Economics Bulletin

Volume 42, Issue 3

The role of supervisor race and gender on promotion likelihood

Yariv Fadlon
Muhlenberg College

Sophie Tripp
Eckerd College

Abstract

Using a nationally representative sample of workers from the National Longitudinal Survey of Youth 1997, we study the role of supervisor race and gender on employees' promotion likelihoods. We use an endogenous switching model to account for the selection issue of employees and supervisors self-selecting into employment with each other. We find both male and female employees have lower promotion likelihoods when they have a female supervisor compared with a male supervisor. We find black employees have a higher promotion likelihood with a white supervisor compared with a black supervisor. We find no evidence that the supervisor's race or gender has an effect on the return to promotion. The results add to the growing literature on the role of supervisors on labor market outcomes.

Citation: Yariv Fadlon and Sophie Tripp, (2022) "The role of supervisor race and gender on promotion likelihood", *Economics Bulletin*, Volume 42, Issue 3, pages 1280-1294
Contact: Yariv Fadlon - yarivfadlon@muhlenberg.edu, Sophie Tripp - trippsr@eckerd.edu.
Submitted: July 13, 2021. **Published:** September 30, 2022.

1. Introduction

A small portion of the vast literature on labor market outcomes focuses on promotions (George-Levi, Golan and Mil 2015; Fadlon and Tripp 2020; Bijkerk and Silvia Dominguez-Martinez 2021). Promotions are important job transitions for workers due to their large role in lifetime earnings. The empirical literature primarily focuses on gender differences, specifically if there are different promotion likelihoods among equally qualified males and females (see for example, Addison, Orgul and Si 2014; Deschacht 2017; Mohsen and McGee 2019; Zhang 2019). This paper adds a new dimension to the topic of promotions by examining the role of supervisor gender and race on workers' promotion likelihoods. Does having a matching or mismatching supervisor in the dimensions of gender or race play a significant role in a worker's chance of receiving a promotion? The second question we explore is whether a matching or mismatching supervisor in the dimensions of gender or race changes the real hourly wage return to promotion?

The literature focusing on gender differences in promotion likelihoods yields mixed results. The conflicting results are in large part due to the differences in data sources. The studies on this topic use samples ranging from single-firm data, single-industry data, and across-industry data. A number of these studies find women with equal observable characteristics to men face lower promotion likelihoods (Acosta 2010; Cabral, Marianne and Green 1981; Cannings 1988; Cobb-Clark 2001; McCue 1996; Olson and Becker 1983; Ransom and Oaxaca 2005; Spurr 1990). On the other hand, there are findings that suggest women with equal observable characteristics to men face higher promotion likelihoods (Barnett, James and Toby 2000; Barry and Milkovich 1989; Hersch and Viscusi 1996). Lastly, some studies find no significant gender differences in promotion likelihoods (Giuliano, Leonard and Levine 2005; Hartmann 1987; Lewis 1986; Paulin and Mellor 1996; Petersen and Saporta 2004; Powell and Butterfield 2010).

There is much less evidence on race differences in promotion likelihoods. McCue (1996) includes a black-white analysis in her study using the Panel Study of Income Dynamics (PSID). Using a hazard model, she finds no significant differences in promotion likelihood of black men and black women compared to white men. Although, she does find a lower wage return attached to promotions for these two categories compared to white men. Giuliano et al. (2005) use data from an individual retail firm and finds promotion rates for black workers are 52 percent lower compared to white workers in low-skill, entry-level positions.

Giuliano et al. (2005) is one of a handful of studies within economics literature that focuses on the role of supervisor race on workers' labor market outcomes. The authors search for racial bias, specifically if racial matches between managers and their employees affect employees' rates of quits, dismissals, and promotions. They find an overall pattern of own-race bias with employees having better outcomes when they share their race with their manager. The relative promotion rate of black employees is 79 percent higher under black managers. Blau and Devaro (2007), using the Multi-City Study of Urban Inequality employer survey, find no significant effect of supervisor gender on employee promotion likelihood and do not analyze the role of race. There is also a growing literature on the effects of supervisor gender and race on wages. Pitts et al. (2014) use the same data as this paper, the NLSY97, find evidence that all workers, except Hispanic males, earn significantly higher hourly wages when working for a supervisor of the same race and sex. With white supervisors, gender has a larger impact on wages compared to race, but with minority supervisors, race has a larger impact compared to gender. Ragan and Tremblay (1988), using the NLSY79, find male supervisors have a significant positive impact on the wages of white females. Though Sicilian and Grossberg (2014) also using the NLSY79, find there is no evidence of a supervisor gender effect for women, and only a small, significant effect for men. The source of the

different findings could be in large part due to different estimation techniques, where Sicilian and Grossberg (2014) used fixed effects models to account for supervisor selection effects.

