Race and Gender in the Labor Market

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1. Introduction

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

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.

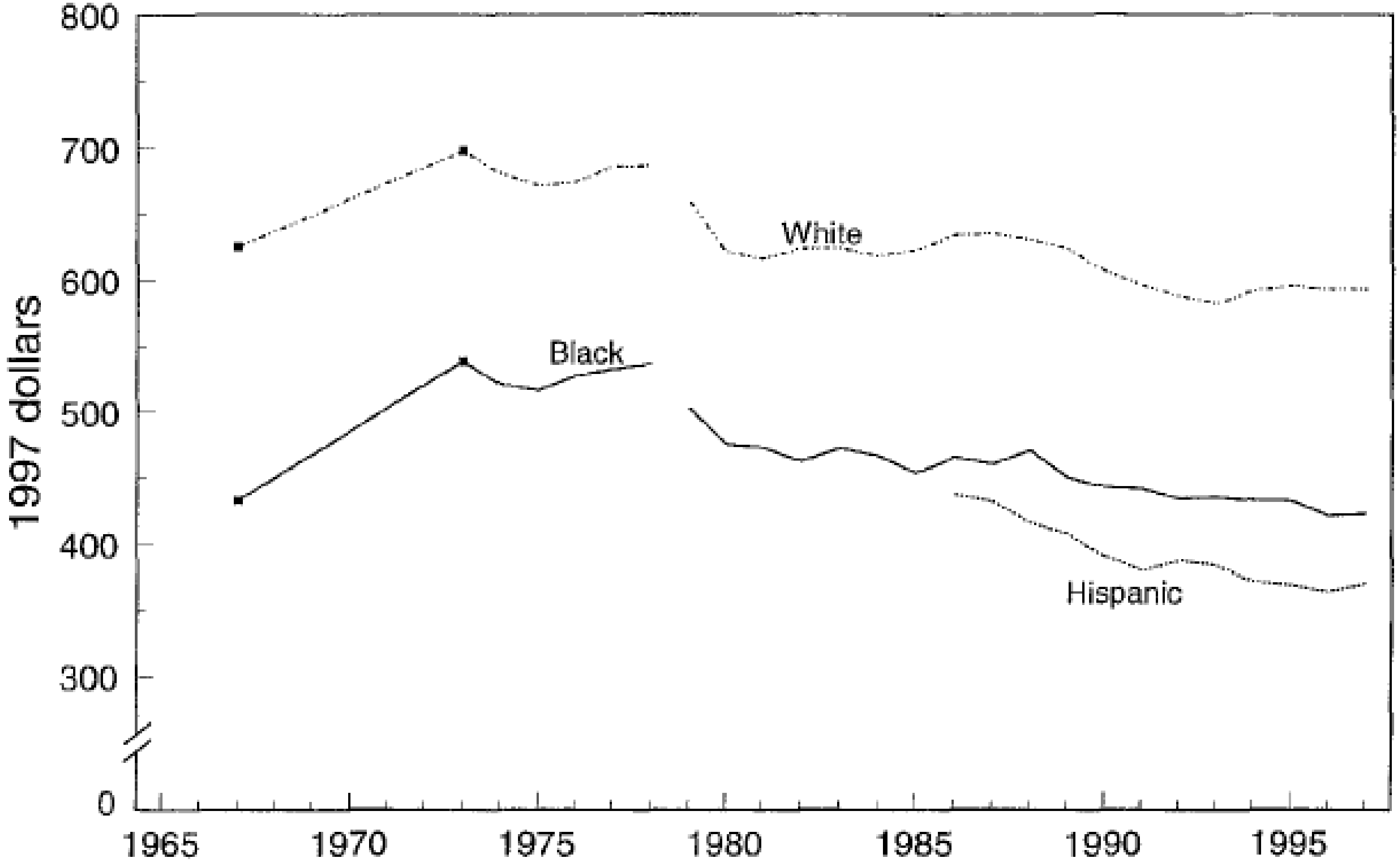

Fig. 1. Median weekly earnings of full-time male workers. Source: Bureau of Labor Statistics.

