding firms to use separate wage schedules conditional on θ_i will eliminate the group differences in human capital investment and wages. It will also lead to an efficiency gain because the induced increase in training for group B comes at a lower marginal cost.

Lundberg (1991) makes the point that preventing firms from using group specific equations to estimate the productivity of an individual will reduce the accuracy of their

estimates of productivity. If output depends on the quality of the match between the job and the worker, then the reduced accuracy may result in an efficiency loss. She points out that an outcomes-based policy such as affirmative action may be preferable to an "equal treatment" policy both because the latter is hard to enforce given the heterogeneity of workers and because an affirmative action policy would allow firms to make group specific assessments provided that outcome goals were met.

There is a research base in psychology suggesting that male managers may be a worse judge of their female employees than their male employees. Cultural and language differences may make assessments by mostly white male managers of the performance of black and female employees less accurate, as Lang (1986, 1993) stresses. In this case, cultural and language differences among workers may affect productivity.[16] In addition, social networks tend to run along gender and racial lines, and referrals and personal contacts are an important conduit of information in the labor market. As Montgomery (1991) shows formally, groups that are poorly represented in higher level positions may be at an information disadvantage. On the other hand, we are unaware of any empirical work that systematically investigates the proposition that the "signal to noise" in employer assessments of workers is lower for women than men or for blacks than whites, despite the prominence of this idea in the discrimination literature. For this reason, we are not clear how much weight should be placed on the statistical discrimination/information quality explanations for differences in group outcomes, nor are we sure about how seriously to take the policy analysis that results from these models.

3.5.3.1. Might affirmative action correct underinvestment in information? One issue that has not been addressed in the literature is the possibility that affirmative action and "equal treatment" policies induce firms to invest in better information about worker productivity and, as a result, partially correct a market failure stemming from the fact that the incentive of any particular firm to invest is limited, while the incentives of workers to invest in skill depend on how easily firms can observe productivity. Individual firms do not capture the full return from better screening because (1) other firms will raid workers from firms known to screen thoroughly and (2) firms ignore feedback effects on the investment decisions of workers.

To make this point, suppose that an individual firm can lower the variance of the noisy element in a worker's productivity signal from σ_ε^2 to 0 by paying a screening cost K per worker. Suppose the parameters of the model are such that it is not in any firm's private interest to do so. One justification for affirmative action policy is to induce firms to screen workers more carefully, particularly from the disadvantaged group. Holzer and Neumark (1997) provide some evidence that affirmative action has had this effect. Suppose after the policy is implemented individual firms have the incentive to spend the K per worker

[16] The actual productivity of an organization may depend on efficient communication and good personal relationships among work teams. This mechanism is stressed by Lang (1986). We do not know of any direct evidence on the quantitative significance of differences in the communications styles of men and women, for example, on the productivity of mixed teams.

regardless of group. As a result β_A and β_B will increase from their old values, say β_{A0} and β_{B0}, to 1. Workers from both groups will increase their skill investments because they are better observed and rewarded by employers. Group differences in outcomes will be eliminated, and it is possible that the policy will increase output net of training costs. The average skill level and productivity of members of group g will increase from β_{g0}/c to $1/c$ at a cost of $0.5(1 - \beta_{g0})/c$. Since the productivity gain outweighs the investment cost for all values of β between 0 and 1, there is a social gain if K is sufficiently small, and β is sufficiently far below one. This is true even if one ignores any gains from better matching of workers to jobs of the type stressed by Lundberg.

The above discussion is only suggestive, but it indicates that a useful avenue for research may be an analysis investigating whether firms underinvest in information and the implications of this for affirmative action. Similarly, better information on the actual differences in information available to employers across groups would also be useful.

4. Direct evidence on discrimination in the labor market

As discussed in Section 2, many researchers take the "unexplained gap" – the difference in wages after controlling for a host of personal and job characteristics – in wage regressions as evidence of discrimination. While the presence of unexplained differences in male/female or black/white wages is certainly consistent with the presence of discrimination, it does not provide a very direct test of the hypothesis. On the one hand, if discrimination is affecting the human capital investments and personal choices that individuals make or if it is affecting job choice, then the "unexplained gap" will *understate* discrimination, because some of the control variables themselves reflect the impact of discrimination.[17] On the other hand, the specifications in many of these wage regressions are limited and researchers typically have only very crude proxies to measure skills and ability (such as years of education) or experience (such as age − education). If there are omitted variables that are missing from these regressions that relate to the human capital and personal tastes of the individual and that are correlated with wages, then the "unexplained gap" will *overstate* the impact of discrimination, since it will reflect both the impact of omitted and unmeasured productivity variables as well as any effects of discrimination.

This section reviews alternative (and we believe more convincing) evidence regarding the presence of discrimination in the labor market. Combined with extensive evidence of persistent "unexplained gaps" – even in studies with detailed control variables – we believe that the evidence suggests there is ongoing discrimination in the labor market, both against blacks as well as women. The exact nature of that discrimination is more difficult to determine.

[17] For example, that analysis of Baldwin and Johnson (1992) suggests that wage discrimination will feed back into group differences in actual experience, and that controlling for these differences will lead one to understate the total effect of wage discrimination on group differences.

4.1. Audit studies and sex blind hiring

To investigate the presence of discrimination, one would like to be able to compare the outcomes of individuals in the same job who are identical in all respects that are relevant to performance but who differ only in race, ethnicity or gender. Audit studies are an attempt to approximate such a comparison at least with regard to hiring.

There are two main types of audit studies. The first approach is to send out resumes that are identical in all respects except race, gender, or ethnicity. For example, "male" and "female" first names may be used. The analyst then compares the probability that firms invite the applicants in for follow up interviews based upon the resumes.

The second approach is to send auditors to companies to interview. One first selects and trains auditors who are selected to match on as many characteristics as possible that are relevant for the job in question. As Heckman and Siegelman (1992) stress, this requires detailed knowledge on the part of the investigator of what features are relevant. These applicants must also have resumes that are essentially identical. The auditors are paired across gender or race lines and sent to a sample of companies, perhaps companies that have advertised job openings. Data are collected on the probability of getting an interview and the probability of getting a job offer. The results are compared across groups as a whole and within matched pairs. Data on treatment during the recruiting process, such as time left waiting prior to an interview, may also be considered. Differences between matched pairs are then averaged by race, ethnic group, or gender.

Audit studies have played an important role in the literature on housing discrimination and are used in the enforcement of fair housing laws, with auditors sent out to rent or purchase homes. They have been less widely used in labor market research. Early examples include Newman (1978) and McIntyre et al. (1980). Three recent studies of employment differences based upon audit pairs are Turner et al.'s (1991) analysis of black and white men in Washington and Chicago, Cross et al.'s (1990) study of Hispanic and white non-Hispanic men in San Diego and Chicago, and James and DelCastillo's (1991) study of Hispanics, blacks, and whites in Denver. The methods and data from these studies are reanalyzed in Heckman and Siegelman (1992), who also summarize most of the key issues concerning the design of labor market audit studies as well as the statistical analysis and interpretation of the data from such studies.

In Table 8 we summarize the key aggregate results of the studies for hiring rates.[18] Columns (1)–(4) respectively report the probability that both the majority and the minority auditor received an offer, the odds that neither received an offer, the odds the majority auditor received an offer and the minority didn't, and the odds the minority auditor received an offer but the majority didn't. Column (5) reports the white/black or Anglo/Hispanic difference in the probability of receiving a job offer.

Turner et al. find a black/white gap ranging from 5.1% in Chicago to 13.3% in Washington, DC (Heckman and Siegelman point out a number of anomalies in this study). The

[18] In assembling the table we have drawn on Heckman and Siegelman (1992).

Table 8
Audit studies of black/white and Hispanic/Anglo differences in hiring rates

	Majority and minority received job (1)	Neither received job (2)	Majority yes, minority no (3)	Minority yes, majority no (4)	Gap (3) − (4) (5)
Turner et al. (1991)					
Blacks and whites, Chicago, 5 pairs, 197 audits	11.2	74.6	9.6	4.5	5.1
Blacks and whites, Washington, DC, 5 pairs, 241 audits	16.6	58.5	19.1	5.8	13.3
Cross et al. (1990)					
Hispanics and Anglos, Chicago, 4 pairs, 142 audits	18.3	51.4	23.2	7.0	16.2
Hispanics and Anglos, San Diego 4 pairs, 160 audits	22.5	48.1	21.2	8.1	13.1
James and DelCastillo (1991)					
Hispanics and Anglos, Denver, 4 pairs, 140 audits	5.0	75.5	12.8	6.5	6.3
Blacks and whites, Denver, 5 pairs, 145 audits	15.8	71.1	4.8	8.3	-3.5

audits involving Hispanics and Anglos obtained gaps of 16.2% in Chicago, 13.1% in San Diego, and 6.3% in Denver. This evidence is consistent with discrimination in hiring against blacks and Hispanics. However, the relatively small number of testers and the clear evidence that results differ substantially across pairs, the difficulty in obtaining auditors who are truly the same in every way that is relevant to productivity, and other issues make it very difficult to draw any macro conclusions about the extent to which differential treatment in hiring reduces the labor market prospects of black and Hispanic workers.

Neumark (1996) conducted a small-scale audit study of sex discrimination in the restaurant industry. He sent two male and two female college students to apply for jobs as waiters in assorted restaurants. He analyzed gender differences in the probability of receiving an interview and in the probability of receiving a job offer. One of the findings of his study was that the men were more likely to receive interviews and job offers in high priced restaurants and the women were more likely to become employed in low priced

restaurants. The study is more a prototype than a full-fledged investigation because only 4 testers were used. The statistical tests that Neumark performed do not account for the likelihood that there are tester/ restaurant price category specific error components that influence the probability of being hired. (Neumark allows for tester specific error components that are common to all restaurant types, but this is not adequate.) Indeed, one of the two female college students was Asian, and she had much less success in medium priced restaurants than the white female. Neumark provides limited evidence that earnings are higher in high priced restaurants and also that the relative probability that a male is hired in a high priced restaurant is positively related to the percentage of men among the clientele. Neumark interprets this finding as suggestive of consumer discrimination. It would be useful to follow up on this study with larger scale research.

While the use of audit studies to examine labor market discrimination is still in an early stage, it is a promising tool for future research. The studies to date generally suggest that hiring discrimination continues to occur.

A recent paper by Goldin and Rouse (1996) provides one of the cleanest tests for discrimination in hiring against women in the literature and in certain ways it is like an audit study using resumes.[19] In the 1970s and 1980s many orchestras adopted the use of a screen or other device to hide an auditioning musician from the jury. In a set of 9 orchestras, the proportion female increased from about 0.10 in 1970 to about 0.20 in 1990. The proportion female among new hires increased even more dramatically. Goldin and Rouse examine the extent to which the adoption of "blind" auditions is responsible for this increase and the extent to which it is a reflection of the general increase in women's labor force participation as well as an increase in the fraction of women studying at the leading music schools. They estimate models of the form

$$P_{ijt} = \alpha + \beta F_i + \gamma B_{jt} + \delta(F_i B_{jt}) + \theta_1 X_{it} + \theta_2 Z_{jt}, \tag{4.1}$$

where P is the probability that person i is advanced from a preliminary round to the next or is hired in the final round in an audition with orchestra j in year t, F is an indicator variable for female musicians, B is an indicator of a blind audition, and X and Z are controls for person and audition characteristics. This specification allows for the possibility that the use of the screen affects advancement rates for both men and women (γ) as well as for gender differences in advancement rates that could be due to differences in performance quality (β). The parameter of interest is δ, which is the effect of the use of the screen on the gender difference in advancement rates. Many members of Goldin and Rouse's sample participated in multiple auditions, so they can control for unobserved heterogeneity by including person specific constants in X_{it}. They also include orchestra constants in Z_{jt}. They find that the "screen" increases the relative probability that women advance from the preliminary round by 50% and has an even larger effect on the relative probability that women are hired in the final round, although use of the screen lowers the relative probability that women advance from a semi-final round in auditions that include a semi-final. While the

[19] A closer analogy are studies of the effects of "double blind" refereeing such as Blank (1991).

results are somewhat mixed, Goldin and Rouse's overall conclusion is that the use of the screen reduced discrimination against women in orchestra hiring and can explain a large fraction of the increase in the proportion female among new hires.

4.2. Discrimination in professional sports

A number of researchers have taken advantage of the rich data on performance and the salaries of professional athletes to study discrimination in professional sports. Kahn (1991) provides an excellent survey of this literature, and we provide only a brief summary here.

A number of studies relate salaries to performance of the player, race, and in some cases Hispanic origin. For example, Kahn and Sherer (1988) find that non-white National Basketball Association players earn less than white players with comparable performance. However, the evidence based on the relationship between salaries and performance is mixed across the various sports and studies. In the case of baseball, there is little evidence of discrimination, while there is reasonably strong evidence of salary discrimination against blacks in the National Basketball Association during the 1980s. In the case of hockey, there is some evidence of salary discrimination against French-Canadian defense men, but no evidence of discrimination in other positions. Kahn (1991) points out that the performance of defense men is harder to measure than that of goal keepers or forwards. Consequently, the finding of discrimination only at the defense man position could be explained by Aigner and Cain's (1977) model of statistical discrimination in which the effect of biases in the priors of team owners matter most for "jobs" in which actual performance is hardest to assess.

Studies that relate salaries directly to player specific performance measures cannot distinguish between consumer discrimination, employee discrimination, or employer discrimination. Some studies test for consumer discrimination by examining whether race and ethnic composition of the team influences attendance at games independent of team performance statistics and won/lost records as well as whether the effect of race and ethnic composition of the team depends on the racial and ethnic makeup of a team's home metropolitan area. For example, Kahn and Sherer (1988) find that home attendance is positively related to the fraction of white players on NBA teams. One can then examine whether differences in marginal revenue product of players that are associated with race or ethnicity explain salary gaps. Outside of professional sports, Holtzer and Ihlanfeldt (1999) have found that racial composition of an establishment's customers is related to the race of who gets hired.

A number of studies examine whether there is discrimination in hiring by comparing the effects of group membership on the probability of being drafted by a professional sports team. The results in this literature are mixed. A number of studies explore "positional segregation" and find that blacks are under represented in certain positions, such as quarterback and kicker in football. Whether this is the result of discrimination in professional sports or differences in the opportunities open to young athletes, perhaps because of pre-labor market discrimination, is not clear.

A clever study by Nardinelli and Simon (1990) investigates customer discrimination in professional sports by examining race differences in the value of baseball cards of retired baseball players conditional on career performance statistics and characteristics of the baseball market. They find that the cards of black and Hispanic pitchers are worth 16% and 12% less than the baseball cards of whites with comparable career statistics. The black/white and Hispanic/white gaps for hitters are 6.4% and 17%, respectively. An advantage of this approach is that it isolates the role of differences in consumer preferences from employer and employee based discrimination. A disadvantage is that the results do not permit one to infer the effects of discrimination on salaries. Also, consumer preferences for sports memorabilia may be different from their preferences for professional sports.

Overall, the high quality of the data on player performance, position, and compensation has made the sports labor market an interesting laboratory for research on discrimination. The results of this literature suggest there is some salary discrimination, particularly in professional basketball, some hiring discrimination, although these results vary depending on the sport and position, and some evidence of consumer discrimination against minority players.

4.3. Directly estimating marginal product or profitability

If the marginal products of workers of different groups were observed, then one could easily check for discrimination by comparing marginal revenue products to wages. Several studies in the professional sports literature attempt to estimate marginal revenue products, but there are major questions about the representativeness of the results. Hellerstein et al. (1996) use establishment level data for manufacturing firms to estimate relative marginal products of various worker types. They then compare the estimates of marginal products to wages.

More specifically, Hellerstein et al. estimate a production function of the form

$$lnY = \gamma ln[(L + (\phi_F - 1)F)(1 + (\phi_B - 1)B/L)(1 + (\phi_G - 1)G/L)(f(X/L; \phi_X))]$$
$$+ \text{non-labor inputs} + \text{higher order terms} + \text{controls} + u, \tag{4.2}$$

where Y is output or value added, L is total employment, F is the number of workers who are female, B is the number of black workers, G is the number with some college, X is vector summarizing the marital status, age distribution, and occupation distribution of the work force and $f(\cdot)$ is a function the details of which we suppress. The variables are normalized so that at the sample means, ϕ_F measures the productivity of women relative to men and is equal to 1 if the productivities are the same. The parameters ϕ_B and ϕ_G measure the productivity of blacks relative to non-blacks and college attenders relative to those who did not attend college.

Hellerstein et al. estimate the relative wages of various worker types by regressing the wage bill of the firms on variables summarizing the demographic composition of the firm, using a specification that parallels Eq. (4.2):

$$\ln w = a' + \ln[(L + (\lambda_F - 1)F)(1 + (\lambda_B - 1)B/L)(1 + (\lambda_G - 1)G/L)(f(X/L; \lambda_X)]$$

$$+\text{controls} + u, \tag{4.3}$$

where w is the wage bill, a' is the log wage of the reference group, and the λ terms are 1 if the relative wage differentials associated with gender, race, or college-going are 0. Since ϕ_F and λ_F measure the marginal product and the wages of women relative to men, evidence against the hypothesis that firms are cost minimizing in a competitive spot market occurs if $\phi_F > \lambda_F$. Discrimination provides a possible explanation for such a finding.[20]

The authors find that ϕ_F exceeds λ_F in all of their specifications. For example, one of their more conservative estimates is that women are 15% less productive than men ($\phi_F = 0.85$) but are paid 32% less ($\lambda_F = 0.68$). This implies that more than half of the wage gap could be attributable to discrimination. The estimates of ϕ_B and λ_B are 1.09 and 1.07, respectively. The authors provide reasons why both parameters are biased up, but taken at face value, they imply that blacks are both more productive and higher paid than whites, with little evidence of racial discrimination. (Within plant wage regressions using the Census micro data show that blacks earn less than whites.) Finally, the authors find evidence that wages exceed relative productivity for older workers.[21]

These results are very interesting, and the authors provide a careful assessment of a number of possible biases in their study. However, there are some anomalies that raise serious questions about the findings. In particular, workers with some college are estimated to be 74% more productive than workers without college, while they are paid only 27% more. Managerial/professional and precision production workers are both estimated to be less productive than unskilled production labor. These discrepancies call into question the reliability of the other estimates in the study even though the authors note that constraining the estimates to sensible values does not change the results for race and gender. One econometric issue that is not addressed is the issue of why firms choose different mixes of workers. Under the null hypothesis of employer discrimination, these differences could reflect unobserved heterogeneity in employer tastes for discrimination. However, under the null hypothesis that firms maximize profit in a competitive labor market, the variation across establishments in the makeup of the work force, particularly in the gender and skill mix, is likely to result mainly from heterogeneity in production

[20] The dataset for the study is the Worker Establishment Characteristics Database, which matches respondents in the 1990 Decennial Census to information on their employers from the Longitudinal Research Database. Information on the demographic composition and the occupation mix of the firm is based on the Census data. The authors are also able to make use of the micro data on wages from the matched Census observations as an alternative to the use of the wage bill from the employer data in estimating the wage equation.