For the first question, in our study, we use an endogenous switching model with panel data to account for a selection bias associated with workers self-selecting into employment with supervisors of a certain gender and race. Using the National Longitudinal Survey of Youth 1997, the results show that female employees have a 16.5 percent lower promotion likelihood when they have a female supervisor compared to a male supervisor. Male employees also have a similar disadvantage with female supervisors, facing a 25.6 percent lower promotion likelihood compared with male supervisors. Black employees have a 30.9 percent higher promotion likelihood when they have a white supervisor compared to a black supervisor.

For the second question in our study, we find no evidence to indicate the return to promotion varies by the supervisor's race and gender. Together with the conclusions from the first question, we conclude that the supervisor's race and gender do play an important role in the likelihood a worker is being promoted, but once promoted, there is no evidence that the identity of the supervisor is affecting the real hourly wage. The summary statistics indicate that black workers are much more likely to be employed by black supervisors compared to white workers. This might explain some of the racial wage gap, as black workers are more likely to be promoted by white supervisors. In addition, since female workers are slightly more likely to have female supervisors, the decrease in the likelihood of being promoted by a female supervisor might explain some of the gender wage gap. These findings are important in the larger context of promotions and the role of supervisors and provide evidence across industries at a nationally representative level.

The theory behind discrimination in labor market outcomes typically falls into two categories, statistical discrimination and in-group bias. With promotions, statistical discrimination occurs when promotion decisions for an individual are based on that individual's average group characteristics rather than his or her own. This theory holds if there is a uniform tendency by all groups to discriminate against a given group. There are two types of in-group bias, taste-based and efficiency-based. Becker (1971) explains people with a taste-based bias are willing to pay a cost to have their preferences of interacting with people of the same race or same gender. Efficiency-based bias occurs when employers prefer to interact with people of the same race or gender because there are reduced costs of communication and mentoring, thus efficiency gains (Lang 1986); Zemsky, Susan and Avery 2000). Both types of in-group bias have strong explanatory powers in the hiring process of the labor market and also provide insight into post-hire outcomes. Supervisors may be forced to make certain hiring decisions for an inclusive work environment, but may still set higher requirements against minority employees for promotions either due to taste-based or efficiency-based biases. Again, the results do not support an in-group bias. The results most closely follow Fryer (2007) "belief-flipping" model. The model finds that if an employer discriminates against a certain group of workers in the hiring stage, he or she may come to favor the successful members of the discriminated group when making promotions from within. Though this theoretical model was not tested empirically, the findings of black employees having a higher likelihood of promotion under white supervisors compared to black supervisors follow the model's predictions.

The remainder of the paper is structured as follows. First, we explain the data and restrictions made to the sample. Next, we explain the model used to estimate the role of supervisor race and gender in employee's promotion likelihood. This section also specifies the wage regression. Following the model, we present the empirical estimates. Lastly, we conclude.

2. Data

The data used in this paper are taken from the National Longitudinal Survey of Youth 1997, a nationally representative sample of individuals born between 1980 and 1984 and first interviewed in 1997. The individuals are interviewed on a regular basis, providing a rich sample of data on labor market outcomes, among many other variables, such as parent characteristics and childhood experiences. We use the years 2006 through 2008 because job promotion information is available in the NLSY97 for these years only. The individuals were asked if they experienced a position change in their current job and they could respond with a promotion, demotion, or no position change. The individuals are between 22 and 29 years of age in these years. We use all of the observations reported by white or black employees who made no change in their job. We are interested in within-firm promotions, not a promotion that results in an employee leaving a firm.