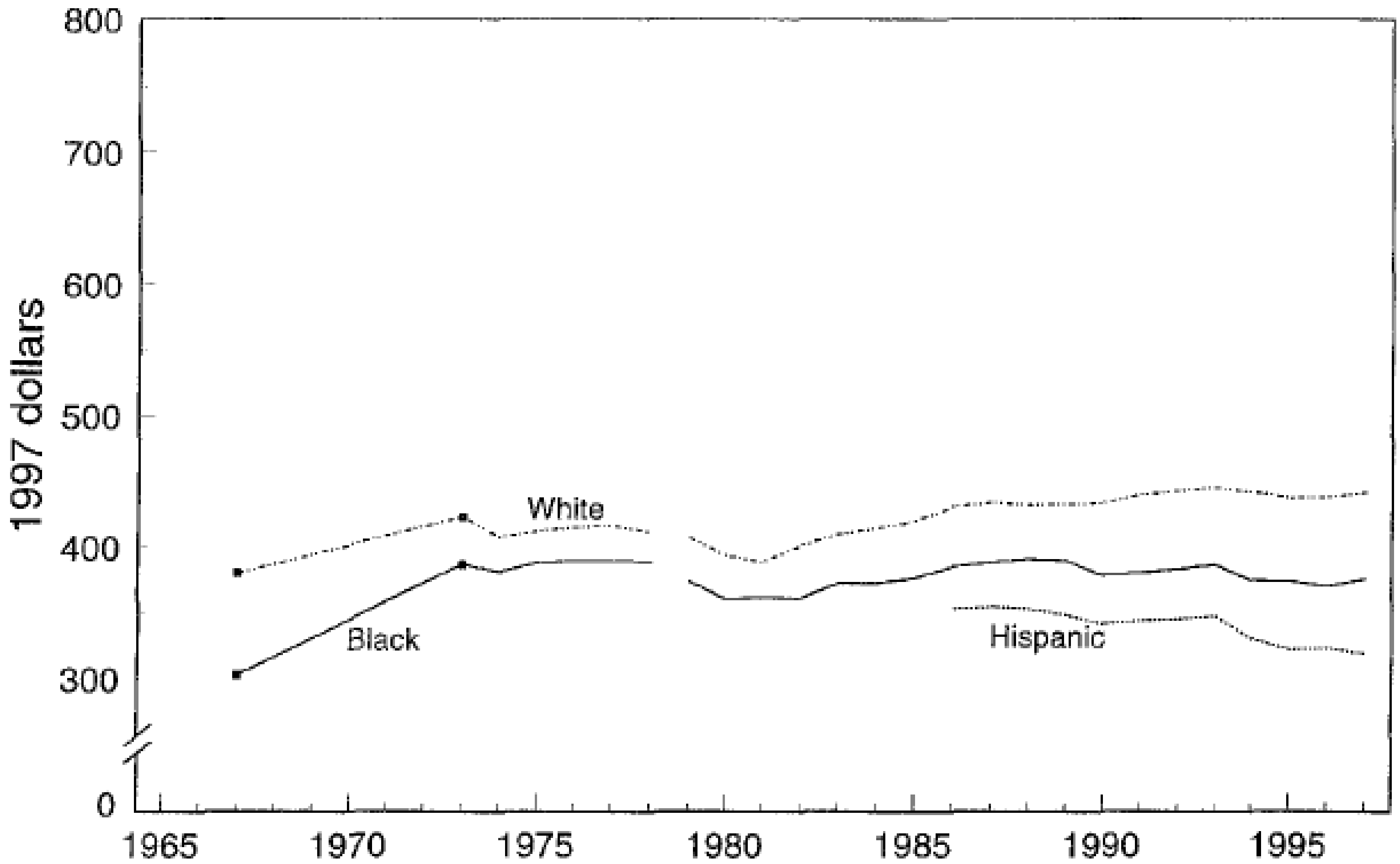

Fig. 2. Median weekly earnings of full-time female workers. Source: Bureau of Labor Statistics.