[21] Hellerstein and Neumark (1999) provide a similar analysis using data on Israeli establishments. They find that the gender gap in wages is about equal to the gender gap in productivity. Leonard (1984) studied the effects of employment composition shifts associated with federal contract compliance regulations on productivity.

technology. The presence of multiple worker characteristics in the model may lead to a pattern of biases that would be hard to sort out a priori.

A related way to test for employer based discrimination is to examine profitability of firms. Hellerstein et al. (1997) use the Worker Establishment Characteristics database to test for sex discrimination by examining whether there exists a cross-sectional relationship between profitability of a firm and the sex composition of the workforce, using Becker's (1971) original argument that, under certain conditions, discriminatory firms will have lower profits than non-discriminatory ones. They also explore how market power affects the discrimination–profitability relationship, and whether discriminatory firms are bought out or are weakened over time.

The cross-section results using plant level data (firm level data) imply that a 10 percentage point increase in the proportion of female employees raises the profit rate by 4.6% (3.7%). The effect of percent female is weakened by the addition of 4-digit industry controls but remains statistically significant. There is evidence that the effect is largest for firms in the highest quartile of market share. These cross-section (short run) results are consistent with Becker's discrimination model.[22] The results of the dynamic models are weaker. Firms estimated to be more discriminatory in 1990 generally do worse in 1995 and are more likely to change ownership, but the estimates are noisy and statistically insignificant.[23]

This last paper is interesting but shares a major problem with Hellerstein et al. (1996), namely, the variation in worker composition, including percent female, is likely to be correlated with heterogeneity in the production technology and may be endogenous to the model. Overall, we find this set of papers very interesting. As a way to test for discrimination, research that looks simultaneously at productivity and wages is likely to be more fruitful than further analyses of the "unexplained" wage differential.

4.4. Testing for statistical discrimination

The basic premise of the statistical discrimination literature is that employers assess the value of younger workers using only the limited information contained in resumes, recommendations, and personal interviews. Given lack of information about actual productivity, employers have an incentive to "statistically discriminate" among young workers on the basis of easily observable variables such as race or gender, if these provide clues to a worker's labor force preparation. However, there is almost no empirical literature testing whether employers do in fact statistically discriminate on the basic of race or gender.

Altonji and Pierret (1997) provide a test of statistical discrimination by firms. Speci-

[22] Hersch (1991) finds that charges of EEO violations lead to reductions in the stock value of firms. If the firms discriminate against blacks or women and the charges lead to greater employment of these groups, then profits would be expected to rise. The legal costs, settlement costs and surrounding negative publicity may more than offset this effect, however.

[23] It would be interesting to examine whether establishments that become part of publicly traded firms are more likely to increase their use of women.

fically, they consider a situation in which (1) group membership s is negatively related to productivity; (2) the relationship between group membership and productivity does not vary with experience; and (3) firms learn over time. They show that if firms statistically discriminate on the basis of group membership in this situation, then the relationship between wages and group membership will not vary with experience. If, on the other hand, firms do not statistically discriminate, then the wage gap will widen with experience. They also investigate the consequences of adding to a wage equation a typically hard-to-observe characteristic z that is positively related to productivity and negatively related to minority group membership. They show that not only should the coefficient on z rise with time in the labor market as firms learn about productivity, but the coefficient on s should fall if statistical discrimination occurs when the worker is first hired.

Their argument is as follows. Let y_{it} be the log of the marginal revenue product of worker i with t_i years of experience. y_{it} is determined by

$$y_{it} = rs + H(t_i) + \alpha_1 q + \Lambda z + \eta_i, \tag{4.4}$$

where s is 1 if the person a member of the minority group, q is a vector of information about the worker that is relevant to productivity and is observed by employers, and z is a vector of correlates of productivity that are not observed directly by employers but are available to the econometrician, such as income of an older sibling or a test score. $H(t_i)$ is the experience profile of productivity. The variable η consists of other determinants of productivity and is not directly observed by the employer or the econometrician. Let e be the error in the employer's belief about the log of productivity of the worker at the time the worker enters the labor market.

Each period that a worker is in the labor market, firms observe a noisy signal of the productivity of the worker, ξ_t. The vector $I_t = \{\xi_1, \ldots, \xi_t\}$ summarizes the worker's performance history. This information, as well as q and s, are public, so competition leads firms to set the wage level equal to expected productivity given s, q, and I_t, if firms violate the law and use the information in s to set wages. In this case Altonji and Pierret show that the log wage level w_t will be

$$w_t = \log[\mathrm{E}(\exp(y_{it}) \mid s, q, I_t)] = \lambda s + H^*(t) + \rho q + \mathrm{E}(e \mid I_t), \tag{4.5}$$

where $H^*(t)$ is equal to $H(t)$ plus a term that accounts for the fact that the log of the expectation of productivity given s, q, and I_t will be influenced by change over time in uncertainty about e, and λ and ρ depend on r and α_1 as well as the relationship of z and η to s and q. The coefficient on s does not change with experience if, as the derivation of Eq. (4.5) assumes, firms make full use of the information in s, because q is time invariant and e is independent of s.

Eq. (4.5) is the process that generates wages. Suppose the econometrician observes only s and z, and regresses w_t on these variables. (In short, the econometrician does not observe q, which the employer knows, but does observe z.) Let the coefficients of the regression of w_t on s and z in period t be b_{st} and b_{zt}. Then

$$E(w_t \mid s, z, t) = b_{st}s + b_{zt}z + H^*(t). \tag{4.6}$$

Altonji and Pierret show that

$$b_{st} = b_{s0} + \theta_t \Phi_s, \tag{4.7a}$$

$$b_{zt} = b_{z0} + \theta_t \Phi_z, \tag{4.7b}$$

where Φ_s and Φ_z are the coefficients of the regression of e on s and z and θ_t summarizes how much the firm knows about e at time t. Under plausible conditions, $\Phi_s < 0$ and $\Phi_z > 0$. For instance, this is true when $s = 1$ for blacks and 0 for whites and the variable z is AFQT, father's education, or the wage rate of an older sibling. Note also that θ_t is 0 in period 0, because in this period employers know nothing about e, so $E(e \mid I_0) = 0$. θ_t rises toward 1 as firms learn about e and $E(e \mid I_t)$ is e. Consequently, b_{st} falls with experience and b_{zt} rises with experience. Or, stated another way, if employers statistically discriminate, over time they will learn the true productivity of the worker and the wage of the worker will become more closely related to productivity-related variables (z) and less closely related to race.

On the other hand, if firms obey the law and do not make direct use of s, then the coefficient on s will rise with time. That is, the race differential will widen as experience accumulates. To see this note that in this case s behaves the same as a z variable, which is essentially unobserved (unused) by the firm. With learning, firms are acquiring additional information about performance that may legitimately be used to differentiate among workers. If race is negatively related to productivity, then the new information will lead to a decline in wages, so over time the impact of race should become larger and more negative.

Altonji and Pierret also show that, regardless of whether firms statistically discriminate, adding to the wage equation a z variable that is positively correlated with race will reduce the racial difference in the experience profile. The intuition is that part of the effect of the new information about productivity is absorbed by the z variable which reduces the impact of the race variable. They also consider the effect of on the job training in their models.

In their empirical study of young men from the NLSY, they find that the race gap does widen substantially with experience, in contrast to the prediction of a model in which firms fully statistically discriminate on the basis of race. They also find that adding father's education, the AFQT score, or the sibling wage rate to the model (z variables) reduces the degree to which the race gap widens with experience. This second result is consistent with employer learning about productivity and is predicted to hold regardless of whether firms statistically discriminate by race. Other results provide support for the hypothesis that firms do statistically discriminate on the basis of education. Over time, wages become more strongly correlated with hard-to-observe productivity related variables and less strongly correlated with easily observable variables such as education. The main limitation of Altonji and Pierret's analysis is that the effects of statistical discrimination on wage

dynamics may be confounded by other influences, such as group differences in the rate of on the job training.

We noted in Section 3 that although the statistical discrimination literature has emphasized differences across groups in the amount of information that is available to firms, we do not know of any empirical evidence on the importance of such informational differences. In Altonji and Pierret's model, differences in the ability of employers to evaluate the performance of members of different groups imply different amounts of noise (from the point of view of the employer) in the signals ξ_t and different paths of θ_t. These differences will lead to group differences in wage dynamics. For example, in the extreme case, when firms are fully informed about group A at the point of hiring, b_{zt} is constant for that group. This might provide a way to examine the hypothesis that the quality of the information that employers have differs across groups.

5. Pre-market human capital differences: education and family background

While our primary interest in this chapter is with the operation of the labor market, labor market outcomes are deeply affected by pre-market differences in family background and education among workers. These differences are particularly important when focusing on race and gender differentials in the labor market. Compared to white workers, black workers are disproportionately likely to come from families with more limited resources, to have experienced the effect of segregated neighborhoods and largely segregated urban schools, and to have made different educational choices and faced different educational constraints. Compared to male workers, female workers are likely to have faced different family expectations and also to have made different educational choices and faced different educational constraints. The role of these factors on labor market outcomes is the topic of this section.

5.1. Race differences in pre-market human capital

Black–white differences in earnings stagnated in the 1980s after narrowing for several of the previous decades, as discussed in Section 2. As discussed further in Section 9, some researchers have suggested this is related to differences in school quality and achievement. Black high school graduation rates have moved towards white levels, but black college graduation rates remain low relative to whites and large racial discrepancies in educational achievement (measured by test scores) remain. A series of papers, beginning with O'Neill (1990) followed by Maxwell (1994) and Neal and Johnson (1996) assess the role of differences in achievement on the race gap using data from NLSY, which contains test scores from the Armed Forces Qualifications Test (AFQT). AFQT scores are typically used as a measure of actual skill level, and appear to provide more information than the typical skill variable measuring years of education. The main conclusion of these papers is that much of the wage gap between blacks and whites is due to differences at the point of

labor market entry in the types of basic skills measured by AFQT. We have already seen this result in Table 6, where we reported results from a wage regression based on NLSY data where we controlled for AFQT scores. It is a very important finding. Table 9 provides a summary of the results in the three papers briefly described here.

O'Neill (1990) starts with a log wage equation of the form

$$\ln W = \alpha_1 + \alpha_2 S_{1980} + \alpha_3 S_{1980+} + X\delta + \varepsilon, \tag{5.1}$$

where $\ln W$ is the log wage, S is years of schooling, and X is a vector of control variables including geographic location and potential work experience (age − education − 5). The years of schooling variable is separated into years before the AFQT was administered (S_{1980}) and after (S_{1980+}) to correct for bias on the AFQT term in the presence of the school quantity variables, given that some persons took the AFQT before completing school while for others it was administered after the completion of schooling. O'Neill estimates (5.1) for black and white men separately and compares the ratio of the predicted wage for blacks if they had the same characteristics as whites. She then augments (5.1) by including AFQT scores, an occupational skill index, and a dummy variable indicating whether the occupation is blue collar, as well as replacing potential experience with actual experience. It should be kept in mind that controlling for type of job is problematic, since occupation may be influenced by discrimination.

As the first row of Table 9 indicates, O'Neill finds that the black/white male wage ratio rises from 0.829 to 0.877 if blacks had the white means on years of schooling, industry and regional location. When one also adjusts for AFQT differences the ratio rises to 0.955 and most of the wage gap is eliminated. (Maxwell (1994) obtains similar results with a somewhat different sample; see middle of Table 9.) Adjusting for actual experience and occupational characteristics brings the predicted black/white wage ratio to slightly above one. O'Neill concludes that the widening of the wage gap between young white and black men in the 1980s, particularly among the college educated, is largely due to disparity in achievement as measured by the AFQT, which can only be eliminated by eliminating family background and school quality differences. Her conclusion is quite consistent with Juhn et al.'s (1991a) interpretation, which we discuss in Section 9.

The careful study by Neal and Johnson (1996) provides a similar analysis. However, they exclude actual experience, industry, and postsecondary schooling from the wage equation on the grounds that they could be influenced by discrimination. They also limit their sample to those who were age 18 or under when the test was administered (in 1980) on the grounds that patterns of postsecondary school attendance and labor market experience are endogenous in the wage equation and might influence AFQT test scores of people over 18. The authors confirm that much of the black–white and all of the Hispanic–white wage gap can be explained by differences in mean AFQT scores among these groups.

The fact that whites have a greater labor force participation rate than blacks may lead to a downward bias in estimates of the black–white wage gap assuming that those who are not employed have worse earnings prospects than those who are. Neal and Johnson assume

Table 9
Summary of studies of ratios of black wages to white wages, unadjusted and adjusted for various measures of worker skills and job characteristics[a]

Author and year	Data and sample	Controls and statistical methods	Earnings measure	Black's earnings as ratio of whites	
				Observed	Adjusted
O'Neill (1990)	NLSY, 1977–1987, full-time workers in 1987. Men only $N = 2957$	S, I, R	ln(Wage), 1987	0.829	0.877
		S, I, R, AFQT	ln(Wage), 1987	0.829	0.955
		S, I, R, AFQT, EXP	ln(Wage), 1987	0.829	1.012
Maxwell (1994)	NLSY, 1979–1988, Men only Those who finished schooling before 1983; $N = 1751$	S, I, R, EXP	ln(Wage), 6 years after school	0.801	0.817
		S, I, R, AFQT, EXP	ln(Wage), 6 years after school	0.801	0.947
		S, I, R, AFQT, EXP, Selection	ln(Wage), 6 years after school	0.801	0.831
Johnson and Neal (1996)	NLSY, 1979–1991 Men only Full-time workers in 1990 or 1991. Age 18 or under in 1980	AFQT	ln(Wage), 1990–1991	0.756	0.928
		AFQT, Median Selection	ln(Wage), 1990–1991	0.648	0.866

[a] S, years of schooling; I, industry controls; R, region controls; AFQT, Armed Force Qualifying Test score; "Selection" in Maxwell (1994) is Heckman procedure, 1st stage being choice of college attendance; "Median Selection" in Johnson and Neal (1996) is median regression with all non-participants assigned a wage of zero (0).

that those who are not employed would have lower wage offers than the median offer of those who are employed and are otherwise observationally equivalent. This is likely to be violated to some degree given measurement error in reported wages, heterogeneity in labor supply preferences, and randomness associated with job search. However, if it is correct, then assigning those with no observed wage a wage of 0 would not affect the conditional median of the wage offer distribution. The authors estimate median wage regressions on the sample of workers and non-workers and find that including AFQT raises the ratio of black/white median wages from 0.649 to 0.866 (see bottom of Table 9).

The strong association between race differences in wages and in AFQT scores raises at least two key issues. The first is whether the strong role of AFQT is due to racial bias in the AFQT test scores, perhaps because of omitted variables that are related to discrimination. Neal and Johnson summarize the results of a National Academy of Sciences study (for the Department of Defense) that found that AFQT predicts performance in tasks required for military occupations about equally well for blacks and whites. They interpret this to indicate the AFQT score provides an unbiased measure of pre-market job preparation. Whether these results are generalizable to jobs outside of the military is unknown, however. In addition, it is worrisome that there are race differences in the coefficients on the components of the AFQT if its separate components are included in the wage equation (with the verbal component of the test mattering more for blacks) as Rodgers and Spriggs (1996) stress. This issue is not yet fully resolved.

A second key question is what drives the racial differences in AFQT scores. Herrnstein and Murray's (1994) claim that the AFQT represents native intelligence, much of it inheritable, and that part of the race gap in AFQT reflects genetic differences generated enormous controversy. A careful review of their evidence would require far more space than we have here.[24] Neal and Johnson present convincing evidence that AFQT scores are heavily influenced by years of schooling. They also show that family background and school quality variables explain much of the gap between whites and Hispanics and whites and blacks in AFQT scores. Winship and Korenman (1997) also provide strong evidence that schooling has a powerful effect on AFQT scores. These results indicate that differences in family background and school quality underlie the differences across groups in AFQT scores, in contrast to the argument in Herrnstein and Murray.

5.2. Gender differences in pre-market human capital

The literature on gender differences in education examines the role of a number of factors, including labor market discrimination, discrimination in access to higher education, social roles, parental preferences, occupational preferences, and the financial attractiveness of home versus market work. We do not consider the literature on gender differences in the

[24] The publication of *The Bell Curve* stimulated much recent research by economists and sociologists on the effects of family background and other environmental influences on educational attainment and wages. We do not discuss this work here. Goldberger and Manski (1995), Heckman (1995), Korenman and Winship (1999) and Dickens et al. (1996) discuss the book and provide references to the literature.

"demand" for education here. Furthermore, as we documented in Section 2, gender differences in basic skills as measured by the AFQT test are minor compared to race differences, as one might expect given that boys and girls have the same parents, are raised in the same families and neighborhoods, and for the most part attend the same primary and secondary schools.

Many studies examine the role of differences in years of education on the gender gap using standard regression techniques. Among younger workers, there is no longer any difference in average years of education between men and women, although older women continue to have lower average education levels (Blau, 1997). As male/female education levels have converged, this has narrowed the wage gap, as confirmed in Blau and Kahn (1997) and O'Neill and Polachek (1993).

A much smaller literature in economics examines differences in what men and women study and differences in aptitude and achievement across subject areas. Blau et al. (1998) report a gender gap in average math SAT scores of 46 points in 1977 and 35 points in 1996, but little difference in verbal scores or in combined SAT scores. Paglin and Rufolo (1990) report an 81 point gender difference on the quantitative portion of the graduate record exam (GRE) and note that women are heavily under represented at the high end, where many people who major in the physical sciences and engineering are located.[25] Tabulations from the National Longitudinal Survey of the High School Class of 1972 show that twelfth grade boys score higher on math achievement tests and lower on reading and vocabulary tests (see, e.g., Brown and Corcoran (1997, Table 2)). The sources of these gender differences in test performance remain an active and controversial area of study in the education and psychology literatures.

Gender differences in the distribution of college majors have declined sharply in the 1970s and 1980s, and the women now receive large fractions of the DDS, MD, MBA, and law degrees granted. The fraction of engineering majors who are women has risen from only 0.6% in 1968 to 15.4% in 1991. Over these same years, the fraction of women increased from 13.6 to 31.5% among physical science majors and from 8.7 to 47.2% among business majors. There are also modest differences in the high school curriculum taken by boys versus girls. Brown and Corcoran (1997) show that among students who graduate, boys take more math and science courses than girls and fewer courses in foreign language and commercial arts. We do not know whether these differences have narrowed during the 1980s and 1990s in parallel with the narrowing of the gaps in undergraduate and graduate fields of study. The relative importance of changes in expected labor attachment and marriage plans, changes in preferences, and various forms of discrimination within the family, in elementary and secondary and postsecondary schools, and in the labor market is still not well understood.

What are the labor market consequences of differences in the type of education men and women receive and differences in their achievement by subject area? Paglin and Rufolo

[25] However, we suspect that part of this gap is due to gender differences in the selectivity of who takes the GRE and related to the fact that disproportionately large numbers of women become teachers, continuing education is common among teachers, and SAT scores are below average for teachers.