Table 1 reports the summary statistics of the sample by workers' race and gender. On average, white workers are more likely to be promoted compared to black workers, regardless of the worker's gender. Within race, white female workers are more likely to be promoted compared to white male workers. Using a two-proportion hypothesis test, we find that this difference is statistically significant at the 10 percent significance level.[1] Black female workers are slightly less likely to be promoted compared to black male workers. But this difference is not statistically significant. The vast majority of male workers have a male supervisor, while a bit more than half the female workers have female supervisors. Most workers have a white supervisor. More than 95 percent of the white workers have white supervisors, whereas about 39 percent of the black workers have black supervisors. These statistics demonstrate the importance of correcting the regressions to potential sample selection biases.

As expected, white male workers earn on average the most, followed by black male workers, female white workers, and finally female black workers. The mean tenure varies between 2.1 and 2.5 years. The proportion of college graduates is very similar to the means reported by the Bureau of Labor Statistics (BLS). That is, on average, white females are most likely to graduate from college, followed by white males, black females, and black males. Black workers are more likely to work in big companies of at least 500 workers. Finally, blacks are more likely to live in the South. All of these statistics are comparable to the averages reported by the BLS.

Table 2 summarizes the sample proportions of supervisor's race and gender by the worker's race and gender. Female workers are slightly more likely to have female supervisors, while male workers have mostly male supervisors. Black workers are more likely to have black supervisors and white workers are more likely to have white supervisors. Table 2 provides more evidence that there are strong correlations between the race and gender of the workers and the race and gender of the supervisors. Specifically, it indicates that there might be a self-selection of workers to supervisors based on both the race and gender of the workers and the supervisors.

[1] The p-value from the test is 0.0793

Table 1: Summary Statistics by Race and Gender

VARIABLES	All	White Male	Black Male	White Female	Black Female
Promoted	0.0740	0.0742	0.0629	0.0846	0.0480
	(0.00298)	(0.00473)	(0.00928)	(0.00504)	(0.00713)
Supervisor Female	0.383	0.175	0.255	0.554	0.624
	(0.00796)	(0.00968)	(0.0221)	(0.0128)	(0.0213)
Supervisor Black	0.112	0.0333	0.404	0.0440	0.365
	(0.00512)	(0.00438)	(0.0252)	(0.00495)	(0.0217)
Real Hourly Wage	15.03	16.58	14.60	14.36	12.43
	(0.223)	(0.403)	(0.980)	(0.285)	(0.429)
Tenure (in years)	2.526	2.696	2.433	2.496	2.136
	(0.0411)	(0.0708)	(0.147)	(0.0618)	(0.0899)
College	0.319	0.291	0.148	0.406	0.261
	(0.00854)	(0.0131)	(0.0214)	(0.0145)	(0.0230)
AFQT	0.232	0.329	-0.520	0.472	-0.273
	(0.0175)	(0.0275)	(0.0581)	(0.0238)	(0.0479)
Northeast	0.162	0.188	0.0959	0.170	0.102
	(0.00684)	(0.0116)	(0.0173)	(0.0112)	(0.0156)
North Central	0.276	0.316	0.159	0.299	0.156
	(0.00839)	(0.0138)	(0.0219)	(0.0139)	(0.0192)
South	0.381	0.290	0.687	0.304	0.693
	(0.00901)	(0.0133)	(0.0275)	(0.0137)	(0.0242)
West	0.181	0.205	0.0582	0.227	0.0492
	(0.00707)	(0.0117)	(0.0137)	(0.0124)	(0.0113)
Metropolitan	0.951	0.944	0.923	0.959	0.969
	(0.00397)	(0.00668)	(0.0169)	(0.00573)	(0.00897)
Big Firm (500+ employees)	0.114	0.103	0.118	0.120	0.132
	(0.00500)	(0.00772)	(0.0163)	(0.00821)	(0.0146)
Union	0.0735	0.0870	0.113	0.0490	0.0767
	(0.00425)	(0.00743)	(0.0161)	(0.00577)	(0.0113)
Mother Education	13.19	13.23	12.66	13.38	12.83
	(0.0468)	(0.0757)	(0.136)	(0.0777)	(0.116)
Father Education	13.11	13.31	11.96	13.33	12.62
	(0.0518)	(0.0821)	(0.152)	(0.0877)	(0.115)
# of Kids	0.458	0.272	0.403	0.499	0.977
	(0.0147)	(0.0175)	(0.0486)	(0.0244)	(0.0550)
Black	0.215				
	(0.00767)				
Female	0.507				
	(0.00940)				
Observations	6,840	2,735	636	2,635	834

Note: The standard errors are clustered by individuals.