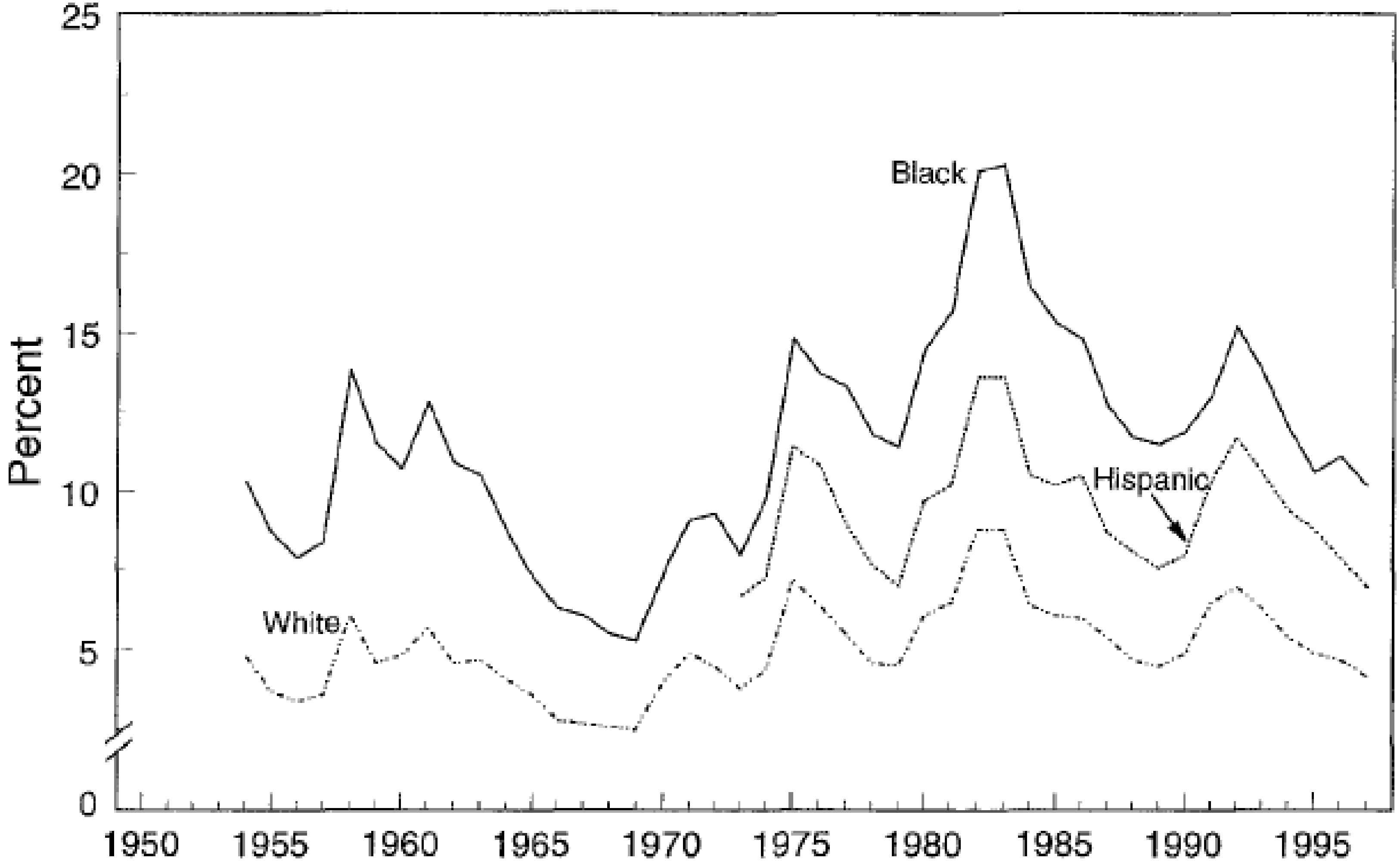

Fig. 3. Male unemployment rates (annual averages). Source: Bureau of Labor Statistics.