(1990) use data from the early 1980s on students who take the Graduate Record Exam to investigate differences in scores by college major and sex. They indicate that women have lower math scores and tend to be concentrated in majors with lower average math scores. They argue that a substantial part of the difference in the distribution of majors is due to the difference in scores. We are somewhat skeptical of the magnitude of their findings in view of the huge change in the gender composition of majors at a time when relative test scores changed by comparatively little. Other empirical work suggests that gender differences in test scores play only a small role in gender differences in the pattern of college and advanced degrees.[26]

Paglin and Rufolo report that most of the gender gap in average starting salaries for college graduates is between, rather than within, detailed college majors. They also find that differences in starting salaries across majors have a strong positive relationship to average math scores within the major. Verbal scores matter much less. Their salary regressions imply that the gender difference in math test scores would lead to a 20% gender gap in the starting salaries of college graduates, which is approximately equal to the gender gap among college graduates reported by Brown and Corcoran (1997) for a sample of persons who are about 33 in 1986.

The evidence in Altonji (1993), Brown and Corcoran (1997), and Eide and Grogger (1995) suggests that, among workers with several years of college, differences in college major account for a substantial share of the gender gap in the earnings, but the effect is much smaller than Paglin and Rufolo's calculations (based on starting salaries). Brown and Corcoran attribute 0.08–0.09 of a 0.20 wage gap to differences in college major. Using NLS72 wage data for 1977–1986, Altonji (1993) finds that gender differences in post-secondary outcomes (including dropping out prior to a BA) lowers the ex ante return to starting college for women holding gender differences in the market payoff to particular education outcomes constant. The results in Altonji (1995) and Brown and Corcoran (1997) suggest that high school courses are a small part of the gender gap.[27]

It is interesting to note that Brown and Corcoran find that SAT scores do not explain much of the difference in earnings of college graduates with several years of experience once one controls for high school courses and college major. Adding SAT scores to a pooled wage regression for college graduates with detailed majors excluded lowers the gender gap by only a small amount. This would seem to contradict Paglin and Rufolo's

[26] This statement is based on unreported education outcome models that underlie the analysis in Altonji (1993). We expect test scores to matter somewhat more in the early 1980s, when more women were considering technical majors. Earlier studies of gender differences in choice of college major include Polachek (1978), England (1982), Berryman (1983). Goldin (1990) provides a historical perspective. The interaction of gender differences in labor force attachment and differences by major in depreciation rates of human capital is a focus in this literature, as well as the role of occupational preferences, institutional barriers and discrimination.

[27] Brown and Corcoran's results for NLS72 suggest that differences in high school courses play a modest role in the gender gap among high school graduates. However, their overall conclusion is that differences in high school courses are not important. Using a pooled sample and treating courses as endogenous Altonji (1995) finds that courses matter little for wages.

findings, and we doubt that much of the discrepancy is due to the fact that Paglin and Rufolo analyze wages of new graduates. Additional research is needed on the causes and consequences of gender differences in achievement and in the type of education received.

6. Experience, seniority, training and labor market search

The accumulation of work experience is perhaps the most important factor in the distribution of earnings across workers. For example, Altonji and Williams (1998) estimate that on average the log wage rates of white men rise by about 0.80 during the first 30 years of labor market experience. This increase in wages is the combined effect of the accumulation of general skills, the returns to job seniority that may reflect both worker investments in job specific skills and incentive devices used by firms, and the return to job shopping over a career. The literature is divided on the relative importance of these three components (see, e.g., Topel, 1991; Altonji and Williams, 1998), but there is no doubt that wage growth over a career is important.

There are a number of reasons to expect gender differences in both the accumulation of and returns to experience. Historically, women have had quite different patterns of labor force participation and job mobility than men. The standard model of human capital investment predicts that investments in general training will be lower for persons who work fewer hours and fewer years over their career. Models of job search imply that the return to search is lower for persons who anticipate having to change jobs for reasons that are not related to career advancement, e.g., to follow the career of a spouse or to adjust hours to take care of children. Becker and Lindsay (1994) and several previous studies point out that the return to investment in firm specific capital is lower for persons with high turnover rates, and the share of investment borne by the worker is likely to be higher. Implications for the shape of the tenure wage profile are ambiguous.

In contrast, it is harder to tell choice-based stories for existing racial gaps in the accumulation of or returns to experience. Many discussions of discrimination argue that the access of minorities to on the job training is limited, although the "search" versions of discrimination models that emphasize prejudice are ambiguous in their prediction about return to on the job search for minorities. On the one hand, discrimination (particularly in high end jobs) will lower the mean and perhaps the variance of wage offers to blacks as well as the probability of receiving an offer. On the other hand, the coexistence of a mix of discriminating and non-discriminating firms may raise the variance of offers and raise the return to on the job search.

In this section of the chapter we review the evidence on group differences in experience, seniority, training and job turnover as a source of wage differences, as well as the role of differences in the market prices associated with these characteristics. We begin with a discussion of the literature on blacks and whites and then turn to the literature on gender differences.

6.1. Race differences in experience, seniority, training and mobility

6.1.1. The effects of job tenure, experience, and training on the race gap

Bratsberg and Terrell (1998) provide a careful study of race differences in returns to experience and seniority. They estimate models of the form

$$\ln w_{ijt} = Z_i \pi_i + T_{ijt}\alpha + X_{ijt}\beta + e_i + \eta_{ij} + v_{ijt}, \tag{6.1}$$

where the subscripts i, j, and t denote the individual, job, and time period respectively, w is the wage, Z is a vector of observed characteristics of the individual, T is job tenure, and X_{ijt} is total labor market experience. They estimate the model separately for whites and blacks using data on young men from the NLSY. They use event history data to construct measures of actual experience as well as current seniority in a firm. The appropriate methodology to estimate the returns to tenure and experience is a matter of contention. The authors use OLS, the IV estimator suggested by Altonji and Shakotko (1987), a two step estimator proposed by Topel (1991), and other variants of these procedures. Bratsberg and Terrell's analysis is consistent with earlier research indicating that OLS and Topel's estimator typically lead to larger estimates of the return to seniority and smaller estimates of the return to experience than Altonji and Shakotko's. However, all three estimators tell the same story about the source of the race gap in wage growth over a career. They imply that the first five years of experience raises the log wage of whites by about 0.10 more than the log wage of blacks. All three estimators suggest that the return to seniority is similar between whites and blacks, and both the Altonji and Shakotko estimator and the Topel estimators suggest that it is a bit higher for black men than white men. These conclusions are robust to a number of modifications to the specification. In particular, there is no evidence that bias in the estimates affects comparisons between blacks and whites.

As we have already discussed, black/white differences in earnings remained constant in the 1980s after narrowing for several of the previous decades. At the same time, employment rates of young (younger than 24) blacks have significantly declined compared to their white counterparts. D'Amico and Maxwell (1994) examine the impact of this pervasive joblessness on the future earnings prospects of black youth. D'Amico and Maxwell's evidence suggests that these differences in job-holding may be an important part of the story. Initial difficulties in obtaining and keeping jobs in the labor market might permanently reduce earnings prospects by precluding strong labor force attachments or leading employers to believe that the black youth are unreliable or "unemployable." Specifically, the authors test whether blacks who experience a smooth transition from school to the labor force enjoy similar earnings prospects as whites (i.e., the return to experience is the same across races), so that the driving force behind subsequent wage differentials is the early joblessness.

They examine a sample of black and white non-Hispanic men from the NLSY who did not continue schooling after high school. They estimate log wage equations of the form

$$\ln W_{t+1} = \beta_0 + \beta_1 AFQT + \beta_2 Black + X_{t+1}\delta + \varepsilon, \tag{6.2}$$

$$\ln W_{t+5} = \beta_0 + \beta_1 AFQT + \beta_2 Black + X_{t+5}\delta + \varepsilon. \tag{6.2'}$$

Eq. (6.2) is estimated for year $t + 1$, which is defined for all respondents as the first year after leaving school. Eq. (6.2′) is estimated for year $t + 5$, the fifth year after leaving school. W represents the wage, $AFQT$ is AFQT score, *Black* is a dummy variable for black workers, and X is a vector of other characteristics, such as local unemployment rates, and regional and urban location. The coefficient on *Black* declines from 0.038 in the first year to −0.079 in the fifth year, confirming a substantial literature that shows that the experience profile of wages is less steep for blacks than whites.

To examine whether returns to experience and tenure are the same for blacks and whites, the authors estimate a conventional wage equation for whites and blacks separately of the form

$$\ln W_{t+5} = \beta_0 + \beta_1 AFQT + \beta_2 \text{Tenure} + \beta_3 \text{Exp} + X\delta + \varepsilon. \tag{6.3}$$

If returns to experience and tenure are equivalent for blacks and whites, the authors reason, then the change in the "penalty" for being black in Eqs. (6.2) and (6.2′) is due to blacks acquiring different levels of tenure and experience than whites, for which Eq. (6.3) controls. The authors also estimate variants of this model that control for past wages or for individual fixed effects. They find that the effects of actual experience on wages are similar for blacks and whites. They also find that blacks worked much less than whites in the initial years after labor force entry, although the gap narrows through time. They conclude that the widening of the race gap is due to an "actual experience" gap during the first 5 years in the labor market rather than to greater returns to actual experience for whites.

Bratsberg and Terrell's estimates of differential black/white returns to experience contradict D'Amico and Maxwell's finding that the race gap in gains from experience early in the career is due to the fact that blacks work much less than whites during this period. Both studies employ measures of actual experience. One possibility is that D'Amico and Maxwell focus on the first 5 years in the labor market and they may be estimating effects that are unique to this early career stage. Bratsberg and Terrell's results are more consistent with the previous literature.

Part of the reason why blacks may have lower returns to experience could be related to the fact that blacks receive less on the job training than whites, a common finding in training studies. This may be related to other characteristic differences between blacks and whites. Veum (1996) finds no race differential in the likelihood of receiving training, of participating in multiple training events, or in total hours of training received in models that control for AFQT, union status, occupation, and industry. Using data from the National Longitudinal Survey of the High School Class of 1972, Altonji and Spletzer (1991) find that blacks are more likely to receive training then comparable whites when education, aptitude, and achievement tests are controlled for. Aptitude and achievement measures have a strong positive correlation with on the job training measures and are lower for blacks. Lower levels of human capital at the time of labor market entry due to

family background, school quality, and other factors may also reduce the quantity and return to job training that blacks receive. However, employer discrimination based upon prejudice, or greater uncertainty on the part of employers regarding the skills of black workers may also reduce training opportunities.

6.1.2. The effects of job mobility on the race gap

The role of differences in the return to job mobility in the race gap in wages is another important research question. Wolpin (1992) is one of only a handful of empirical papers to use a structural model to study race differences in job search, job mobility, and wage growth. He specifies a dynamic discrete choice model in which the probability that workers receive wage offers depends upon whether they are currently employed or not as well as their employment history. Among the predictions of the model are much higher initial non-employment rates among blacks, lower rates of accumulation of both general and firm specific experience, longer average durations of unemployment, and lower average accepted wage levels. Wolpin estimates the model on quarterly unemployment and non-employment data using a sample of black and white workers who complete high school but do not go on to college from the NLSY. He estimates separate models for whites and blacks. The key parameters of the model are the value of non-market time, the tenure slope and experience slope of offered wages, the variance of offered wages, the probabilities of receiving an offer, and the layoff and recall probabilities.

Wolpin finds that the employment pattern of black male high school graduates would be much closer to that of whites if they faced the same wage offer distribution. In fact, they would have greater work experience than whites in all but the first quarter. His analysis also illustrates the pitfalls of using accepted wages to make inferences about wage offers; he finds that the mean accepted wages for blacks would actually be lower if they faced the white wage offer distribution rather than the black wage offer distribution.

Wolpin's model is very simple, the sample sizes are quite small, and no standard errors are provided. Consequently, we would not want to make too much of the specific results, which Wolpin is properly cautious about. However, the basic line of research taken in this paper may well pay off in the future.

Although Topel and Ward (1992) and others have shown that job mobility is a key contributor to wage growth over a career, there is relatively little research on race differences in the gains from mobility. Oettinger (1996) provides a model analyzing the role of statistical discrimination in the widening of the black-white wage gap with experience. The basic framework is a Jovanovic (1979) type job matching model. Each individual works for 2 periods ($t = 1, 2$) and maximizes expected lifetime earnings. At the start of period t, each worker receives a single job offer. The population distribution of match productivity is known and identical for blacks and whites: $\mu_t \sim N(m, \sigma_\mu^2)$. Ex ante, the worker and employer observe only a noisy signal of true match productivity $s_t = \mu_t + \varepsilon_t$, where $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$. Oettinger's crucial assumption is that the signal is noisier for blacks than for whites: $\sigma_{\varepsilon B}^2 > \sigma_{\varepsilon w}^2 > 0$. This assumption is in the same spirit as the statistical

discrimination models discussed earlier. It may be valid if white employers are more likely to "miscommunicate" with black applicants than with white applicants.

Wages are equal to expected productivity. The first period wage w_1 is

$$w_1 = \theta\hat{\mu}_1 + (1 - \theta)\mu_1, \tag{6.4}$$

where $\hat{\mu}_t \equiv E(\mu_t \mid s_t)$. In this situation, θ represents the weight given to ex ante expected productivity in determining the starting wage level.[28] The true value of match productivity is learned after the first period, and workers who stay with the same firm earn this true value (μ_1) in the second period. Thus,

$$w_2 \equiv \left\{ \begin{array}{c} \mu_1 \\ \theta\hat{\mu}_2 + (1 - \theta)\mu_2 \end{array} \right\} \left\{ \begin{array}{l} \text{if } \mu_1 \geq \hat{\mu}_2(\text{stayers}) \\ \text{if } \mu_1 < \hat{\mu}_2(\text{movers}) \end{array} \right\}, \tag{6.5}$$

where $\hat{\mu}_2$is expected productivity the worker's second period alternative job. Note that the model assumes the odds of mobility across races are similar (for a given gain to mobility) and that θ is also identical for both races. Both of these assumptions might be questioned.

There are three testable implications. First, wages in the first period are independent of race. Second, blacks have higher wage growth within jobs. Intuitively, this follows because blacks (with less informative signals) experience larger within-job changes between periods 1 and 2. The negative changes are disproportionally censored because workers who suffer wage declines tend to change jobs. Third, the component of the return to experience that is due to movement into better jobs is larger for whites than blacks. The intuition for this is that the greater precision of s for whites means that they have a lower probability of making a "mistake" in deciding whether to move or stay, so that their expected wages in period 2 are higher.

Oettinger investigates these issues using a sample of black and white non-Hispanic men from the NLSY who entered the labor force full-time. He estimates

$$\ln W_t = \beta_0 + \beta_1\text{Education} + \beta_3\text{Black} + \beta_4\text{Tenure}_t + \beta_5\text{Experience}_t + \beta_6(\text{Black} \times \text{Education}) + \beta_7(\text{Black} \times \text{Tenure}_t) + \beta_8(\text{Black} \times \text{Experience}_t) + X_t\delta + \varepsilon, \tag{6.6}$$

where X represents a set of control variables. He estimates the equation for different levels of experience and finds that the initial wage gap is small but widens substantially as experience increases, even after controlling for the widening of the black-white wage differential that is occurring at the same time in the 1980s. Fixed effects and random effects estimates obtained using panel data are consistent with Bratsberg and Terrell's finding that blacks have flatter experience profiles. In contrast to the predictions of the model, Oettinger finds a small negative race differential in the return to tenure, but it is not statistically significant.

[28] This allows both for contracts where the firm pays the worker his or her expected productivity ($\theta = 1$), where the firms pays piecework wages (in which wages reflect true productivity and $\theta = 0$), or any contract in between.

The return to job mobility is likely to be a function of the amount of information that workers have about job openings and employers have about particular workers. Many jobs are found through personal contacts, and there is an extensive literature on the role of personal networks in labor market search. (See Granovetter (1995) and Montgomery (1991) for detailed references and Montgomery for an elegant model of how race and gender differences in networks may lead to differences in labor market success.)

Korenman and Turner (1996) use data from an NBER survey of the low-wage labor market in Boston to examine the possibility that networks influence race differences in the return to search. Such differences might lead to lower initial wage levels for minorities as well as lower initial employment levels. They might also reduce the returns to job mobility over a career by raising the cost of finding better jobs. The authors find that minorities are less likely to have found jobs through personal contacts, and their contacts are less likely to be relatives. They conclude that differences in contacts help explain the race gap in employment but not the race gap in wages. As we noted in Section 3, Bowlus and Eckstein's analysis suggests that blacks will have a lower return to job search than whites and will set lower acceptance wages. On-the-job search is not incorporated into their analysis.

6.1.3. The spatial mismatch hypotheses

During the postwar period, there has been substantial movement of people and jobs from central cities to suburbs. The basic idea of the spatial mismatch hypothesis is that this movement has created employment problems for persons living in inner cities, particularly blacks who face constraints on housing choices resulting from discrimination and/or a lack of social networks or financial resources that would facilitate a move. Physical distance from jobs may raise both commuting costs and costs of locating jobs. The hypothesis was first advanced in a serious way by Kain (1968). It has been the focus of much research and controversy since. Some studies relate differences in housing segregation or in measures of the relative concentration of employment demand near where blacks live to differences in employment outcomes. Others, such as Ellwood (1986) for Chicago and Ihlanfeldt and Sjoquist (1990) for Philadelphia, Chicago, and Los Angeles use Census track level data on proximity to jobs. For example, Leonard uses the number of blue collar jobs within a 15-min commute divided by the population above 16 years of age in the commuting zone, while Ihlanfeldt and Sjoquist relate youth employment probabilities to mean travel time of workers in the community.

A relatively recent development in the literature are studies that examine the response of black and white workers to employer relocations from the central city to the suburbs. Zax and Kain (1996) examine the propensity of black and white workers to quit and to move following the relocation by their firm from downtown Detroit to a suburb. They find that white employees whose commutes lengthened were more likely to move, but no more likely to quit, than white employees whose commute shortened. In contrast, black employees whose commutes lengthened as a result of the relocation were more likely to move and

to quit. This suggests that firm relocations out of the inner city have a more negative impact on blacks. Zax and Kain conclude that "the restrictions on black residential choice imposed by segregation forced approximatley 11.3% of black workers to quit in the wake of the relocation." However, the firm in the study was also sued for racial discrimination at the time, so it is possible that other factors were at work. Fernandez (1994) studies a food processing plant that was planning a move from downtown Milwaukee to a suburb. He shows that the move led to much larger increases in commuting costs for black employees than white employees and as a result was likely to have a more negative impact on black workers.

Unfortunately, a clear consensus has not emerged on the contribution of the spatial mismatch to black/white differences. We refer readers to the surveys by Holtzer (1991), Jencks and Mayer (1990) and Kain (1992).

6.2. Gender differences in experience, seniority, training and mobility

There are two main themes in recent research on the role of experience, tenure, and job mobility on the gender gap in wages. First, a number of studies examine the effects of using more complete measures of actual (as opposed to potential) experience and estimate how much of the narrowing of the gender gap is due to a convergence in the actual experience levels of male and female workers. Second, other studies examine differences in job mobility between men and women. These differences in mobility patterns have been related to differences in on the job training between men and women. We discuss both of these literatures in this section.