Table 2: Proportion of Supervisor's Gender and Race by Worker's Gender and Race

	Proportion of female supervisor
Female worker	0.5708
	(0.485)
Male worker	0.1899
	(0.3922)
	Proportion of white supervisor
White worker	0.9615
	(0.1925)
Black worker	0.6184
	(0.486)

3. Empirical Models

We estimate a selection equation to control for a possible bias with individuals selecting jobs based on their supervisors' race or gender. When estimating the effect of a female supervisor on a female employees' promotion likelihood, the endogenous selection equation is given by

$$\Pr\left(Female\ Supervisor_{it} = 1\right) = \beta_0 + \beta_1 X_{it} + \beta_2 Y_{it} + \beta_3 Z_{it} + \epsilon_{it} \qquad (1)$$

where $Female\ Supervisor_{it}$ defines if an individual, *i*, worked for a female supervisor in year *t*. *X* is a vector of human capital measures, including a college dummy, job tenure, and the Armed Forces Qualification Test (AFQT). *Y* is a vector of characteristics about the job, including a union dummy, metropolitan statistical area (MSA) dummy, three region dummies, nine occupation dummies, eight industries dummies, firm size dummy (at least 500 employees), and supervisor age. *Z* is a vector of personal characteristics, including mother's highest grade completed, father's highest grade completed, and number of children. We also include year fixed effects for 2007 and 2008. This selection equation is also used when estimating the promotion likelihood for employees with white supervisors. The results of the selection equations are given in Appendix I. Selection equations should include at least one variable not included in the promotion equation. The variable(s) should be correlated with supervisor selection, but not promotion likelihood. Following Pitts et al. (2014), we use mother's highest grade completed, father's highest grade completed, and number of children.

We use the following logistic model, for male and female employees separately, to estimate the effect of a female supervisor on promotion likelihood

$$P(promoted_{it} = 1) = \frac{e^{\alpha + e^{\gamma_1 female\ supervisor} + e^{\pi' X_{it}} + e^{\pi' Y_{it}} + e^{\pi' Z_{it} + \epsilon_{it}}}}{1 + e^{\alpha + e^{\gamma_1 female\ supervisor} + e^{\pi' X_{it}} + e^{\pi' Y_{it}} + e^{\pi' Z_{it} + \epsilon_{it}}}} \qquad (2)$$

where *promoted* is a dummy variable equal to unity if the worker was promoted, *X* is a vector of human capital measures, *Y* is a vector of job characteristics, and *Z* is a vector of personal characteristics. All the variables present in the selection equation, except parents' education and

number of children, are present in this equation. We use the same logistic model, for black and white employees separately, to estimate the effect of a white supervisor on promotion likelihood

$$P(promoted_{it} = 1) = \frac{e^{\alpha} + e^{white\ supervisor} + e^{\pi' X_{it}} + e^{\pi' Y_{it}} + e^{\pi' Z_{it}} + \epsilon_{it}}{1 + e^{\alpha} + e^{\gamma_1 white\ supervisor} + e^{\pi' X_{it}} + e^{\pi' Y_{it}} + e^{\pi' Z_{it}} + \epsilon_{it}} \quad (3)$$

The main coefficient of interest is γ_1 which is the effect of a female supervisor on an employee's promotion likelihood in equation (2) and the effect of a white supervisor in equation (3). If γ_1 is less than one, for example, then a white supervisor has a negative effect on the employee's promotion likelihood. To consistently estimate γ_1, we utilize the endogenous switching model to control for possible bias.

We also test whether there is a variation in the hourly real wage return to promotion because of differences in the supervisor race and gender. Specifically, we run the following regression:

$$\ln(wage_{it}) = \beta_0 + \beta_1 promoted_{it} + \beta_2 promoted_{it} * female\ supervisor_{it} + \beta_3 promoted_{it} * white\ supervisor_{it} + \pi' X_{it} + \pi' Y_{it} + \epsilon_{it} \quad (4)$$

where X_{it} and Y_{it} are vectors with the same controls as in equations (2) and (3). The coefficients of interest are β_2 and β_3. If any one of these two coefficients is different from zero, then it means that the return to job promotion varies by either the supervisor gender or the supervisor race. To remove individual unobserved heterogeneity (including sample selection bias), we use fixed effects estimates.