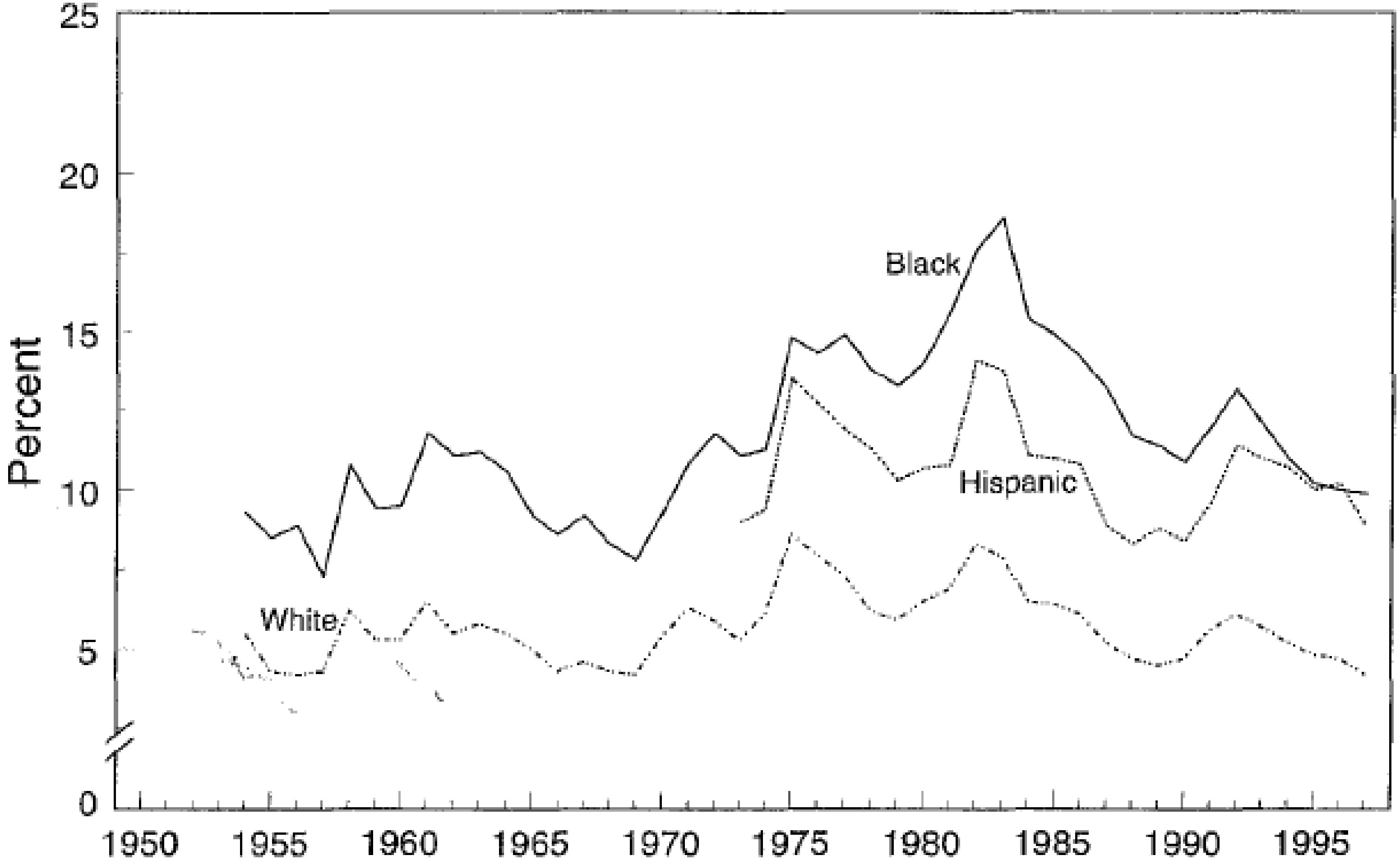

Fig. 4. Female unemployment rates (annual averages). Source: Bureau of Labor Statistics.