6.2.1. The effects of experience and tenure on the gender gap

As we have already discussed, changes in experience have been more important than changes in education in closing the male/female wage gap. Women are more likely to have worked fewer years than men and, when they are working, are more likely to have been part-time rather than full-time workers. As women have increased their labor force participation over time, however, women's accumulated labor force experience has also increased. As we discuss below, Blau and Kahn (1997) use the rich data on experience in the Panel Survey of Income Dynamics (PSID) to show that changes in accumulated experience have been far larger and explain a much larger share of the decline in male/female wages than do changes in education. However, many datasets have no information on actual experience and hence researchers use potential experience as a proxy for actual experience. Potential experience is especially likely to overstate actual experience for women because of the amount of time that women spend out of the work force. A number of recent papers, including Filer (1993), Wellington (1993), Kim and Polachek (1994) and Light and Ureta (1995) explore the contribution of gender differences in actual experience and labor force interruptions to the gender gap.

Filer (1993) works with data from original National Longitudinal Survey (NLS) panels

of Young Women and Mature Women and the NLSY. He estimates the relationship between actual experience measured as total weeks worked divided by 52 and independent variables such as age, years of schooling completed, marital status, number of children born to the woman, and race. The results show that the amount that potential experience overstates actual experience varies systematically with other variables, such as race and education, possibly leading to biased estimates of the coefficients on these other variables in female wage equations. This is a potentially serious concern for the large number of studies that use the Census or the Current Population Survey (which lack measures of actual experience) to examine gender differences in the occupational structure of wages. This paper suggests the use of predicted experience when actual experience is unavailable. Datasets, such as NLSY and PSID, that include actual experience can be used to estimate coefficients from which predicted experience is derived.

The effect of experience on a woman's wage is much greater when estimated with predicted rather than potential experience. The size of this difference is the largest at the lowest levels of experience. Filer concludes, "In general, each year of predicted experience increases wages by about twice as much as each year of potential experience." Predicted time out of the labor force and its square have jointly significant negative coefficients, which may represent the depreciation of human capital accumulated earlier. In line with earlier work, when Filer uses potential experience, being black seems to have little effect on wages. But when using the better predicted experience variable, Filer finds that being black significantly lowers women's wages. This may be explained by the fact that actual experience is a larger percent of potential experience for black women than for white women.

Furthermore, estimating the equation with predicted experience lowers the return to each year of schooling by about 20%. Part of the apparent returns to education when using potential experience may be due to more educated women spending more of their lives working. This raises issues about comparisons over time in estimates of the return to education for women using the CPS and the Census given large changes in women's actual experience. Finally, Filer uses a small sample of women from the 1988 NLSY to estimate wage equations with actual, predicted and potential experience. The return on experience with true experience was 5%, with predicted experience it was 2%, and it was insignificant for potential experience. Returns to schooling were 9, 7.7 and 7.6% with potential, predicted and true experience, respectively. This sample, however, was from a time outside of the period used to estimate the prediction model, and the predictions underestimate experience. In contrast to Light and Ureta (1995), which we discuss below, Filer does not account for the potential endogeneity of actual experience in the wage equation. This is likely to lead to an overstatement of the effect of actual experience on wage growth.

The inability to control well for differences in work history has always been a problem for analysis of the effect of experience on gender wage differentials. Wellington (1993) uses detailed measures of tenure, experience, and labor market attachment in wage regressions that control for selectivity using the inverse Mills ratio from a probit on labor force

participation.[29] Using data from the 1976 and 1985 PSID, she finds that the coefficients on these variables are similar for men and women, and that there has been little change in the relative values of the coefficients between these time periods. She concludes that the finding in some earlier studies that men receive a higher return to broad measures of experience is due to the fact that men and women differ in the types of experience they accumulate. She confirms the results of Brown (1989) for men that a year of full-time work in a position in which the person receives training is particularly valuable. She also finds that women have gained over time relative to men in all of the work history variables, including years of tenure, years of training on the current job, and years of full-time work. Hence, she concludes that it is increases in the accumulated experience of women versus men that is driving down the wage gap, not changes in the relative returns to experience for men and women. Some potential methodological problems with this paper are that the experience measures Wellington uses are likely to be endogenous, and the correlation with unobserved wage components may be more serious for women than men. An additional problem is that the paper cannot address the issue of whether differences in experience patterns or access to jobs where training is provided are due to the work preferences of women or discrimination.

Light and Ureta (1995) provide the best study to date of the effects of the timing of work experience on wages. They control for detailed measures $X_1,\ldots,X_t$ of the fraction of time worked in each of the years from the beginning of a career to time t. They also include five dummy variables $O_t,\ldots,O_{t-4}$ that equal 1 if the person worked 0 hours in the 5 years prior to time t. The O variables are intended to measure the penalty for prolonged absence from the labor market. They also include variables that measure the affect of interruption in careers. They compare these results to those based upon more conventional specifications involving a quadratic in actual experience or a quadratic in potential experience.[30] The effects of the experience and labor force interruption measures are identified using the variation over time for a given person rather than the cross-sectional variation. To look at the effect of timing on the gender gap, Light and Ureta decompose the wage gap using estimates from the work history specification into the part that is due to differences in returns to experience patterns, and the part due to male/female differences in characteristics.

Light and Ureta have several findings. First, the estimated returns to experience are higher but the returns to tenure are lower in the work history specification than in the more conventional specification. Second, a career interruption causes a smaller initial wage drop

[29] The labor force attachment variables are the number of hours of work missed due to another's illness, and the number due to one's own illness. The work history variables are years of work experience with previous employers; years of full-time work; years out of the labor force since the end of schooling; and a dummy variable for working part-time. The tenure variables measure tenure with the current employer, and are divided into years prior to the current position, years of training in the current position, and years since training was completed.

[30] The paper uses data from the young men and young women cohorts of the NLS. Only individuals born between 1944 and 1952 are included. An individual's career starts when he or she leaves school and begins full-time employment for at least 18 months. The sample is restricted to white workers whose careers are in progress during the entire 7 year period.

for women than for men, and women recover more quickly. They suggest that women may tend to work in occupations that allow for a quicker restoration of skills, and that men may have career interruptions for reasons that are more negatively related to productivity. The career interruptions may be correlated with transitory variation in the error terms, biasing the coefficients upward in absolute value, particularly for men.[31] Third, they find that the wage gap narrows after nine years of experience, which is consistent with Light and Ureta's (1990) evidence that continuously employed women perform similarly to their male counterparts. Differences in the returns to and timing of experience account for more of the gender gap as experience increases. Predictably, however, the amount due to differences in timing falls after nine years of experience. At nine years of experience, they find that 12% of the wage gap is due to differences in the timing of experience (evaluated using the men's coefficients), while 30% of the gap is due to differences in the return to experience.

The bottom line of this research is that differences between men and women in labor market participation are important causes of the gender wage differential. Both the timing of work experience and differences in the total amount of experience are important. As we discuss in Section 9, the growing similarity in the work patterns of men and women is partially responsible for the reduction in the gender gap in wages.

6.2.2. The effects of turnover and training on the gender gap

Women have traditionally had higher turnover than men. This difference in turnover has been used in several theoretical models to explain gender differences in the quantity and financing of general and specific training. In this section, we begin by briefly reviewing some recent evidence on gender differences in job mobility and turnover. We then summarize the results of a set of papers on incidence and receipt of training, paying special attention to Royalty's (1996) study of the role of turnover in the receipt of training and Becker and Lindsay's (1994) analysis of the relationship between gender differences in turnover and gender differences in the return to job seniority.

Becker and Lindsay (1994) estimate a logit regression of the probability of staying with a firm for four years or more based on sex, age, marital status, number of children, schooling, wages, and industry. At the mean values of the explanatory variables, the estimated probability of a woman staying with a new employer is 14.6%, while the same probability is 23.2% for a man. Mobility declines with age, especially in the case of women. Marriage has a positive affect and children a negative effect on the probability of staying.

Sicherman (1996) provides confirming evidence that women quit jobs at a higher rate than men, and indicates that their reasons for quitting are systematically different as well.

[31] In contrast, Wellington (1993) finds that years out of the labor force has only a small effect on the wages of men and women once other detailed experience controls, including receipt of employer training, are included. We are not sure what underlies the difference in the results of the two studies.

Sicherman uses personnel data from 1971 to 1980 on 16,000 workers from a large insurance company based in New York. He estimates gender specific Cox proportional hazards models of rates of departures from the firm for each of 13 reasons for departure as a function of tenure and education level. The hazard rate of leaving for women is higher than that for men at every level of tenure, although part of the differential is due to the fact that in this firm, women are younger, less educated, and in lower-level jobs than men. Sicherman finds that 12% of women and 4% of men left due to a change of residence, 6% of women and 2.6% of men left due to personal health problems or illness in the family. His findings suggests that women take short-run (market) considerations into account when changing jobs, while men place more importance on long-run (career) considerations.

Light and Ureta (1992) investigate whether stayers are easier to predict among men than among women. If more women are quitting because of unobserved heterogeneity, then firms may be more likely to use statistical differences by gender in determining the longterm tenure prospects of applicants. This would influence the training and promotion prospects of women as well as access to "career track" jobs. They find that unobserved heterogeneity in quit behavior is clearly evident among older cohorts, but among younger cohorts one cannot tell the men from the women on the basis of quit behavior once observable characteristics are controlled for.

Women who quit to leave the labor market suffer longterm wage losses. But job mobility – quitting to take another job – may be something quite different. Altonji and Paxson (1992) indicate that job mobility is strongly linked to hours changes. Women who face major changes in family responsibilities are more likely to make a major adjustment in their labor market hours if they also change employers. To the extent that wages play less of a role in the job choices of women than men, this may lead to lower wages over a career.

On the other hand, we have already emphasized in our discussion of racial differences in the gains from mobility that job mobility among younger workers appears to be highly correlated with wage increases, as workers move to jobs that are higher in the wage distribution. Among a younger cohort of workers, Loprest (1992) finds that women switch jobs less often than men, leading to a flatter overall experience/wage relationship. Abbott and Beach (1994) also find that job changes can have an important and positive effect on wages. Using Canadian data on adult women, they estimate that changes in jobs produce larger wage gains for women than for men although women change jobs less frequently. These results on women changing jobs less frequently than men may appear inconsistent with statistics on high job turnover among women. The issue, as Becker and Lindsay (1994) discuss, is that women who stay with a job are differently selected and likely to show longer tenure and larger wage gains with experience than equivalent men.

Higher turnover among women is often related to lower on the job training. A number of studies have linked women's lower firm training levels to their lower wages. Gronau (1988) indicates that differences in training have a substantial effect on male-female wage differences. Lynch (1992), Hill (1995), and Olsen and Sexton (1996) indicate that

women receive less on the job training and this affects their wages relative to men. The latter paper suggests that these training differences have lessened between the 1970s and the 1980s, a partial explanation for the narrowing of the gender wage gap between those decades. In fact, based on data for young workers between 1986 and 1991, Veum (1996) finds no gender difference in the likelihood of receiving training or in the hours of training received. Altonji and Spletzer (1991) indicate that the incidence of training is no lower among women, but the duration of their training is shorter than among men. Lynch (1992) and Royalty (1996) both find that women participate in off-job training at a higher rate. However, they also find off-job training has less of a positive impact on wages than on-the-job training and that women receive less on-the-job training. Overall, the evidence suggests that women receive less training than men.

Barron et al. (1993) develop a job-matching model to explain lower training levels based on the fact that women have higher turnover rates than men. Under these circumstances, firms will offer women jobs with lower starting wages and less training. Royalty (1996) directly investigates the link between men's and women's job turnover rates and their likelihood of receiving training. Differences in labor market attachment between men and women may lead to differences in firm financed training. The two key horizons over which the returns to training are received are total expected lifetime employment and the expected duration of the current job. She highlights the role of these two expected horizons using the following simple model of general and specific training.

Royalty specifies the probability of investing in general training G as

$$\Pr(G)_t = f(C_{Gt}, B_{Gt}, L_t - X_t), \tag{6.7}$$

and the probability of investing in specific training S as

$$\Pr(S)_t = f(C_{St}, B_{St}, D_t - T_t), \tag{6.8}$$

where C_{gt} and B_{gt} are expected costs and benefits of each type of training ($g = G,S$), L_t is total expected lifetime employment, X_t is total experience, D_t is the expected duration of the current job, and T_t is the job tenure at time t. Royalty uses the predicted job-to-non-employment and job-to-job turnover probabilities as proxies for total expected lifetime employment and the expected duration of the current job, which are the horizons over which training is received.[32] She estimates the effect of these turnover probabilities on the probability of receiving training and examines the effect of including these probabilities on the coefficients of the other variables. The training equations also include controls for tenure, experience squared, schooling, union status, and asset income. She includes dummy variables for occupation groups in the models since these may be related to the costs and benefits of training.

[32] The estimated probabilities of job-to-job turnover and job-to-non-employment turnover are based on gender and education group models that include tenure, experience, the real wage on the current job, health status, union status, asset income, marital status, number of children, and dummy variables for the local unemployment levels.

Her main finding is that job-to-job and job-to-non-employment transition probabilities do influence the probability of receiving training. Gender differences in these transition probabilities explain part of the difference between men and women. Her estimates support Barron et al. (1993) model, and indicate that the male/female training difference is primarily explained by differences in job turnover between men and women.

Becker and Lindsay (1994) analyze sex differences in tenure profiles from the perspective of Hashimoto's (1981) model where such profiles reflect shared investment in specific human capital between employer and employee. The larger the fraction paid for by the employee, the steeper that employee's tenure profile should be. Fixed wage contracts are formed to eliminate potential opportunism due to unexpected variation in the realized payoff to firm-specific training. These contracts lead to inefficient separations. The most efficient contract has the property that the worker's share of the costs and the returns to firm-specific capital investments are a positive function of the degree of uncertainty at the start of the match about the worker's future productivity outside the firm.

Suppose that the variance of productivity inside of the firm is unrelated to gender, but increased productivity at home leads to higher variance of productivity outside the firm for women than for men, and for younger women than for older women. Then Becker and Lindsay's analysis implies that women, especially young women, will bear a higher share of firm-specific investment and have steeper tenure profiles. (This assumes that the overall quantity of investment in specific capital does not diminish). The model also predicts that workers in firms that require firm-specific investment will have higher tenure slopes than workers in firms that require no firm-specific investment.

In the empirical work persons who stay on a job for five years are classified as stayers and assumed to be sharing the returns to firm-specific training, while those who leave before 5 years are dubbed leavers and assumed to share no firm-specific investment. The basis for this classification is that the model implies that expected tenure is longer for workers in firms that require firm-specific investment than for workers in firms that do not. However, the empirical work does not address the fact that staying 5 years is an outcome that may reflect random variation in the time paths of productivity inside and outside the firm that is unrelated to human capital investment. Nor does it deal with the fact that it is more exceptional for women to stay 5 years and therefore there is some presumption that the unobserved characteristics of the female stayers or the jobs that they hold are likely to differ from those of the men.

Using data from the PSID for 1983–1987, Becker and Lindsay find that wage-tenure profiles of stayers are steeper for females than males, which is a key prediction of the model if one assumes that stayers are in jobs that require specific human-capital investment. The coefficient of tenure is 37% larger in the female than in the male equation. They also find that the gender difference in tenure effects is much larger for younger workers than for older workers. This is consistent with their model under the hypothesis that gender differences in outside prospects decline as women leave the reproductive years. They find that tenure profiles among male and females leavers are both relatively flat. Overall, the

empirical results are consistent with the hypothesis that gender based differences in job turnover rates influence the financing of specific capital.

Gender differences in training and firm-specific investment are clearly due to a complex set of factors, including differences in turnover, in non-market opportunities, and in lifetime work expectations. These differences, in turn, have significant affects on women's wages. A key unanswered and complex issue is to untangle how much of these differences are the result of statistical discrimination by employers, how much they are the result of differential choices by women, and how much these two effects feed back into each other.

7. Job characteristics, taste differentials, and the gender wage gap

7.1. Overview

There is disagreement about whether differences in job characteristics between the jobs held by men and women – items such as occupation, unionization, industry, part-time work, or job-related amenities or disamenities – should be counted as constraints that women face in the labor market (because they are denied access to other jobs) or as an indication of differential tastes by women for the jobs that they want to hold. In Table 3 we showed that there are substantial gender differences in the occupational distribution. These differences imply large differences in the characteristics of the jobs worked by women and men. Differences in job characteristics are important because it is well established that job attributes "explain" a substantial part of the male-female wage differential. For example, Blau and Kahn (1997) show that adding industry, occupation, and collective bargaining variables to male and female wage regressions reduces the "unexplained" share of the differential from 22% to 13% in 1988. Macpherson and Hirsch (1995) find that the inclusion of a wide variety of job characteristics reduces the unexplained differential from 17% to 12% in pooled data from 1983 to 1993.

The effect of occupational location on the gender gap has been a key research question for several decades. Does this simply reflect competitively determined prices on the bundles of job attributes men and women prefer, or is it the result of labor market constraints that have limited women's participation to specific sectors of the labor market? The model of occupational crowding analyzed in Section 3 illustrates the potential role for both mechanisms to affect the occupational distribution and the relative wages of men and women.

In historical data, there is clear evidence that women face barriers in the labor market against entering certain occupations, including explicit rules that barred hiring or training women in selected occupations.[33] After such constraints became illegal, however, it became more difficult to label occupational effects as "constraint" versus "choice."

[33] For one particularly interesting example of this, see Goldin's (1990) discussion of the "marriage bar", which forced women to quit certain jobs upon marriage.

Kidd and Shannon (1996) try endogenizing occupational location in a limited way, but do not focus on the effect of this on the wage differential. More research needs to be done that endogenizes occupational choice and/or choice into jobs with particular characteristics, and that estimates how this affects the wage differential. For example, Blank (1990a) finds that after controlling for selection in the labor market as well as selection into part-time versus full-time work, the negative effect of part-time work on women's wages is much smaller (and even positive for a few high-skilled occupations.)

This section focuses solely on the male/female wage gap. As Table 3 indicates, there are also substantial differences in occupational choice between black and white workers, and these differences also affect the racial wage gap. We summarize research on the impact of changes in black occupational location on the black/white wage gap in Section 9 below, but do not focus on race-related job differences here, in part because we ran out of space and time but also because there is much more widespread agreement that occupational differences by race are the result of historical constraints on black participation in the labor market and human capital difference rather than preferences. In many ways, this simplifies the conversation about differences in job characteristics by race and avoids many of the difficult choice/constraint arguments that we discuss here in the context of gender differentials.

7.2. The occupational feminization of wages

Research by economists and sociologists has shown that the percent of women in an occupation is negatively associated with the wages received by both men and women in that occupation. These research results have been one of the forces behind the move to implement comparable worth policies, as we discuss further in Section 10.

Most of this research is based on wage regressions estimated with cross-sectional data. The following basic model is typically estimated separately for men and women:

$$\ln W = F\beta_g + X\Gamma_g + u, \qquad g = \text{male or female}, \tag{7.1}$$

where W represents the wage of an individual, F is the fraction of women in the occupation which this individual occupies, and X is a set of individual control variables such as age, education, and marital status. In some cases X also includes occupational characteristics from the Dictionary of Occupational Titles and dummies for different industries. Blau and Beller (1988) find that β is negative for both men and women, using data from both 1971 and 1981. Using data from the 1983 CPS and the 1984 PSID, Sorenson (1990) finds that the effect of F is negative and that the variable explains between 15% and 30% of the male-female wage gap. The coefficient on F tends to decline as observed occupational characteristics (such as specific vocational preparation, general education development, environmental conditions, and physical demands) are added to the model. Since occupational categories and occupational characteristics are often crudely measured, this raises the issue of whether important unobserved differences in the types of jobs women and men perform remain. This issue is hard to resolve without firm-level data.