Table 3: Logit Estimates of the Role of Supervisor Gender on Promotion Likelihood

	Female Employees	Male Employees
Female supervisor	0.835*	0.744**
	(0.09617)	(0.1259)
Supervisor age	0.9884***	0.996
	(0.00333)	(0.00328)
Tenure	1.2142***	1.091**
	(0.05342)	(0.0454)
$Tenure^2$	0.9779***	0.989**
	(0.00699)	(0.00557)
Union	0.73677**	1.117
	(0.14100)	(0.0940)
Black	0.8279**	1.022
	(0.08900)	(0.08539)
College	1.006	1.019
	(0.08679)	(0.08936)
Married	0.9925	1.017
	(0.07033)	(0.07367)
Observations	3,469	3,371
R^2	0.073	0.052

Notes: The dependent variable is the dummy variable promoted. All regressions control for year fixed effects, nine occupation dummies, eight industry dummies, AFQT, hours worked each week, number of employees, number of employees squared, a union dummy, and a metropolitan dummy. Estimates are odds ratios.

* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level

4. Results

Table 3 presents the results from the estimations of the role of supervisor gender on promotion likelihoods. The coefficients are odds ratios. The estimates imply that both female and male employees have lower promotion likelihoods with female supervisors compared with male supervisors. Specifically, female employees with female supervisors have a 16.5 percent lower promotion likelihood than female employees with male supervisors. This estimate is statistically significant at the 10 percent significance level. Male employees with female supervisors have a 25.6 percent lower promotion likelihood than male employees with male supervisors. Tenure has a positive and diminishing return to the likelihood of being promoted. It is also interesting to note that female employees that are union members have a lower promotion likelihood compared to females not in a unionized job.

Table 4 presents the results for the estimations of the role of supervisor race on promotion likelihoods. The estimates in column 1 indicate that white employees that are employed by white supervisors are about 17 percent more likely to be promoted compared to if they are employed by black supervisors. This estimate, however, is not statistically significant. Black employees have a

statically significant effect of about 31 percent greater promotion likelihood if they have a white supervisor compared to a black supervisor.

The estimates in Table A1 reported in the Appendix Section summarize the first stage estimation in the regressions. Specifically, it reports the estimates of the likelihood of a selection to a supervisor based on race and gender. The estimates show that they are often statistically significant. These estimates are fairly similar to the estimates reported in Pitts et al (2014).[2]

The results in Tables 3 and 4 indicate that the supervisor's race and gender do have a statistically and economically significant effect on the likelihood of being promoted. Fadlon and Tripp (2020) showed that the return to promotion varies based on the worker's race and gender. Therefore, we next test whether the return to promotion varies by the supervisor's race and gender. Table 5 reports the estimates from the regressions of equation (4).

The estimates suggest that promotions have a statistically and economically significant effect on real wages. These estimates are consistent with previous findings in Fadlon and Tripp (2020) and it also amplifies the importance that promotions play in the evolution of wages. Specifically, a promotion is associated with an increase of about 14 percent in real hourly wages regardless of the supervisor's race and gender in the entire sample. The other estimates of promotion multiplied with supervisor's race and gender are not statistically nor economically significant in the entire sample. This implies that in the entire sample the supervisor gender and race identity does not change the return to promotion.

The other columns in Table 5 summarize the estimates of the log wage regression estimates by the gender and race of the workers. For black workers, the estimate suggests that promotion is associated with an increase in real hourly wage by about 20 percent. The estimates in Column 2 also suggest that the race of the supervisor does not have a statistically significant effect on the return to promotion. The estimate of the supervisor race suggests that a black worker with a white supervisor receives about 5 percent if promoted in addition, but this estimate is not statistically significant, and we cannot reject the assumption that this coefficient is equal to zero.

[2] All of the estimates on the Inverse Mills Ratio's coefficients are statistically significant at the 5 percent significance level.