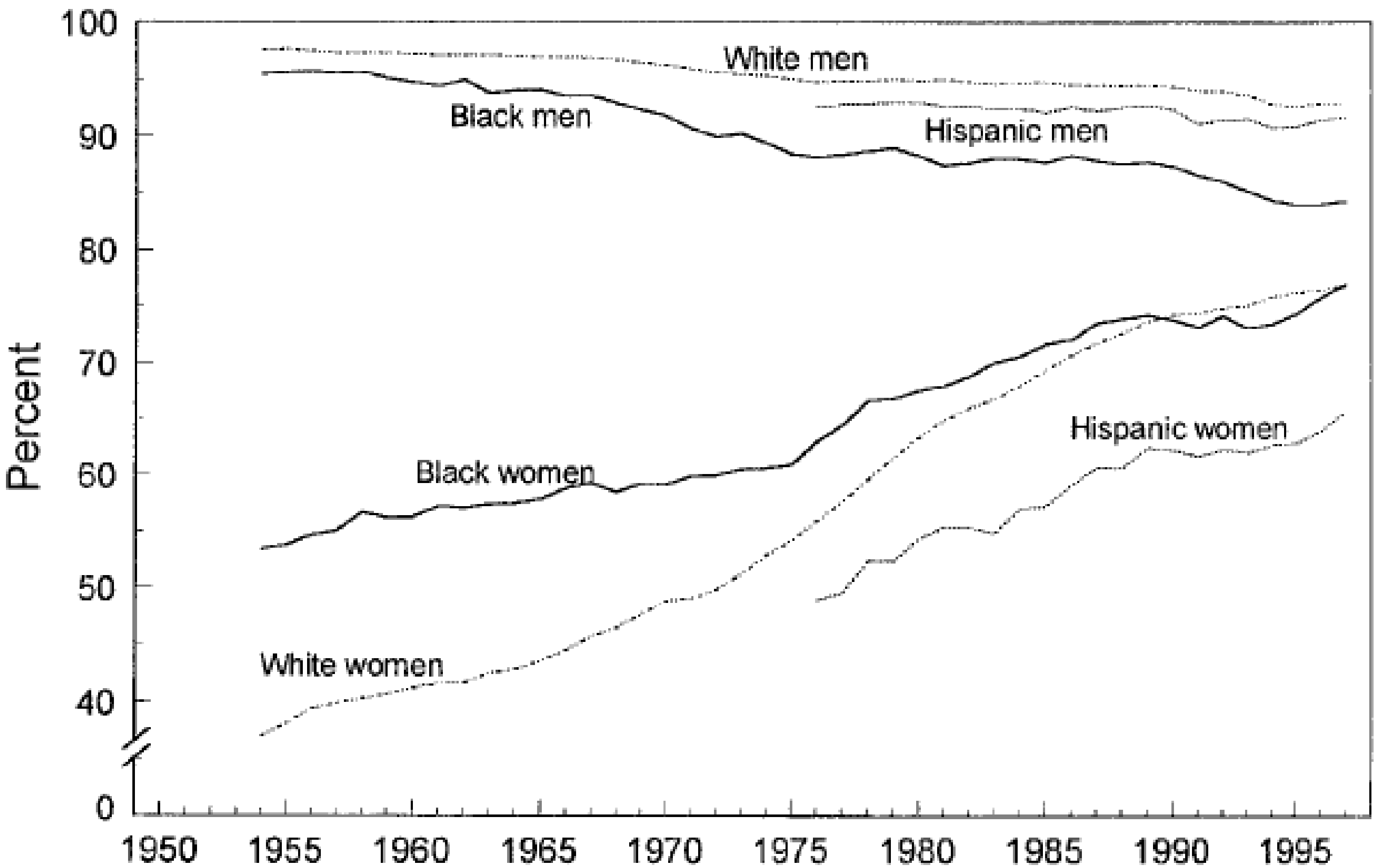

Fig. 5. Labor force participation rates, 25–54-year-olds. Source: Bureau of Labor Statistics.

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.

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

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

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

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

	All	White males	Black males	Hispanic males	White females	Black females	Hispanic females
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.

- 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

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

where W_{gt} and X_{gt} represent the mean wages and control characteristics for all individuals in group g in year t.

2.3. Estimating simple models of wage determination

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

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 (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.

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

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 (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.

2.4. Estimating simple models of labor force participation

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

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

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

	Blacks vs whites	Hispanics vs whites	Females vs males
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.

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

3.1. The impact of group differences in preferences and skills

3.2. An introduction to theories of discrimination

Following Cain (1986), let the wage Y equal

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

- 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 $\alpha < 0$

3.3 Taste-based discrimination

- To be specific,

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

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.

- Let $G(d;\bar{d})$ denote the CDF of the prejudice parameter d in the population of employers
- $\bar{d}$ summarizes the location of the distribution
- The fraction of firms that hire B workers is $G\left(\omega_a - \omega_b; \bar{d}\right)$
- 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

$$pF'(N_b) = \omega_b + d$$

for firms that hire B workers. The number of workers hired is decreasing in ω_a for firms

- 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.

- 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.

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

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

- 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.

- 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,

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

3.4. Discrimination and occupational exclusion

- 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.

- 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

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

- In this case

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

The *desired* relative labor supply of group g is given by

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

where θ_g is a taste parameter and $\psi'(\cdot) > 0$.

The *desired* relative labor supply of group g is given by

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

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:

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

- 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.

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

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

- 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.