Lewis (1996) analyzes the US Office of Personnel Management's Central Personnel Data File for the years 1976–1992. He finds that gender segregation has decreased substantially.[34] A regression of the average civil service grade in 1993 (grade is an indicator of level of responsibility) on the change in percentage male within grade, shows that as the percentage male in an occupation fell, the mean grades fell for both men and women, even after controlling for worker characteristics. Salary also declined as the number of women increased in an occupation. Lewis (1996) calculates that declining segregation accounts for 31% of the narrowing of the male-female grade gap in the federal government between 1976 and 1992, and 31% of the narrowing of the salary gap.

Schumann et al. (1994) study the assignment of job points to occupations. Job points are often used to define compensation systems. They conclude that job points are far more determined by the gender composition of the occupation than by its human capital requirements. Paulin and Mellor (1996) indicate that occupations with higher percent female also have lower promotion probabilities. However, it should be kept in mind that job points are often adjusted to reflect turnover and competitive factors, and to a substantial degree may simply mirror the salary structure required to attract and retain the skill mix in a firm. Compensating differentials may arise in a competitive, non-discriminatory labor market and work to the disadvantage of women if preferences of women for particular job attributes boost competition for the jobs women prefer.

A key issue is whether F, the share of women in an occupation, is correlated with unobserved worker skills or characteristics within the occupations that influence compensating differentials. Groshen (1991) finds that adding more detailed human capital variables to a regression does not lessen the effect of occupational gender composition on wages. However, Gerhart and El Cheikh (1991) use data from the NLSY for 1983 and 1986 to estimate the effect of percent female on wages using fixed effects to control for unobserved heterogeneity in skills. This panel data design parallels the use of individual fixed effects to control for unobserved heterogeneity in studies of industry wage premiums, the union premium, and the firm size premium. When individual characteristics and individual fixed effects are included in a longitudinal wage regression, the coefficient on the percent female is -0.276 for men and -0.165 for women. The corresponding coefficients from a cross-sectional regression (using the average of the 1983 and 1986 observations) are -0.276 for men and -0.086 for women.[35] These results provide little support for the view that unobserved heterogeneity is important. However, when occupational characteristics are added to the fixed effects model, the coefficients on percent female are -0.226 for men and -0.045 for women while the cross-sectional estimates are -0.278 for men and -0.103 for women. When industry dummies are added, the

[34] In 1967, 42% of women and 49% of men held federal jobs in which at least 95% of their co-workers were of the same sex. By 1993, these percentages had dropped to 12% and 3%. The percentage of women holding professional and administrative positions almost tripled from 1976 to 1992 (from 18% to 45%) while that of men increased from 66% to 73%.

[35] The individual characteristics include years of education, weeks worked since 1975, weeks worked squared, collective bargaining coverage, marital status, usual weekly hours, and school enrollment status.

coefficient on percent female declines to −0.036 (for women) and is no longer statistically significant. These declines in the coefficient on feminization when fixed effects are added to models that control for observed occupation and industry suggest that the feminization effect may be due to differences in the types of people who choose to work in the more feminized occupations.

Replication of this result on other datasets should be a high research priority. It would also be useful to carefully attempt to address the possibility that measurement error in occupation and selectivity in who changes occupation leads to an understatement of the effect of occupational feminization on wages.[36]

7.3. The impact of other job characteristics

Going beyond occupation, other studies have focused on the impact of alternative job characteristics. Both Macpherson and Hirsch (1995) and Hersch (1991) show that measures of the nature and type of job-related tasks have a significant relationship to male/female wage differences. Chauvin and Ash (1994) find that among white collar professional workers, much of the gender pay difference is associated with differences in the share of base versus contingent pay on the jobs which women and men work.

There has been a growing amount of research on the impact of part-time work and of contingent work on wages and other labor market outcomes. Women are heavily over represented in part-time jobs and temporary jobs. These jobs typically pay less than full-time, permanent jobs.[37] At the same time, women devote more time and energy to home work, which may imply a greater fraction of women than men prefer part-time and temporary jobs. One way to try and separate out choice from constraints is to control for the choice process into a particular set of jobs and then estimate wages conditional upon choice. For instance, Blank (1990b) does this in investigating the effect of part-time work on wage levels. She finds that controlling for women's selection into non-employment, part-time, and full-time employment substantially reduces the negative effect of part-time work on women's wages. Even with these results, however, the underlying relative importance of choice versus constraints is not clear. Less productive women may be selecting into part-time work, in which case the part-time wage differential reflects additional differences in the human capital attributes of the workers. Or part-time jobs may provide less effective support for workers, limiting their productivity because employers do not provide efficient technologies or adequate management resources to workers in these jobs. In this case, if women disproportionally accept such jobs because of their other advantages (such as flexible scheduling), the lower wages reflect a market-imposed

[36] As Gerhart and Cheikh note, the decline in the fixed effects estimates as occupational controls are added is much larger for women than men, suggesting that a simple measurement error explanation will not work. A complicated multivariate one is still a possibility.

[37] On part-time work, see Blank (1990a, 1998). On temporary work, see Segal and Sullivan (1997a,b) and Houseman (1997).

constraint on the jobs, and do not reflect productivity differences in worker ability. The same issues arise for temporary work and for other job characteristics.

Hersch and Stratton (1997) examine a related issue, which is whether the greater time and energy that women devote to home work may influence their productivity in the market as well as their preferences for particular types of jobs. They show that hours devoted to housework have a negative effect on hourly wage rates even when individual fixed effects are controlled for. This result is broadly consistent with Becker's (1985) theory that a share of the male-female wage differential is due to productivity differences that arise from the fact that women carry a heavier load of responsibilities at home than men do. Further work on this issue, particularly as a partial explanation for under representation of women at the highest levels of managerial and professional occupations, deserves a high research priority.

The existing research indicates that the characteristics of the jobs that women fill have a substantial effect on their wages and on the male/female wage gap. Models of occupational crowding ascribe these affects to discriminatory barriers in the labor market. Models that emphasize male/female taste differentials ascribe these affects to differential market choices that reflect the preferences of workers. Of course, these are not easily separable theories. Historical occupational discrimination may lead women of necessity to develop a different set of preferences. Research in this area will continue to garner a great deal of attention, in part because this distinction between choice and constraint is one of the most difficult and controversial topics in the discussion of the gender wage gap.

8. Beyond wages: gender differentials in fringe benefits

Full compensation involves more than wages; indeed, non-wage benefits currently compose about one-third of total compensation. The male/female difference in wages is also visible in fringe benefits. Vella (1993) indicates that using the wage rather than a measure of full compensation to indicate the price of labor can result in incorrect estimates of labor supply elasticities. As with wages, some of the male/female difference in non-wage compensation relates to the human capital and productivity differences between workers of different genders, some of it relates to differences in the characteristics of jobs held by men and women, and some of it remains unexplained.

Even and Macpherson (1990, 1994) investigate the male/female gap in the likelihood of receiving a pension. They indicate that much of this gap can be accounted for by differences in the characteristics of male and female workers, and that this gap is much lower among younger cohorts of workers. Among those who have pensions, the gender gap in benefit levels is largely explained by gender differences in income. Solberg and Laughlin (1995) use information on multiple benefits to estimate an index of compensation. They find that the inclusion of non-wage compensation narrows the gender wage gap, although this may reflect the fact that their data is from younger workers only.

There is remarkably little good research on the role of fringe benefits in the labor

market, which means there is a lack of understanding about male/female differences in non-wage compensation as well. While the research cited above on pensions does fill some of these gaps, there is no equivalent work on health insurance, an increasingly important fringe benefit, or on other fringe benefits. We need to do a better job of collecting and analyzing the value of non-wage compensation, and in determining how male/female differences in the availability of such compensation may or may not create problems for women in the long run. For instance, many women who do not receive health insurance from their employer are fully covered by their spouse's insurance. Lack of coverage in this situation is quite different than lack of coverage for a single mother who has no other source of insurance. Lifecycle estimates of the importance of fringe benefit provision for women in the workplace might be particularly useful, particularly since many of these benefits are paid out currently but their benefits (in improved health care or in pension coverage) may be realized only over time.

We have been unable to locate much research that analyzes racial differentials in non-wage compensation. Given the substantial gap in black/white wages and differences in the occupational distribution of black and white workers, there are also differences in the receipt of health insurance, pensions, and other non-wage benefits among black workers. Research is clearly needed on the effects of these gaps on the behavior and well-being of black workers and their families.

9. Trends in race and gender differentials

Much high quality research has been devoted to the analysis of changes over time in race and gender differentials. In Section 9.1 we introduce this literature with a presentation of the standard methodology for decomposing wage changes between groups over time, with a particular emphasis on some recent methodological developments. We then summarize the research which utilizes these methodologies to study the effects of changes in prices of observed and unobserved skills on wage differentials. In Section 9.2 we discuss a variety of factors that have influenced the relative labor market success of black and white men over time. In Section 9.3 we turn to research on trends in the gender gap and summarize the main findings in this literature. We close the section with a brief review of the evidence on the role of civil rights policies on race and gender differentials.

9.1. Methodologies for decomposing wage changes between groups over time

9.1.1. The standard approach

We begin the discussion by reproducing Eq. (2.3):

$$W_{1t} - W_{2t} = (X_{1t} - X_{2t})\beta_{1t} + (\beta_{1t} - \beta_{2t})X_{2t}, \tag{2.3}$$

where W_{gt} represents mean wages for group g at time t (assume the minority group is group 2 and the majority group is group 1), X_{gt} are the mean characteristics of group g which

affect wages, and the βs are their related coefficients, estimated at time t. As we noted above, this equation underlies a large body of empirical work that attempts to decompose wage or earnings differentials between groups into "explained" and "unexplained" components. To analyze the sources of change over time in the labor market outcomes of different groups, Eq. (2.3) is differenced between periods. Let the operator Δ represent the mean difference between group 1 and group 2 in a designated year. The change in wage differentials between time periods t' and t can be presented as

$$\Delta W_{t'} - \Delta W_t = (\Delta X_{t'} - \Delta X_t)\beta_{1t} + \Delta X_{t'}(\beta_{1t'} - \beta_{1t}) + (\Delta\beta_{t'} - \Delta\beta_t)X_{2t} + (X_{2t'} - X_{2t})\Delta\beta_{t'}. \tag{9.1}$$

In Eq. (9.1) the first term represents the effect of relative changes over time in the observed characteristics of the two groups and the second term represents the effect of changes over time in the coefficients for group 1, holding differences in observed characteristics fixed. These two components represent the change over time in the wage gap that would be expected given changes in the characteristics of the two groups and the coefficients on those characteristics for group 1 in periods t and t'.

The third and fourth terms capture the change in the unexplained component of the gap, $(\beta_{1t} - \beta_{2t})X_{2t}$ in Eq. (2.3). The third term is the effect of changes over time in relative coefficients between the two groups. The fourth term captures the fact that changes over time in the characteristics of group 2 alter the consequences of differences in group coefficients $(\beta_{1t} - \beta_{2t})$. Researchers typically compute each of these terms as well as the subcomponents corresponding to individual elements of X and β.

A disadvantage of this decomposition is that it does not provide much insight into how the wage gap is affected by changes in the overall wage distribution, such as occurred over the 1980s when the returns to skill rose rapidly. Increases in the dispersion of wages will increase the gap between the mean wages of group 1 and group 2 (if group 2 is below the mean and group 1 is above the mean) even if these changes have no effect on the location of the distributions of the two groups. Recent work by Juhn et al. (1991a) and Card and Lemieux (1994, 1996) provides ways to isolate the effect of a change in the dispersion of the unobservable wage components affecting both groups from a change in the location of the skill distribution of group 2 relative to group 1.

9.1.2. Juhn, Murphy, and Pierce's approach

Juhn et al. (1991b) (hereafter JMP) develop a new methodology for decomposing wage changes, that particularly emphasizes the role of changes in the relative distribution of each group. Re-write Eq. (2.3) as

$$W_{1t} - W_{2t} = (X_{1t} - X_{2t})\beta_{1t} - U_{2t}, \tag{9.2}$$

where the unexplained component $-U_{2t}$ is

$$-U_{2t} \equiv (\beta_{1t} - \beta_{2t})X_{2t}.$$

Recall that μ_{1it} and μ_{2it} are error components from the wage regressions for person i at

time t in groups 1 and 2 (see Eqs. (2.1) and (2.2)). Note that μ_{1it} is the component of the wage for a member of the population 1 that is not explained by the group 1 regression function and $U_{2it} = \mu_{2it} + (\beta_{2t} - \beta_{1t})X_{2it}$ is the component of the wage of a person in group 2 that is not explained by the group 1 regression function. One can always write μ_{1it} as $\mu_{1it} = \sigma_t\theta_{1it}$, where θ_{1it} is the standardized error term with mean 0 and variance 1 and σ_t is the standard deviation of μ_{1it}. One can also write $\mu_{2it} + (\beta_{2t} - \beta_{1t})X_{2t}$ as $\sigma_t\theta_{2it}$ where $\theta_{2it} \equiv U_{2it}/\sigma_t$ is normalized to have a variance of 1 (note that JMP implicitly assume that $\sigma_{1t} = \sigma_{2t} = \sigma_t$ in all years). One may re-write Eq. (9.2) as

$$W_{1t} - W_{2t} = (X_{1t} - X_{2t})\beta_{1t} + \sigma_t(\theta_{1t} - \theta_{2t}) = (X_{1t} - X_{2t})\beta_{1t} + \sigma_t(-\theta_{2t}). \tag{9.3}$$

Think of σ_t as the "price" on the component of wages that is not explained by the group 1 regression function and note that θ_{1t} and θ_{2t} are the means for groups 1 and 2 of this component. (The second equality follows because $E(u_{1it}|X_{1it}) = 0$.) The second term is the residual gap.

Changes between groups over time can then be written as

$$\Delta W_{t'} - \Delta W_t = (\Delta X_{t'} - \Delta X_t)\beta_{1t} + \Delta X_{t'}(\beta_{1t'} - \beta_{1t}) + (\Delta\theta_{t'} - \Delta\theta_t)\sigma_t + \Delta\theta_{t'}(\sigma_{t'} - \sigma_t). \tag{9.4}$$

The third and fourth terms are an alternative to the decomposition of the effects of changes in unobservables on the change in the wage gap provided in Eq. (9.1). The third term represents changes in the relative position of group 1 and group 2 within a constant distribution of the unobservable wage components. The fourth term represents changes in the wage distribution, holding the mean difference in the black/white unobservables ($\Delta\theta_{t'} = -\theta_{2t'}$) constant.

The third term in Eq. (9.4) is estimated as follows. Let $F_{1t'}(U_{2it'})$ denote the value of the CDF of group 1's wage residuals evaluated at the value of the wage residual of the ith member of group 2 in year t'. Let $F_{1t}(\mu_{1it})$ be the CDF of wage residuals for group 1 in period t. Let $F_{1t}^{-1}(\cdot)$ be the inverse of the CDF. The term $\Sigma F_{1t}^{-1}(F_{1t'}(U_{2it'}))/N_{2t'}$ is the mean of the wage residuals members of group 2 *would have had* in year t if they held the same position in the group 1 wage distribution in year t that they held in t'. U_{2t} is the mean of the actual residuals in year t. Consequently, Juhn et al. (1991) estimate $(\Delta\theta_{t'} - \Delta\theta_t)\sigma_t$ as

$$(\Delta\theta_{t'} - \Delta\theta_t)\sigma_t = -\sum_{i=1}^{N_{2t'}} F_{1t}^{-1}(F_{1t'}(U_{2it'}))/N_{2t'} + U_{2t}, \tag{9.5}$$

where $N_{2t'}$ is the number of observations on group 2 members in year t' and we have used the fact that $\theta_{1t}\sigma_t = \theta_{1t'}\sigma_t = 0$. Again, this term measures movement of group 2 through the group 1 wage distribution between periods. (If there is no such movement, then it is 0.)

The effect of the change in prices on unobservables is estimated as

$$\Delta\theta_{t'}(\sigma_{t'} - \sigma_t) = \sum_{i=1}^{N_{2t'}} F_{1t}^{-1}(F_{1t'}(U_{2it'}))/N_{2t'} - U_{2t'}. \tag{9.6}$$

This measures the difference between the mean of what the residuals would have been if the ith person in group 2 held the same position in the group 1 wage distribution in year t that he held in year t' and the mean of the actual residuals for group 2 in period t'. This term measures the effects of changes in the shape of the wage distribution (changes in σ_t) on the wage gap.

Increases in the dispersion of wages hurt low wage workers and will tend to increase the wage gap. It is important to point out, however, that this decomposition into the effects of changes in the market value of group 1 relative to group 2 is clear cut only when the skill distribution of group 1 members does not change.

We have followed JMP in using Eqs. (9.3) and (9.4) as the motivation for Eqs. (9.5) and (9.6). However, the motivation that these equations provide for Eqs. (9.5) and (9.6) is not obvious. JMP's presentation seems to restrict analysis to cases in which the change in skill prices affects all skill levels equally when in fact it is more general. Given the importance of JMP's analysis we digress briefly here to provide a more complete motivation.