- 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_j 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

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

and

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

- $s_1 = \lambda_1 L_{f1}/N_1$ 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
- σ is the elasticity of substitution between the two occupations

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

- A fraction find it profitable to train

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

The equilibrium priors of the firm solves the two equations

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

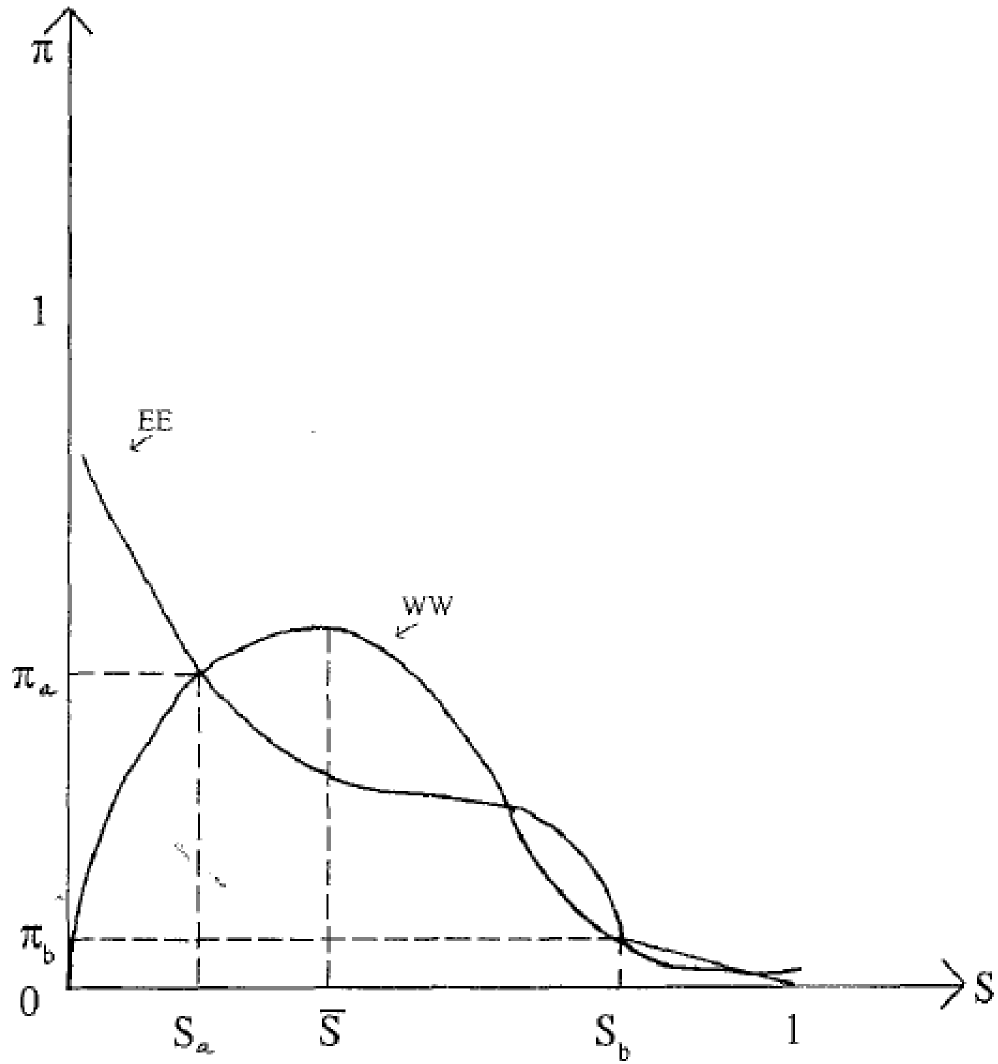

Fig. 6. An equilibrium with negative stereotypes against *B*s. Based on Coate and Loury (1993b, Fig. 2).

- 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.

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

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.

- 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

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

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

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

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

- 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

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

- 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.

- Consequently, workers choose skill to solve the first order condition

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

- 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

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

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

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

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

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

- 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.

- 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.
- The productivity indicator is determined by

- 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

4. Direct evidence on discrimination in the labor market

4.1. Audit studies and sex blind hiring

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

- They estimate models of the form

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

- *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
- *X* and *Z* are controls for person and audition characteristics

4.2. Discrimination in professional sports

4.3. Directly estimating marginal product or profitability

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

$$lnY = \gamma ln[(L + (\phi_F - 1)F)(1 + (\phi_B - 1)B/L)(1 + (\phi_G - 1)G/L)(f(X/L; \phi_X))]$$

$$+ \text{non-labor inputs} + \text{higher order terms} + \text{controls} + u, \quad (4.2)$$

- 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
- $f(\cdot)$ is a function the details of which we suppress

- 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):

$$\ln w = a' + \ln[(L + (\lambda_F - 1)F)(1 + (\lambda_B - 1)B/L)(1 + (\lambda_G - 1)G/L)(f(X/L; \lambda_X)] + \text{controls} + u, \quad (4.3)$$

- w is the wage bill
- a' is the log wage of the reference group
- λ terms are 1 if the relative wage differentials associated with gender, race, or college-going are 0

4.4. Testing for statistical discrimination

- 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

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

- 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
- 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

- In this case Altonji and Pierret show that the log wage level w_t will be

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

- $H^*(t)$ 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

- Then

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

Altonji and Pierret show that

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

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

- Φ_s and Φ_z are the coefficients of the regression of e on s and z and θ_t, summarizes how much the film knows about e at time t.

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

5.1. Race differences in pre-market human capital

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

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

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).

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	S, I, R	ln(Wage), 1987	0.829	0.877
	in 1987. Men only $N = 2957$	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	S, I, R, EXP	ln(Wage), 6 years after school	0.801	0.817
	Those who finished schooling before	S, I, R, AFQT, EXP	ln(Wage), 6 years after school	0.801	0.947
	1983; $N = 1751$	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	AFQT	ln(Wage), 1990–1991	0.756	0.928
	Full-time workers in 1990 or 1991. Age 18 or under in 1980	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).

5.2. Gender differences in pre-market human capital

6. Experience, seniority, training and labor market search

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

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

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

- 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
- X_{ijt} is total labor market experience

- 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

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

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

- 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

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

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

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

where $\hat{\mu}_t \equiv E(\mu_t \mid s_t)$.

- 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,

$$w_2 \equiv \begin{Bmatrix} \mu_1 \\ \theta\hat{\mu}_2 + (1-\theta)\mu_2 \end{Bmatrix} \begin{Bmatrix} \text{if } \mu_1 \geq \hat{\mu}_2 \text{(stayers)} \\ \text{if } \mu_1 < \hat{\mu}_2 \text{(movers)} \end{Bmatrix}, \quad (6.5)$$

- $\hat{\mu}_2$ is expected productivity the worker's second period alternative job.

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

- 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

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

- 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
- T_t is the job tenure at time t

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

7.2. The occupational feminization of wages

The following basic model is typically estimated separately for men and women:

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

- *W* represents the wage of an individual
- *F* is the fraction of women in the occupation which this individual occupies
- *X* is a set of individual control variables such as age, education, and marital status

7.3. The impact of other job characteristics

8. Beyond wages: gender differentials in fringe benefits

9. Trends in race and gender differentials

9.1. Methodologies for decomposing wage changes between groups over time

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

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

- 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
- βs are their related coefficients, estimated at time t

- The change in wage differentials between time periods t' and t can be presented as

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

- Rewrite Eq. (2.3) as

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

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

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

- One may rewrite Eq. (9.2) as

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

Changes between groups over time can then be written as

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

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 $\theta_{1t}\sigma_t = \theta_{1t'}\sigma_t = 0$.

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 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

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

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

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

If education is the *only* factor that differs between the groups, then

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

where β_{1t} is the return to a year of education in year t of the quality received by whites.

- Consider the wage equation for person *i* in year *t*

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

- D_i equals 1 for blacks and 0 for whites
- x_{it} is a set of productivity determinant
- ε_{it} is an error term

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]

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

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

- a_i is a fixed component
- u_{it} is a stationary AR1 process with a time invariant innovation variance
- Ψ_i is the price associated with the both the permanent and transitory unobserved skill components
- These restrictions imply that the wage equation may be written as

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

- 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

$$w_{ijt} = \theta_{ijt} + \varepsilon_{ijt}, \qquad (9.16)$$

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.

Productivity is described as

$$\theta_{ijt} = \mu_{jt} + a_{ijt}, \qquad (9.17)$$

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

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

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

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

Eq. (9.19) implies

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

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 analyze this question using the identity

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

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

- 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

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

- D_i is 1 for blacks and 0 otherwise
- X is a vector containing measures of experience and education

- Juhn addresses this question using the equation

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

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

- 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*
- t' is the base period

- 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

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

where $P_{gt}(w_{ht})$ is the predicted aggregate participation rate of group g using the wage distribution of group h.

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.

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

9.4. The overlap between race and gender

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

10.1. The impact of anti-discrimination policy

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

11. Conclusion and comments on a research agenda