As before, let θ_{it} be an index of unobserved characteristics that influence wages and let θ_{it} have the distribution $h_{1t}(\theta_{it})$ for whites and $h_{2t}(\theta_{it})$ for blacks. Since one cannot distinguish unobserved "price" effects from worker quality effects unless there is a reference group with a *fixed* skill distribution, we explicitly assume that the density h_1 is constant within the sample period. The wage residual for a person with unobserved characteristics θ_{it} is $U_{1it} = \mu_{1it} = \sigma_t(\theta_{it})$ in the case of whites and $U_{2it} = \mu_{2it} + (\beta_{1t} - \beta_{2t})X_{2t} = \sigma_t(\theta_{it})$ in the case of blacks, where the price function σ_t is strictly increasing. (A special case occurs when σ_t is constant across t.) The regression procedure guarantees that the mean $U_{1t'}$ of $\mu_{1it'}$ is 0 in each year, which, under the assumption that $h_1(\theta_{it})$ is fixed, may be thought of as a normalization on the price function σ_t. This implies

$$U_{1t} - U_{2t} = 0 - \int \sigma_t(\theta)h_{2t}(\theta)\mathrm{d}\theta.$$

The time difference $[U_{1t'} - U_{2t'}] - [U_{1t} - U_{2t}] = U_{2t} - U_{2t'}$ is

$$\int \sigma_t(\theta)[[h_{1t'}(\theta) - h_{2t'}(\theta)] - [h_{1t}(\theta) - h_{2t}(\theta)]]\mathrm{d}\theta + \int [\sigma_{t'}(\theta) - \sigma_t(\theta)][h_{1t'}(\theta) - h_{2t'}(\theta)]\mathrm{d}\theta$$

$$= \int \sigma_t(\theta)[h_{2t}(\theta) - h_{2t'}(\theta)]\mathrm{d}\theta + \int [\sigma_t(\theta) - \sigma_{t'}(\theta)]h_{2t'}(\theta)]\mathrm{d}\theta, \tag{9.7}$$

where the second equality follows from the assumption that $h_{1t}(\theta) = h_{1t'}(\theta)$ and from the normalization that the mean of the group 1 residuals is 0 in each year, so that

$$U_{1t'} \equiv \int \sigma_{t'}(\theta)h_{1t'}(\theta)\mathrm{d}\theta = \int \sigma_t(\theta)h_{1t'}(\theta)\mathrm{d}\theta = \int \sigma_t(\theta)h_{1t}(\theta)\mathrm{d}\theta \equiv U_{1t} = 0. \tag{9.8}$$

The assumption that $h_{1t}(\theta) = h_{1t'}(\theta)$ implies that the CDF $H_{1t}(\theta) = H_{1t'}(\theta)$. This fact and the monotonicity of $\sigma_t(\theta)$ implies that $F_{1t'}(\sigma_{t'}(\theta)) = F_{1t}(\sigma_t(\theta)) = H_{1t}(\theta)$. This implies that

$$\int \sigma_t(\theta)h_{2t'}(\theta)\mathrm{d}\theta = \int F_{1t}^{-1}(F_{1t'}(U_{2it'}))\mathrm{d}F_{2t'}(U_{2it'}), \tag{9.9}$$

which is the theoretical counterpart to the $\Sigma F_{1t}^{-1}(F_{1t'}(U_{2it'}))/N_{2t'}$. Note that

$$\int \sigma_{t'}(\theta)h_{2t'}(\theta) = U_{2t'}, \qquad \int \sigma_t(\theta)h_{2t}(\theta) = U_{2t} \tag{9.10}$$

Using these results to evaluate the right-hand side of (9.7) establishes that the effect of changes in the unobserved skill distribution evaluated at the old prices is

$$\int \sigma_t(\theta)[h_{2t}(\theta) - h_{2t'}(\theta)]\mathrm{d}\theta = U_{2t} - \int F_{1t}^{-1}(F_{1t'}(U_{2it'}))\mathrm{d}F_{2t'}(U_{2it'}). \tag{9.5$'$}$$

The effect of the change in prices is

$$\int [\sigma_t(\theta) - \sigma_{t'}(\theta)]h_{2t'}(\theta)]\mathrm{d}\theta = \int F_{1t}^{-1}(F_{1t'}(U_{2it'}))\mathrm{d}F_{2t'}(U_{2it'}) - U_{2t'}. \tag{9.6$'$}$$

These equations correspond to Eqs. (9.5) and (9.6) and provide a more general formulation of the JMP approach.

JMP use Eqs. (9.5) and (9.6) to examine the effect of changes in the wage distribution on the black/white male wage differential. They are particularly interested in trying to explain the slowdown in convergence of black/white male wages over the past decade. As JMP discuss, distinguishing whether their measures of the unobservables reflect changes in unobserved differences in the labor market productivity of the groups or changes in discrimination is not straightforward. The term $(\Delta\theta_{t'} - \Delta\theta_t)\sigma_t$ captures changes in the race gap among blacks and whites with the same level of education, experience and initial earnings. This may reflect either changes in the unobserved skills of blacks relative to whites or changes in level of labor market discrimination. JMP argue that Eq. (9.5) is more likely to capture the effect of changes in skill prices affecting both groups rather than a change in discrimination. However, they also point out that in some models of discrimination the relationship between the skills and wages of a group is altered. Consider, for example, models in which group 2 members are confined to jobs as laborers, and assume that productivity as a laborer is not sensitive to skill level. In this case a demand shift in favor of managers and professionals will increase the wage gap due to the inability of group 2 members to make optimal use of their skills. That is, if U_{2t} is negative because discrimination keeps high skill members of group 2 out of high skill jobs, then a labor demand shift in favor of high skill jobs may change the wage gap produced by a fixed level of discrimination. The interpretation of Eqs. (9.5) and (9.6) is clear only under the null hypothesis that the distribution of U_{2it} reflects differences in skill.

Using CPS data, JMP finds that between 1979 and 1987 changes in levels of education and experience reduced the black/white wage gap by 0.34 (black characteristics moved closer to white characteristics), while changes in the returns to education and experience increased the gap by 0.27. They find that 0.33 of the 0.34 "unexplained" widening in the

wage gap is due to changing wage inequality as embodied in Eq. (9.6) – virtually the entire amount. In short, black relative wages declined because black men were disproportionately located in the lower end of an increasingly unequal wage distribution.

JMP further explore the contribution of skill price changes to the "unexplained" portion of the race gap by considering the polar case in which all of the race gap is due to differences in educational quality. Suppose that X is the mean of years of education and θ_{2t} is the mean of the difference in the effective years of schooling of blacks relative to whites with the same number of years of schooling. If the quality of education received by blacks is lower, then θ_{2t} is negative. If education is the *only* factor that differs between the groups, then

$$W_{1t} - W_{2t} = (X_{1t} - X_{2t})\beta_{1t} + \beta_{1t}(-\theta_{2t}), \tag{9.11}$$

where β_{1t} is the return to a year of education in year t of the quality received by whites. Consequently, one can estimate $-\theta_{2t}$ as $[(W_{1t} - W_{2t}) - (X_{1t} - X_{2t})\beta_{1t}]/\beta_{1t}$ where β_{1t} is estimated from a regression of wages on X_{1t} among group 1. (In practice, a non-linear education specification is used and estimates of θ_{2t} specific to each education level are obtained.) One may difference Eq. (9.11) across time. The term $-(\beta_{1t'} - \beta_{1t})\theta_{2t}$ is the change in the contribution to the race gap of unobserved race differences in education quality that is due to the change in returns to education. Estimating this constrained model, JMP conclude that this factor explains −0.76 of the unexplained change in the wage gap for the years 1979–1987. This at least suggests that unobservable school quality differences between blacks and whites may have been a key factor in the slowdown of black/white wage convergence, if the returns to quality (like other returns to skill) have widened.

9.1.3. Card and Lemieux's multidimensional skill model

Card and Lemieux (1994) (hereafter CLem, to distinguish them from the Coate and Loury abbreviation, CL, used in Section 3) propose an alternative way to analyze the effects of changes in skill prices on the wage gap when panel data are available. Consider the wage equation for person i in year t.

$$w_{it} = b_t + D_i\alpha_t + x_{it}\beta_t + \varepsilon_{it}, \tag{9.12}$$

where D_i equals 1 for blacks and 0 for whites, x_{it} is a set of productivity determinants and ε_{it} is an error term. Impose the restriction that the prices β_t on the observed components of skill all change by the same proportion over time, i.e., $\beta_t = \delta_t\beta$, where δ_t is the relative price of skill and is normalized to 1 in the base year (1979 in CLem).

CLem parameterize the race differential as

$$\alpha_t = \phi_t\alpha, \tag{9.13}$$

where ϕ_t measures the race differential relative to a base year in which ϕ is set to 1.[38]

[38] If x_{it} is education and if the race difference in educational quality is constant, then for a given value of x_{it} this nests a special case of the model JMP use to relate the wage gap to changes in the value of education, with $\alpha = \theta_{2t} = \theta_2$ and $\phi_t = \beta_t$. However, in CLem's model the gap in t does not vary with education.

Changes in skill prices affect the error term in the following way

$$\varepsilon_{it} = \Psi_t(a_i + u_{it}) + v_{it}, \tag{9.14}$$

where a_i is a fixed component, u_{it} is a stationary AR1 process with a time invariant innovation variance, and Ψ_t is the price associated with the both the permanent and transitory unobserved skill components. The term v_{it} is measurement error. These restrictions imply that the wage equation may be written as

$$w_{it} = b_t + \phi_t(D_i\alpha) + \delta_t(x_{it}\beta) + \Psi_t(a_i + u_{it}) + v_{it}. \tag{9.15}$$

One may estimate the model by first working out its implications for the first and second moments of the data and then selecting the parameter values that minimize the distance between the sample moments and the implied moments. CLem use PSID data to produce estimates for men and women for the years 1979–1985. For men the return to observed and unobserved skills rose by 5–10% between these years. For men, the black/white wage gap falls between 1979 and 1985, a change that is inconsistent with the expected effects of rising returns to skill and is inconsistent with the evidence from CPS data over these same years. This evidence is also inconsistent with JMP's results, particularly their investigation of the relationship between changes in the return to education and changes in the "unexplained" component of the race gap. For these reasons, we hesitate to place too much weight on the empirical results in this study.

The Card and Lemieux (1994) results are at variance with Chay and Lee (1997) and Card and Lemieux (1996), to which we now turn. Chay and Lee (1997) use CPS data in a model that is similar to Eq. (9.15) to provide a further exploration of the possibility that changes in the return to unobserved skills explain the decline in the rate of convergence between black and white men. Their basic idea is to use changes in the variance in wages within age-education-race cells to identify changes over time in the price Ψ_t associated with the unobserved skill components $(a_i + u_{it})$ under the assumption that the variance of $a_i + u_{it}$ differs across cells. *Conditional* on assumptions about the fraction of the race gap $\phi_t\alpha$ in 1979 that reflects discrimination and about the fraction that is due to a race difference in the mean of $\Psi_t a_i$, one can estimate the effect of changes in the skill price Ψ_t on the race gap.[39] We have some serious reservations about the reliance on group heterogeneity in the variance of $a_i + u_{it}$ to identify this model. Changes over time in the CPS response rates and in treatment of top coding may be a source of differences between groups and over time in within cell variances, a problem Chay and Lee raise and that is not unique to their study. Unfortunately, in the absence of panel data this approach is necessary.

[39] One of Chay and Lee's main points is that without an assumption about the importance of unobserved skill differences at a point in time, one cannot identify the contribution of changes in skill prices from changes due to other sources without other strong assumptions. This point is correct, but if one is willing to assume that changes over time in discrimination are smooth and the unobserved skill gap is constant, then one can see whether changes in the gap implied by changes in the market value of unobserved skill differences track the actual changes. This is what JMP do.

The results in Chay and Lee's paper imply that if one assumes that all of the race gap in 1979 was due to unobserved skill differences, then the change in skill prices between 1979 and 1991 should have lead to a larger widening of the race gap than is observed. This finding squares with JMP's calculation for 1979–1987 that almost all of the wage race gap within education levels is due to race differences in education quality.

Card and Lemieux (1996) use a different approach to explore the implications of a one dimensional skill model of changes on the structure of wages. Let wages w_{ijt} be

$$w_{ijt} = \theta_{ijt} + \varepsilon_{ijt}, \tag{9.16}$$

where j denotes a particular group (such as an age, education, race cell) and i and t are subscripts for individuals and the year respectively. The term θ_{ijt} is a productivity component and the term ε_{ijt} is a random error that captures measurement error and random variation around the mean of productivity (which might be associated with randomness in labor market search for example). The variance of ε_{ijt} is assumed to be constant across groups and time. This assumption is inconsistent with the predictions of some statistical models of discrimination. In this model, the underlying components of skill can be aggregated, and the market price associated with them changes proportionately.

Productivity is described as

$$\theta_{ijt} = \mu_{jt} + a_{ijt}, \tag{9.17}$$

where μ_{jt} is the mean of productivity for group j members in period t and a_{ijt} is a person specific deviation around the mean. The mean wage for cell j in period 0 is

$$w_{j0} = E(\mu_{j0} + a_{ij0}) = \mu_0. \tag{9.18}$$

The one dimensional skill index assumption amounts to the assumption that relative productivity differentials are "stretched" by a function $f(\cdot)$ between a base period 0 and period t. In a multidimensional model, productivity in t might directly rely on j as well as on the individual components that make up θ.[40] In the one skill case, the expected value of the wage associated with a person with skill level θ would be θ in period 0 and $f_t(\theta)$ in period t. The group mean of the wage in period t is $w_{jt} = \mathrm{E}(f_t(\theta_{ijt}))$.

If the distribution of θ_{ijt} is constant across time, then

$$w_{jt} = E(f_t(\mu_{j0} + a_{ij0})) \approx f_t(\mu_{j0}) + r_{jt}, \tag{9.19}$$

where the remainder term r_{jt} is

$$r_{jt} \approx (1/2)\mathrm{var}(a_{ij0})f''_t(\mu_{j0}),$$

The remainder term is approximately constant across jt cells if the within cell variance of unobserved ability is constant and if f is close to quadratic. (r_{jt} is 0 if f is linear.) Since the mean of the wage w_{j0} equals μ_{j0}, Eq. (9.19) implies

[40] Note that Eq. (9.16) is a special case of Eq. (9.15) if the j groups are defined by values of $\{D_i, x_{it}\}$.

$$w_{jt} = f_t(w_{j0}) + r_{jt}. \tag{9.20}$$

The key idea is that one may examine the one dimensional skill index model by looking for an approximation to the mapping between average cell wages across periods.[41]

To illustrate, if f_t is quadratic, CLem estimate the model

$$w_{jt} = a + bw_{j0} + cw_{j0}^2. \tag{9.21}$$

These models are based on CPS data and take account of the effects of sampling error in the sample estimates of w_{j0} and w_{j0}^2. For example, for white men when the base year is 1973/1974 and t is 1979, they obtain

$$w_{jt} = 0.521 + 0.893w_{j0} + 0.029w_{j0}^2.$$

One may test the single-index model by adding characteristics of the cells such as age or education to the regression. For instance, CLem find that education enters the wage models for 1973/1974–1979 negatively. Education enters the models for 1979–1989 positively in the case of men and negatively in the case of women. These results are consistent with other evidence that, at least for men, the education premium rose less rapidly than the return to other skills in the 1970s and more rapidly in the 1980s. There is a sizeable positive quadratic term in the 1980s for men, but the linear specification does quite well for women.

The key issue of interest here is whether changes in race and gender gaps in the 1970s and 1980s were caused by changes in the overall wage structure or by other factors. Let w_{jt} be the average wage of cell j in year t, let w_{jt}^p be the predicted wage based on the single index model for white men, let π_{jt} be the share of employment in cell j in year t, and let $\overline{w}_t$ be the overall average wage for black men. One may analyze this question using the identity

$$\bar{w}_{89} - \bar{w}_{79} = \sum_j \pi_{j79}(w_{j89}^p - \bar{w}_{j79}) + \sum_j \pi_{j79}(\bar{w}_{j89} - w_{j89}^p) + \sum_j (\pi_{j89} - \pi_{j79})\bar{w}_{j89}. \tag{9.22}$$

The first term is the wage growth for the group implied by the quadratic single-index model for whites. In the case of males, this term predicts that the race gap should have grown 5.3%, suggesting that the increase in the return to skill has increased the gap. This result is consistent with JMP's finding that changes in the price on unobserved skills have reduced wage growth for blacks relative to whites. This is partially offset by small declines in the gap in the second and third terms, respectively, which are the unpredicted within cell change and effect of the change in the cell distribution.

In contrast, rising wage inequality is estimated to have increased the race gap for women by only 2%. The reason for this difference is that the wage distributions of black women and white women in 1979 were closer than for black and white men. The second term indicates that black women's wages experienced a further 1.8% unpredicted decline, while

[41] Under a more restrictive set of assumptions about the error distributions, Card and Lemieux derive similar models relating the quantiles of the distribution across time periods as well as the mean. We do not pursue this here because of space considerations.

the third term indicates that changes in the relative distribution of black women across age and education cells somewhat raised their relative wages.

CLem also investigate changes among specific education and age groups. These results indicate that older black men and women experienced wage gains relative to equally productive whites of 8–10%, while younger black men and women (particularly those with more education) suffered substantial wage losses relative to whites. College educated black women do substantially worse than comparable whites.

In summary, both JMP and Card and Lemieux (1996) find that changes in skill prices had a strong negative effect on the wages of blacks relative to whites in recent decades. Both studies suggest that movements in the race gap are linked to some degree to changes in the return to education, a connection that JMP interpret as a race gap in the quality of education for a given number of years of education.[42]

9.2. Accounting for trends in the black/white wage differential

The previous section summarizes the literature on how the black/white wage differential is affected by the widening wage inequality of the 1980s. This section focuses on other factors that appear to have affected the trend in the race wage gap for men.

9.2.1. The role of industry shifts, regional shifts, and other factors

Bound and Freeman (1992) explore the role of industry and regional shifts in demand as well as other factors in studying the relative labor market trends for black and white men with less than 10 years of experience.[43] Their consideration of many factors stands in contrast to the highly parsimonious analyses discussed above. For their younger age group, they find that the gap widened by 0.57% per year from 1973/1974 to 1989, but this obscures a decline of 1.55% per year for college graduates.

To measure the contribution of various factors influencing the trend in the race differential in earnings, they start by estimating a standard regression model of the form

$$\ln(w_{it}) = A_t + b_t D_i + c_t X_{it}, \tag{9.23}$$

[42] Grogger (1996) uses the National Longitudinal Survey of the High School Class of 1972 and High School and Beyond to show that differences in measurable school inputs are small for blacks and whites by the 1970s. He also finds these differences and differences in unobserved characteristics that can be controlled for with high school fixed effects have little relationship to the race gap in outcomes. He concludes that trends in school quality explain little of the convergence in black/white earnings during the 1970s or the widening in the 1980s. Although he contrasts his finding to the indirect inference of JMP, there is no necessary contradiction, since the latter study emphasizes the changing consequences of a constant race gap in unobserved skills when skill prices rise. Grogger's evidence is counter to Smith and Welch's (1989) speculation that the relative quality of education for black labor force entrants declined in the 1980s. The rise in test scores of blacks relative to whites cited by Bound and Freeman (1992) also provides evidence consistent with Grogger.

[43] Bound and Freeman are unusually thorough in discussing a number of data issues that potentially could affect comparability across groups and over time in the many studies that use the CPS. They investigate the effects of using alternative wage definitions and different data sources (the May CPS versus the outgoing rotation group files.) They also explore the impact of techniques used by the Census to impute earnings when data is missing, of undercounts among certain populations, and of top coding procedures.

where D_i is 1 for blacks and 0 otherwise and X is a vector containing measures of experience and education. They then regress the race gap estimates b_t on a time trend. By examining how the coefficient on the time trend in this second stage regression changes as dummy variables for region, industry, occupation, union status, and the minimum wage are added to Eq. (9.23), they can identify the role of each of these factors in the trend. (The results were not very sensitive to the order in which the various factors were introduced into the wage model, although unionization matters more if it is put in before industry.)

Decomposing the 0.57 annual increase in the black/white wage gap between 1973 and 1989, Bound and Freeman estimate they can explain about 62%, with 0.08 due to a shift in metropolitan location,[44] 0.06 due to industry shifts, 0.11 due to occupational shifts, 0.03 due to changes in unionization, and 0.10 due to changes in the minimum wage. Their results for Midwestern workers who are high school graduates or less are particularly striking. For this group the wage gap widened by 1.42% per year. Of this 0.19 was due to changes in metropolitan location and 0.46 was due to industry shifts, particularly the drastic decline in durable manufacturing.[45]

The authors examine the role of a number of other factors in explaining the relative trend in employment and earnings. Addressing the argument that unmeasured skills among blacks may have deteriorated, they point out that standardized test scores have risen for blacks relative to whites. This is correct, but as JMP and CLem's analyses make clear, an increase in the "price" of these skills could increase the earnings gap even as the skill gap narrows. Bound and Freeman provide evidence that changes in participation in the military had little effect. They note that most of the changes in family composition (the rise in single parenting) occurred among later cohorts than the ones they are studying. They note that differences in drug and alcohol use are unlikely to explain these changes; reports of drug and alcohol use do not differ much by race, drug use fell in the 1980s, and serious drug users are missing from the CPS. While the direct effects of marriage on labor market outcomes for men is controversial,[46] adding marital status has little effect on the estimated time trend, although the earnings erosion is larger for married men than unmarried men. As we discuss below, Bound and Freeman find that criminal involvement had little impact on the wage gap even though it is important in the relative decline in employment rates of black high school dropouts. Their conclusion is, "There is too much diversity in the black economic experience for a single-factor story of change to stand up under scrutiny".

Finally, Bound and Freeman investigate the fact that young black college graduates did much worse than whites. They note that if affirmative action in the 1970s lifted the earnings of blacks relative to comparably skilled whites, then any weakening of affirmative

[44] Bound and Holzer (1996) use data from 132 MSAs from the 1980 and 1990 decennial censuses to show that the lower propensity of the less educated and of blacks within education groups to migrate is part of the reason why they were more adversely affected by negative demand shifts in some regions in the 1980s.

[45] Bound and Freeman estimate that the fraction of black young men with a high school education or less who are employed in this industry fell from more than 40% in the mid 1970s to 12% in 1989. The comparable drop for whites was 10%.

[46] See Korenman and Neumark (1992) and Neumark and Korenman (1994) for evidence and a discussion of the econometric issues.

action in the 1980s coupled with an increase in the price on unobserved skill differentials and an increase in the supply of young black college graduates would provide a negative "double whammy" on relative black/white wages.

9.2.2. The effects of selectivity in employment

We have focused most of this paper on wage determination, partly because of space constraints and partly because of the fact that much of the change in female labor force participation is due to changes in labor supply. However, there are important trends in the race differential in employment that have received attention in a number of studies, including Welch (1990), Bound and Freeman (1992), and Juhn (1992, 1997). These require some discussion. We begin by documenting the changes and then considering possible causes.

Juhn (1992) uses CPS data to estimate the fraction of males who were employed during the calendar year as well as the fraction who were employed during the survey week. She reports that the race difference in annual employment rates was 2% in 1969 but grew to 7% in 1979 and 8.5% in 1989. The race gap in weekly employment grew from 7% in 1969 to 12% in 1979 to 13% in 1989. Bound and Freeman (1992) use logit models that control for potential experience and education to estimate the employment rates of black men and white men who have 12 years of schooling and five years of experience. They find that the employment rate for blacks was 0.84 in 1973 and 0.74 in 1989, while the corresponding values for whites are 0.93 and 0.89. Thus they estimate that the employment gap increased from 0.09 in 1973 to 0.15 in 1989. Interestingly, Bound and Freeman and the data in Juhn (1992, 1997) show that employment outcomes of less educated blacks fell relative to whites even while there was improvement in the relative earnings of blacks. During the 1970s the annual employment differential grew by 10 points for high school dropouts. It grew by an additional four points during the 1980s. At the same time, there was only a small change in the relative employment rates of black college graduates while the relative earnings of black college graduates fell substantially.[47] Below we discuss evidence from Juhn (1997) showing that the decline in employment was concentrated among low-wage blacks and that the selective exit from the labor force of these workers led to an understatement of the relative decline in wages of less skilled blacks.

A change in employment rates could be caused by an increase in the entry rate into non-employment or a decline in the exit rate. Using a hazard model methodology, Juhn (1992) shows that the entry rate into non-employment for blacks fell by 19 points from 1967 to 1987. However, the exit rate fell by 70 points. These results indicate that the relative decline in employment among blacks is primarily due to a decline in their exit rate from non-employment. She suggests this may be due to an increase in the fraction of black men who are disconnected from the labor market.

[47] The drop in the employment to population ratio was −0.35 points per year overall and −0.95 for high school dropouts.

What are the causes of these changes? Juhn (1992) and a number of previous papers demonstrate a positive relationship between wage rates and the employment rates of men. Given that the decline in employment rates are much larger for less skilled persons, this raises the possibility that the decline in employment rates is a labor supply response to shifts in the wage distribution. Juhn addresses this question using the equation

$$P_t - P_{t'} = \int p_t(w) f_t(w) \mathrm{d}w - \int p_{t'}(w) f_{t'}(w) \mathrm{d}w$$

$$= \int p_{t'}(w)[f_t(w) - f_{t'}(w)]\mathrm{d}w + \int [p_t(w) - p_{t'}(w)] f_t(w) \mathrm{d}w, \tag{9.24}$$

where P_t is the aggregate participation rate in time t, $p_t(w)$ is the participation probability of an individual at time t with wage w, $f_t(\cdot)$ is the density of wages in t, and t' is the base period. The first term is the effect of the change in the wage distribution between t and t' evaluated using the fixed participation function from year t'. This is the change in aggregate participation that is due to the shift in the wage distribution. The second term is the residual change due to the shift in the participation function evaluated using the wage distribution in t. Juhn's Table 6 shows that the decline in weekly participation rates from 1970/1972 to 1985/1987 closely tracks relative wage changes. For example, the decline in participation rates for whites in the first decile of the wage distribution was 0.075 while the corresponding wage change was −0.274. In the top two quintiles of the wage distribution, participation was essentially unchanged, and wages increased by 0.027. The results for blacks are qualitatively similar, in that the largest declines occur for men in the lowest wage percentiles. However, the employment declines in the first and second decile of the wage distribution were much larger for blacks than whites. Consequently, the share of the employment decline predicted by the drop in wages for low-wage men is only about one third of the total decline.

Juhn (1992) investigates the issue further by examining the contribution to the employment gap of differences in wage distributions and differences in participation given wages. The decompositions are based on the identity

$$P_{wt} - P_{bt} = [P_{wt}(W_{wt}) - P_{wt}(W_{bt})] + [P_{wt}(W_{bt}) - P_{bt}(W_{bt})], \tag{9.25}$$

where $P_{gt}(w_{ht})$ is the predicted aggregate participation rate of group g using the wage distribution of group h. The first term on the right is the participation differential due to the black/white wage differences evaluated at the white participation function. The second term measures the difference in participation rates due to differences in participation behavior evaluated at the wages for blacks. Controlling for wage differences reduces the 10.9% gap in weekly participation for the years 1985/1987 to 6.7 percentage points. The results imply that about half of the decline in the black employment rate since the early 1970s can be explained by the decline in wage rates, particularly of the less skilled, and half by the decline in the participation rate conditional on wages. The predicted race gap in weekly participation rates rises from 0.028 to 0.042 between 1967/1969 and 1985/

1987 while the actual difference rises from 0.063 to 0.109. The growth in the residual difference occurred mainly during the 1970s.

Bound and Freeman (1992) focus on employment rates of black and white workers with less than 10 years of potential experience. As we noted earlier, they consider a number of standard supply and demand factors, including shifts in the industry and regional composition of blacks and whites in different education groups. They conclude that relative demand and supply factors are an important part of the employment story for both blacks and whites but do not explain the much steeper decline in weekly employment rates for black high school dropouts relative to white dropouts.

Bound and Freeman consider and dismiss a number of possible explanations for the high school dropout results, including changes in drug use and the effects of changes in family structure or school quality on the human capital of young blacks and whites. Their analysis of the role of crime suggests that it was a major factor in the decline of the participation rates of black men with less than a high school education. They use data from NLSY to estimate the effect of past imprisonment and probation status on employment. They show that the employment participation rate in the survey week is 0.21 lower (relative to a mean of 0.61) for those incarcerated in prior years using 1983 data, and 0.17 lower in 1988. Using this relationship and data from various sources on the fraction of black male high school dropouts between the ages of 18 and 29 who were incarcerated, they conclude that 0.05 of the 0.07 decline in the employment/participation rate of black dropouts between 1979 and 1989 is due to crime.[48]

The results concerning crime are striking, but it is important to point out that the effect of crime is largest in the 1980s, when there was an increase in imprisonment of young blacks. We noted above that most of the increase in the employment gap that is not explained by wage movements or changes in the participation rate given wages occurred during the 1970s. Consequently, Bound and Freeman's analysis of the role of crime does not offer an explanation for Juhn's finding. On the other hand, Juhn's result is for all men with 1–30 years of experience rather than for dropouts with less than 10 years of experience. It would be the interesting to repeat Juhn's analysis after disaggregating by experience level and wage or education class. Her results for all experience levels do show a much larger decline in the employment rate of low-wage blacks between 1970/1972 and 1985/1987 that is not explained by changes in the wage distribution. This is potentially consistent with Freeman and Bound's analysis.

Juhn (1992) considers a number of additional explanations for different trends in the employment rates of blacks and whites with similar market wages, including changes induced by increases in the relative income of other household members, and by changes in government transfers, particularly Social Security benefits. She finds some support for the hypothesis that government transfers, particularly disability benefits, contributed to the decline in the employment rates of low-wage workers from the late 1960s to the mid-1970s, although not in later periods.

[48] They note that crime has also increased sharply for white dropouts, but has had little effect on the employment rate for this group because it starts from a low base.

In summary, there has been a substantial decline in the employment rate of blacks relative to whites, particularly less educated blacks. Much of this decline is associated with a reduction in the transition rate into employment. Both a labor supply response to a relative decline in wages and an unexplained shift in the employment rates at a given wage for less skilled blacks relative to whites have occurred. Criminal involvement may have taken a particularly large toll on young black high school dropouts during the 1980s.

The sharp relative decline in employment rates for blacks, especially among lower wage workers raises the issue of whether the change in earnings of blacks relative to whites has been understated due to changes in the selectivity of who is employed, an issue raised earlier by Butler and Heckman (1977). To see the potential problem, let W_{wt} denote the average wage of workers in a particular population, let W_{nwt} equal the average potential wage of non-workers, let W^*_t equal the average wage or potential wage of the population, including workers and non-workers, and let N_t denote the fraction of the population that does not work.

Then

$$W^*_t = (1 - N_t)W_{wt} + N_t W_{nwt}, \tag{9.26}$$

Most studies use W_{wt} to summarize the wages of a population group because W^*_t is unobserved. The correction factor C_t is $W_{wt} - W^*_t$ or

$$C_t = N_t(W_{wt} - W_{nwt}) = N_t GAP_t, \tag{9.27}$$

where GAP_t is difference in the average offers to workers and non-workers. The change over time in C_t is

$$C_t - C_{t-1} = GAP_t(N_t - N_{t-1}) + N_{t-1}(GAP_t - GAP_{t-1}), \tag{9.28}$$

so it is affected by changes in GAP_t as well changes in the fraction of the population who are working. A number of approaches have been used to estimate C_t. For example, Brown (1984) assumes that non-workers earn less than the median and Welch (1990) estimates non-worker wages based on the wages of entrants and exiters from the matched March CPS, assuming that those observed to make labor force transitions are most like non-workers. Juhn (1997) follows Juhn (1992) and Juhn et al. (1991a) and sets W_{wnt} for persons in a given year, race, education, and potential experience category equal to the average wage of part year workers (14–26 weeks) who are in the same category.[49]

Juhn (1997) shows that between 1969 and 1989 the wage differential between part year and full year workers increased by a large amount for both blacks and whites. Taking non-workers into account by assigning them the wages of part year workers reduces the estimated increase in wages for all blacks over the period 1969–1989 from 8.5% to 1.9%.

[49] Because of sampling error in wages by education group Juhn assigns wages to those who work only 1–13 weeks as well as non-workers. She documents that observed characteristics of non-workers and those who work only 1–13 weeks are worse than those who work 14–26 weeks or more on dimensions such as years of schooling and fraction married. Persons working only 1–13 weeks have lower wages than those working 14–26 weeks or working full-time. Her corrections are likely to understate the effects of selection bias.

Over the 1969–1989 period, the black/white wage differential declined by about 12 percentage points among those employed in a typical week. However, when non-workers are taken into account the gap fell by only 8 percentage points, indicating that one-third of the decline is due to selection. Most of the bias in growth rates from selection occurred during the 1969–1979 period rather than between 1979 and 1989.

The wage correction $(C_t - C_{t-1})$ for non-workers is largest for high school dropouts, who experienced the largest declines in employment. Between 1979 and 1989 the black/white wage gap for high school dropouts fell by 8.6 percentage points for workers in a typical week but by only 5.3 points for the entire population, suggesting that convergence among high school dropouts is overstated by 3.3 percentage points. The race gap for high school and college graduates *increases* during the 1980s, and this is not affected by the selectivity correction.[50]

In related research, Darity and Myers (1994) note that among young potential workers negative selection into employment can arise if the most qualified workers are most likely to pursue college. Since a higher fraction of whites select college, these effects might be larger for whites, leading to an understatement of the race gap in the offer distribution. Race differences in participation in the military and self employment will also affect selection. Blau and Beller (1992) find that during the 1980s the sample of employed white workers became more selective relative to blacks, while selectivity had little effect on the race gap for younger workers. It would be interesting to redo this work by education level and to redo Juhn's analysis to distinguish between age as well as education.

The bottom line is that one must pay careful attention to employment as well as wages when studying racial differences in the labor market success of white and black males. Comparisons of average or median wages of persons with jobs do not provide an accurate picture of changes in the offer distributions faced by black and by white workers.

9.3. Accounting for trends in the male/female wage differential

The aggregate male/female wage differential was relatively stable between the post-World War II era and the late 1970s. Since then there has been a major decline in the gender wage gap. For example, Blau and Kahn (1997) find that the log male/female wage differential declined from 0.47 to 0.33 between 1979 and 1988. Our own tabulations from CPS data show a decline from 0.44 in 1980 to 0.29 in 1995. This section summarizes recent research relating to male and female wage differentials. Much of this research is organized around

[50] For all education groups combined, the race differential in the rise in the wage gap between workers and non-workers $(N_{t-1}[GAP_t - GAP_{t-1}])$ and in the decline in employment rates $(GAP_t(N_t - N_{t-1}))$ contribute about equally to the selectivity correction factor of 3.4 percentage points in the 1970s, while the race differential in the rise in the wage gap is the whole story in the 1980s. Juhn uses methods similar to those of Juhn et al. (1991a) to show that much of the increase in the wage differential between white weekly participants and non-participants and black weekly participants and non-participants was due to composition effects rather than a change in skill prices for both whites and for blacks.

models similar to Eqs. (2.3) and (2.4). Many papers measure human capital and labor market preparation differences between men and women, and explore how much this explains of the wage differential and how it has changed over time. A second set of papers relate male/female wage differences to aggregate economy-wide changes in wage inequality and in industry composition using the methods discussed in Section 9.1.

9.3.1. The role of human capital variables

Education and experience are perhaps the most important human capital characteristics in the determination of wages. As Table 2 demonstrates, women continue to have less attractive human capital characteristics than men, but this differential has been declining over time. Relative changes in gender differences in experience and education play a key role in discussions of gender differences in wages. A major explanation for the stability in the average male/female wage differential through most of the 1970s is that relative shifts in the wage distribution in favor of women were offset by the fact that new groups of women entering the labor market typically had lower education or experience than those already in the labor market (Smith and Ward, 1989; Goldin, 1990). Hence, the experience and educational gains made by women over this time period were systematically "diluted" by new entrants.[51] More recently, women's gains in experience and education are major factors behind increases in relative female/male wages. Using regressions of wages on education and experience, Blau and Kahn (1997) estimate that gains in these variables reduced the log wage gap by 0.076. Similarly, O'Neill and Polachek (1993) find that one-third to one-half of the narrowing in the gender wage gap between the mid 1970s and the late 1980s is due to relative changes in schooling and work experience. (Ashraf, 1996) also discusses these issues.)

Education levels are a key determinant of wage opportunities. Among younger workers, there are no longer any differences in average years of education between men and women, although older women continue to have lower average education (Blau, 1997). As male/female education levels have converged, this has narrowed the wage gap, as confirmed in Blau and Kahn (1997) and O'Neill and Polachek (1993). Gender differences in the distribution of college majors have also declined sharply, as discussed in Section 5. On the other hand, changes in the returns to education have worked to widen the wage gap, as discussed below.

Changes in experience have been more important than changes in education in closing the male/female wage gap. Women are more likely to have worked fewer years than men and, when they are working, more likely to have been part-time rather than full-time workers. As women have increased their labor force participation over time, however, women's accumulated labor force experience has also increased. Blau and Kahn (1997) indicate that changes in accumulated experience have been far larger and explain a much larger share of the increase in female/male wages than do changes in education.[52] Missing

[51] Blau and Beller (1988) suggest that the wage differential does begin to narrow slightly over the 1970s, however.

from the current literature is an analysis of any impact of selectivity bias among who participates in the labor market on women's relative wage trends. This is particularly surprising, given an extensive older literature on the selectivity effects of female labor force participation on their wages.

Finally, as we discuss below, there is a substantial literature suggesting that women receive less on-the-job training than comparable men. At least some studies have linked women's lower training levels to their lower wages. Olsen and Sexton (1996) provide evidence that the training differences have lessened between the 1970s and the 1980s, which may also be a partial explanation for the narrowing of the gender wage gap between these decades.

9.3.2. The role of aggregate economic changes

Even while women have been improving their relative skills in the labor market, certain aggregate labor market trends have been moving against them. In particular, changes in the returns to skill have favored more skilled workers and lowered the wages of less skilled workers. Since women on average are in less-skilled jobs, these shifts should have lowered the wages of women relative to men, just as they have widened the black/white wage gap. Research on this issue parallels our earlier discussion of the effects of labor market trends on the race gap. For this reason we will be brief and focus on the main empirical findings.

Blau and Kahn (1997) investigate the effects of wage changes on the male/female wage structure using Juhn et al.'s (1991a) approach. They conclude that these changes have clearly disadvantaged women, and would have lowered their relative wages all else equal. In their analysis, the male/female wage gap has declined because women have improved their average skill levels (particularly their experience levels) and because women's treatment in the labor market controlling for all other factors (i.e., their residual location relative to men) has improved. These changes were large enough to offset the wage losses that women would otherwise have experienced due to the widening wage inequality between more and less skilled jobs. According to their estimates, changes in the wage structure would have raised the male/female wage differential by 0.07 log points between 1979 and 1988 if nothing else had changed.

Consistent with Katz and Murphy (1992), Blau and Kahn find that among more educated workers, the returns to skill have risen more among men than women. In other words, women have not gained as much as men from the rising returns to skill. On the other hand, among less educated women, the returns to skill have declined less than

[52] Coleman and Pencavel (1993) and Blau (1997) provide extensive summaries of changes in women's labor supply over time. Women's labor force involvement has grown steadily over time, as Fig. 5 indicates. Labor force participation rates among adult women increased by 50% between 1970 and 1995. Between 1940 and 1980, more women began to work a standard 40 h week. On average, hours of work among women workers have also increased, although these increases are concentrated among more skilled workers. Blau and Kahn (1997) summarize the evidence from Polachek (1990) and O'Neill and Polachek (1993) documenting increased lifetime labor market participation for women. For example, O'Neill and Polachek estimate that between 1976 and 1987 increased labor market participation explains 26.7% of the decline in the gender gap in wages.

among less educated men. These changes suggest that it is increasingly important to differentiate labor market experience by skill level. The factors behind the falling wage gap for higher-skilled women are different than those behind the falling wage gap for less-skilled women.

Not all aggregate labor market changes have disadvantaged women. In particular, industry-level shifts have benefited women relative to men as blue-collar manufacturing jobs (where women are under represented) have declined and workers who have been displaced from these jobs have faced large pay cuts. These industry changes are correlated with the continuing decline in union representation, which has lowered men's wages more than women's because of the higher initial degree of unionization among male workers (Blau and Kahn, 1992; O'Neill and Polachek, 1993). Jacobson et al. (1993) note that when women are in manufacturing jobs and suffer displacement, their earnings losses are less than those of men (although their wages were lower as well) and they do not recover as quickly. Crossley et al. (1994) discuss contrasting effects in Canadian data.

The potential importance of shifts in industrial mix are underscored by Fields and Wolff (1995) who indicate that interindustry wage differentials among women are large and the pattern across industries is different for women than men. In the late 1980s, they estimate that up to one-fifth of the male/female wage differential can be explained by differences in the patterns in industry wage differentials. In a related paper, Gittleman and Howell (1995) explore job changes in the context of a primary/secondary model of the labor market.

A final economy-wide change which has affected male/female wage differentials is the overall decline in unionization. Even and Macpherson (1993) show that unionism has fallen more slowly among women workers than among men, because unionization fell most in occupations dominated by men. Between 1973 and 1988, they estimate that 14% of the decline in the gender wage gap is due to differential changes in the extent of unionism among men and women. Using a slightly different technique to look at the union/non-union effect on the gender differential and using Canadian data, Doiron and Riddell (1994) find generally similar results. Because wages in the union sector are so much more compressed, they note that male/female earnings gaps in the non-union sector explain a far larger share of the gender earnings gap than do male/female earnings gaps in the union sector.

Overall, the literature on trends in the gender wage gap have focused more on industry and occupational issues than has the literature on the race wage gap. Surprisingly, the impact of changing employment selectivity on wages among women has been less investigated in recent years than among races. The most sophisticated work in both literatures is recent research exploring the effects of the widening wage distribution and the rising returns to skill on gender and race wage differentials. These effects have been the primary force behind the widening in the black/white wage gap, and they have significantly slowed progress in the decline of the male/female wage gap.

9.4. The overlap between race and gender

During the 1960s and 1970s, black women experienced rapid changes in their earnings and job opportunities. Cunningham and Zalokar (1992) note that black women's occupational distribution changed dramatically in the post World War II era, from 71% working in domestic service or farm labor in 1940 to 7% in such jobs by 1980. They also note a major convergence in black and white women's wages over this time period.

Wage convergence among black and white women occurred until the early 1980s. Research investigating the causes of this convergence has emphasized geographical location. King (1995) notes that black women's migration from the south into higher-wage labor markets with a different set of job options contributed more to the occupational mobility of black women post World War II than did changes in education or experience. Cunningham and Zalokar (1992) note that the greater wage disadvantage facing black women in the south in 1940 had disappeared by 1980. Other researchers emphasize the role of anti-discrimination legislation. Fosu (1992) indicates that Title VII of the Equal Opportunity Act of 1964 improved black women's occupational mobility. Heckman and Payner (1989) show that the rise in black women's relative wages in South Carolina manufacturing occurred just after the enactment of Title VII. Leonard (1984) emphasizes the role of affirmative action requirements for Federal contractors in raising the relative employment of black women and men.

Since the 1980s, the black/white wage gap among women has grown somewhat (see Fig. 2). Blau and Beller (1992) discuss these trends, as does Blau (1997). Different forces have operated to keep black women's wages lower in recent years. McCrate and Leete (1994) note that the education gap and the experience gap between white women and black women has actually widened over the 1980s, while the gap in returns to experience and tenure has declined. The widening returns to skill over the 1980s have benefited white females more than black females, whose average skill levels remain lower and who are still in a lower-paying set of occupations. Both Anderson and Shapiro (1996) and Blau and Kahn (1997) discuss the effects of the changes in returns to skill on the black/white wage gap among females.

It has been disappointing to see the divergence in black/white female wages over the past 20 years, as well as the stagnation in black/white male wages. While the role of widening wage inequality and changes in the returns to skill have been investigated, there is still a need for further research in this area. Much of the literature on black/white wage gaps focuses on black and white men only. Exploring the impact of changes that vary between black men and women – such as differential changes in college attendance and completion rates – might be particularly fruitful.

10. Policy issues relating to race and gender in the labor market

While we have talked about the impact of market forces, of individual tastes, and of

discrimination on wage gaps, we have largely ignored the fact that many of these things can be affected by policy. Public policy influences everything from the educational choices made by individuals to the behavior of firms towards their workers. In fact, we discussed several models in Section 3 where the presence of affirmative action-type policies changed the investment levels of workers and the hiring and wage payment behavior of employers.

There are a very large number of policy issues one could potentially discuss that affect relative white/black and male/female labor market outcomes. Given our interest in the potential role of discrimination in the labor force, a key area is the impact of anti-discrimination policies on labor market outcomes among groups. The first part of this section summarizes research in this area. The second part of the section focuses on two policy issues of particular concern in discussions of the gender gap, namely, the impact of maternity leave legislation mandating employers to provide maternity leave and the role of comparable worth policies in the public sector. These are two policy areas where recent legislative changes have produced a growing body of research.

10.1. The impact of anti-discrimination policy

In this section we provide a brief discussion of the literature on the effects of civil rights policy on race and gender differentials. Our discussion is more a listing of the main results from some of the prominent studies than a detailed analysis, explication and critique of the methods that underlie them. We draw upon our own reading and Donohue and Heckman's (1991) review of the earlier literature, as well as more recent studies that examine the effects of these policies.[53] Blau and Kahn (1992) provide a summary of the evidence on the effects of civil rights policy on both race and gender differentials.

It may be helpful to start by reviewing the key labor market legislation. The Equal Pay Act of 1963 requires equal pay for "substantially equal" work among men and women but is silent on hiring, layoffs and promotion. Title VII of the Civil Rights Act of 1964 prohibited discrimination in wages and employment opportunities (wages, hiring, layoffs, and promotion) on the basis of race, gender, or national origin. It also established the Equal Employment Opportunity Commission (EEOC) to help enforce Title VII. In 1965, Executive Order 11246 banned discrimination against minorities in hiring and promotion by federal contractors; this order was extended to women in 1967. The Office of Contract Compliance was established to monitor compliance, and required contractors to develop "affirmative action" plans for the h;iring and promotion of minorities and women. The 1972 Equal Employment Opportunity Act authorized the EEOC to initiate lawsuits on behalf of workers.[54]

There is little doubt that the race gap in wages among employed workers narrowed substantially during between the 1960s and early 1970s. The question is why. Chay

[53] Much of the research in this area was conducted in the 1970s and early 1980s and is reviewed in Brown (1982) and Cain (1986). Chay (1995) provides references to many of the early studies.

[54] A number of states outside the South had fair employment laws pre-dating the Civil Rights Act.

(1998), Donohue and Heckman (1991), and Blau and Kahn (1992) review the evidence on a variety of factors that could explain the narrowing of the race gap in these years. Donahue and Heckman aggregate the estimated affects of competing explanations and treat the residual as the amount that could potentially be the result of civil rights policy. They discuss Card and Krueger's (1991) evidence that 5–20% of the post 1960 black gains were due to improved school quality. Card and Krueger argued that improvements in schooling quantity were not important, while Smith and Welch (1989) attribute 20–25% of the gain for blacks to improvement in school quantity. Donahue and Heckman conclude that selectivity (the lowest wage blacks dropping out of the labor market) accounts for 10–20% of the reduction in the gap. Migration from South to North is another explanation for a declining race gap in wages, but most of this occurred prior to 1964. Adding up the lower bound estimates and upper bound estimates of these factors leaves between 35 and 65% of the change in the gap unexplained.

It is difficult, however, to establish that the unexplained change is due to civil rights policy. Most studies of government policies use state level data to look for a relationship between labor market outcomes and the level of EEOC activity or the fraction of employers who are federal contractors. Such analyses may understate the effects of the policy because of spillovers to states with few federal contractors or low EEOC activity or because the decision to become a Federal contractor or the level of EEOC activity depend on race or gender differentials in wages.

While mindful of these limitations, the literature generally finds evidence that these laws made a difference. Leonard (1984) and Heckman and Payner (1989) provide evidence that Title VII lawsuits improved the employment and occupational status of blacks in the 1960s and 1970s. A careful study by Chay (1998) gives added support to this conclusion (see also Chay and Honore, 1998). Chay uses Social Security earnings histories matched to the 1973 and 1978 CPS to examine the effects of the Civil Rights Act of 1964 on the earnings histories of individual workers. He employs a model similar to Card and Lemieux (1994) to distinguish between the effects of changes in the price of unobserved skill differences and the effects of the law. He finds that after the law was enacted the earnings gap in the South narrowed 1.5–2.6% more per year for men born between 1920 and 1929 and by 2.8–3.4% more per year more for men born between 1930 and 1939 than before. There was little change for the cohort born between 1910 and 1919, and only the youngest cohort benefited outside the South. Similarly, Beller (1982) provides evidence that Title VII lead to a reduction in the gender gap in wages and in occupational segregation by sex between 1967 and 1974. The affirmative action activities of the Office of Federal Contract Compliance Program helped to raise the occupational status and employment rates of blacks (Leonard, 1984; Smith and Welch, 1984; Smith, 1993). Most of these gains came in the South, and did not appear to benefit white women.

Donohue and Heckman criticize studies that look directly at the effects of civil rights enforcement on the race gap, arguing that the surge in enforcement during the 1970s was spread across cases involving age discrimination, sex discrimination, and wrongful discharge cases rather than racial discrimination. They point out that the early enforcement

was concentrated on the South where most of the reduction in the black/white wage gap occurred and where initial race differences were largest. They also emphasize that enforcement of equal opportunity laws in the labor market was made in the context of civil rights pressure for open housing and desegregated schools. They provide an interesting argument that civil rights activity in the labor market and elsewhere helped to break down a discriminatory equilibrium in the South in which firms were afraid to use black workers because of social pressure. They argue that the various civil rights policies may have had a non-linear effect which would be hard to quantify using conventional econometric methods.

Overall, there is reasonably strong evidence that civil rights policies aided blacks and women in the 1960s and 1970s. The evidence is particularly convincing that civil rights policy lead to substantial gains for blacks, primarily in the South. However, the evidence does not support tight estimates about the magnitude of the effects. Further evidence on the impacts of these laws and the effectiveness of their specific enforcement mechanisms would be useful, particularly with regard to the effects of this legislation on the gender pay gap, which has been less studied than the race pay gap.

In addition, there are currently no studies of the impact of waning enforcement and the tightened legal standards for labor market discrimination cases that occurred in the 1980s. Reduced funding of affirmative action enforcement and the spread of attention to age discrimination, gender discrimination, and discrimination against people with disabilities might have led to a reversal of earlier effects. Certainly the 1980s saw a slowdown in the rate of convergence (or even a reversal among some groups) in the race gap in the 1980s, although it was exactly these years when the gender gap began to close most quickly.

10.2. The role of policies that particularly affect women in the labor market

10.2.1. The impact of maternity leave legislation

The passage of the 1993 Family and Medical Leave Act (FMLA) in the United States created a mandate that large employers must provide job-protected (but unpaid) leave of up to 12 weeks to employees to care for a newborn or ill family member. The implementation of this law provides an opportunity to study the effects before and after such a mandate. Other research has relied on the variation in maternity leave policies across countries or across states within the United States as a source of policy variation that can be used to investigate the effects of such laws. (For a summary of maternity leave laws in Europe and North American, see Ruhm and Teague (1997).)

Waldfogel (1996) shows that the use of job-protected maternity leaves increased post-FMLA. Comparing women affected by the law with women unaffected by it, she finds no negative effects on wages or employment following the passage of the legislation. In Waldfogel (1997) she notes that such a law could actually have positive wage effects if it allows women to maintain their tenure with a particular firm. Women who return to their original employers following maternity leave have higher pay, even after controlling for higher pre-birth wages among these women. Ruhm (1999) investigates the effect of

different cross-national parental leave policies, using an annual panel of country-specific data from 1969 to 1988. He finds some evidence that women in countries with more extensive leave receive somewhat lower relative wages, but also finds increases in total employment due to parental leave laws.

Actually measuring the impact of such legislation while controlling effectively for the attributes of workers and jobs is difficult. It is hard to find an appropriate control group (most research uses women without children) and it is hard to control for the heterogeneity between women in jobs which provide leave and women in jobs that do not. (Klerman and Leibowitz (1994) note that women with leave prior to the passage of the FMLA were workers with higher wages and more training.) Nonetheless the existing research suggests that the negative impacts of family leave legislation are not large and there may well be positive effects on both employment and wages for some group of women. In contrast to this research, Gruber (1994) shows that mandated maternity benefits in health care plans caused substantial cost shifting, as targeted groups of women received lower wages following the increase in health care maternity mandates. It would be interesting to compare the relative costs of each of these legislative provisions to employers to try and explain their differential effects.

10.2.2. The impact of comparable worth legislation

The differential in pay between female-dominated and male-dominated jobs has created a concern about the "undervaluation" of women's occupations. Comparable worth policies are a way to address any such problem, by doing a job evaluation of each job and setting pay so that jobs with comparable skill requirements have comparable wage levels. It is primarily the public sector that has shown an interest in comparable worth, with 20 states and a host of municipalities implementing comparable worth evaluations and pay restructuring over the past 15 years. Sorenson (1994) provides a review of these efforts.

The debate over the advantages and disadvantages of comparable worth policies has been intense, with strongly expressed opinions on all sides. A variety of books and edited volumes have tried to provide summaries of this literature (among the most recent are Hill and Killingsworth, 1989; Michael et al., 1989; Killingsworth, 1990; Sorenson, 1994). The earlier research literature in this area involved simulations of the predicted effects of comparable worth. For instance, Johnson and Solon (1986) suggest that an economy-wide implementation of comparable worth would significantly reduce the male/female wage gap, but raise doubts about the value of implementing this policy only within certain industries since so much of the gender wage gap is due to disparities in pay across industries and firms. Ehrenberg and Smith (1987) indicate that the employment decline associated with comparable worth might be small. Sorenson (1990) argues that comparable worth can have a significant effect on wages, even when implemented only within industries.

More recent research has studied the direct effects of the implementation of comparable worth in specific locations. Almost all studies agree that comparable worth policies raise women's wages relative to men's. Orazem and Mattila (1990) indicate that the comparable

worth plan implemented by the state of Iowa in state-level jobs resulted in wage gains among lower wage and lower skilled workers (disproportionately women) relative to higher wage workers. O'Neill et al. (1989) finds increases in female relative wages in the state of Washington following comparable worth legislation. Both Killingsworth (1990) and Sorenson (1994) analyze data from the state of Minnesota. Both find relative increases in the pay of female state employees relative to men as a result of this policy; using data after the complete implementation, Sorenson finds that female state employees received an average 15% increase in pay as a result of comparable worth.

The results are more mixed on employment effects. O'Neill et al. (1989) studies employment effects of comparable worth in the state of Washington, and Killingsworth (1990) investigates such effects in San Jose and the state of Minnesota. In all three locations, this research suggests negative employment effects in jobs where comparable worth wage increases were largest. Sorenson (1994) criticizes these studies methodologically and suggests that a re-analysis of the Minnesota data shows no significant disemployment effect. Kahn (1992) notes that employment in San Jose rose among women after the implementation of comparable worth, although Killingsworth claims that it would have risen faster in the absence of such a policy. We do not feel that the empirical research to date supports strong conclusions about the employment effects of comparable worth.

Both the comparable worth literature and the maternity leave literature indicate the important role of policy interventions in labor market outcomes. The public discussion of such policies typically focuses on their positive benefits, while economists are always concerned about unanticipated market-based effects, such as a decline in female wages following a mandated maternity leave benefit. While the evidence in the two policy areas reviewed here is mixed, it seems clear that those who forecast large negative effects were incorrect. In both cases, the policies did appear to have some direct benefits for the group of female workers at which they were targeted.

11. Conclusion and comments on a research agenda

This chapter has summarized some of the key research in economics that relates to differential outcomes by gender and race in the labor market. Such differentials have been remarkably persistent and have actually increased in the last 15 years among blacks versus whites (particularly among women). While gender differences have been narrowing over the past two decades, they are still large. In addition, a large share of gender differentials remain "unexplained" even after controlling for detailed measures of individual and job characteristics. Among blacks versus whites, little unexplained variation remains once a measure of skill is included in the regression.

While we have mentioned areas deserving further research throughout the text of this chapter, we take the opportunity here to highlight four areas where we think additional research would be particularly fruitful. First, expanding current models of labor market discrimination would deepen our understanding of how differential outcomes might

emerge and persist. After more than a decade with almost no new theoretical research on discrimination, within the past few years, there has been a set of very good new papers that have improved existing models by incorporating costly search and differential labor market information. Building further on these models would be useful, as would theoretical work that takes existing models and investigates the effects of various labor market policies. Particularly given the emerging debate about race-blind versus preferential policies, we need better models by which to evaluate the impact of different approaches.

Second, most of the existing literature on race and gender focuses on black and white males or on males versus females. While these are important groups, we could learn much more about comparative labor market differentials by widening the research focus to include other groups. The recent wage and employment experiences of black women (which have deteriorated) are understudied. In addition, there is a major need for more research in economics on Hispanics and on Asian Americans with regard to their labor market involvements. In addition, because each of these populations (like the white population) are extremely heterogeneous, research on the relative experiences of various ethnic subgroups (such as Mexican Americans) can also be useful. Greater cross-group research can provide comparative information that helps us better understand the nature of racial, ethnic and gender-based differences in the labor market.

Third, despite major public and private resources devoted to anti-discrimination policy, the research literature on the results of these efforts is sparse. While we recognize the difficulties of studying nationally enacted legislation, in many cases there are differences over time or across regions in the implementation of such legislation, or there is variation in related state-specific legislation. Such research may require the collection of administrative and outcome data at a sub-national level, which is always time-consuming and difficult, but it is likely to provide useful information, particularly in a world where existing anti-discrimination measures in education and in the labor market are at the center of a major public debate about the appropriate response to ongoing racial differentials.

Finally, we are struck by a few specific areas that appear ripe for more research. For instance, the impact of women's changing selectivity into the labor market on their wages has not been revisited in recent years. Much of the upsurge in female labor force participation in recent years has been among non-married women or among women with pre-school children. This suggests that our older estimates of selectivity could be outdated, and impacts may vary among different groups of women workers.

Moving from issues of gender to issues of race, the growing interest in research on the impact of widening wage inequality on changes in the returns to unobserved skills opens up a number of new research topics. Most importantly, we need to find more effective ways to measure school quality and its determinants, if we want to test the hypothesis that education quality differentials are a major cause of the black/white wage gap. Similarly, we need more data that provides good measures of worker skills, to further understand the result that controlling for AFQT test scores eliminates the race differential; it is possible that firm-specific studies are one way to provide this. It would also be useful to know more about how less-skilled workers can overcome some of the negative wage effects they have

recently been experiencing. Firm-specific training programs, new management techniques, and/or new workplace technologies may all be important ways by which currently low-wage workers can increase their productivity.

Overall, we are encouraged by the recent growth in both theoretical and empirical approaches to studying race and gender differentials in the labor force. After a period of hiatus, this is an area which is again generating interest among top scholars. We expect that further good research will be forthcoming in the years ahead.

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