Table 4: Logit Estimates of the Role of Supervisor Race on Promotion Likelihood

	White Employees	Black Employees
White supervisor	1.1719	1.3097**
	(0.30771)	(0.12659)
Supervisor age	0.991***	1.000
	(0.00296)	(0.00467)
Tenure	1.161***	1.0057
	(0.06160)	(0.06093)
Tenure^2	0.983***	0.9886
	(0.000723)	(0.00786)
Union	0.987	0.9293
	(0.09587)	(0.12675)
Female	1.046	0.8134**
	(0.05793)	(0.10107)
College	0.994	1.0486
	(0.06989)	(0.12325)
Married	1.042	0.8531
	(0.05521)	(0.12355)
Observations	5,370	1,470
R^2	0.05	0.13

Notes: The dependent variable is the dummy variable promoted. All regressions control for year fixed effects, nine occupation dummies, eight industry dummies, AFQT, hours worked each week, number of employees, number of employees squared, a union dummy, and a metropolitan dummy. Coefficients are odds ratios.
* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level

In Column 3 of Table 5, we report the estimates from the log wage regression for white workers. Here the estimates suggest that white workers get about 16 percent return to a promotion regardless of the supervisor's race. The estimates in Column 4 of Table 5 indicate that male workers enjoy about a 12 percent increase in real hourly wage when promoted regardless of the supervisor's race. This estimate increases by almost 2 percent if the worker has a male supervisor, but this increase is not statistically significant. In Column 5 of Table 5, the estimates indicate that female workers receive about 18 percent to the real hourly wage if promoted. If the female worker has a female supervisor, she enjoys an additional 1 percent if promoted, but this addition is not statistically significant.

Putting together the estimates in Table 5, we find strong evidence that promotions are associated with an increase in real hourly wage. In addition, there is no statistical evidence that the return to promotion changes with either the supervisor's race or gender. Therefore, the supervisor's race and gender do play a role in the likelihood of being promoted, but once promoted, the increase in the real hourly wage is not affected by the identity of the supervisor's race or gender.

The other estimates in Table 5 indicate that college educated, workers in big firms, and union members are more likely to have a higher real wage. In addition, the supervisor's age does seem to have some positive effect on the hourly wage, but there is no evidence that it changes the return to promotion.

Table 5: The Effect of Supervisor Race and Gender on Wage when Promoted

	All	Black Workers	White Workers	Male Workers	Female Workers
VARIABLES	(1)	(2)	(3)	(4)	(5)
Promoted	0.142***	0.201**	0.157**	0.118***	0.180**
	(0.046)	(0.093)	(0.079)	(0.043)	(0.087)
Supervisor White	-0.0201	-0.0342	2.62e-05		
	(0.0235)	(0.0293)	(0.0363)		
Promoted * Supervisor White	0.0218	0.0501	-0.0324		
	(0.117)	(0.0742)	(0.211)		
Supervisor Female	-0.0222			-0.0466*	0.0550**
	(0.0173)			(0.0275)	(0.0223)
Promoted * Supervisor Female	-0.0345			0.0227	0.0119
	(0.0370)			(0.0469)	(0.0500)
Tenure	0.0253**	0.00672	0.0298**	0.0567***	-0.00271
	(0.0110)	(0.0182)	(0.0132)	(0.0166)	(0.0134)
$Tenure^2$	-0.00274*	-0.00193	-0.00289*	-0.00561**	-6.23e-06
	(0.00146)	(0.00277)	(0.00174)	(0.00236)	(0.00151)
College	0.202***	0.101	0.228***	0.174***	0.212***
	(0.0395)	(0.0719)	(0.0460)	(0.0626)	(0.0512)
Big Firm (500+ workers)	0.0850***	0.0514*	0.0983***	0.108***	0.0647***
	(0.0210)	(0.0285)	(0.0266)	(0.0362)	(0.0244)
Union	0.0929***	0.120**	0.0743**	0.0683**	0.123***
	(0.0263)	(0.0512)	(0.0306)	(0.0319)	(0.0438)
Metropolitan	-0.0109	0.00787	-0.0155	-0.0570*	0.0973**
	(0.0302)	(0.0463)	(0.0373)	(0.0319)	(0.0466)
Supervisor Age	0.00173**	0.00270*	0.00151	0.00187	0.00151
	(0.000797)	(0.00150)	(0.000923)	(0.00118)	(0.00106)
Promoted * Supervisor Age	-0.000554	-0.00357	-0.000152	-0.000140	-0.000819
	(0.00201)	(0.00254)	(0.00227)	(0.00289)	(0.00273)
Constant	2.371***	2.281***	2.383***	2.454***	2.188***
	(0.0532)	(0.0739)	(0.0698)	(0.0642)	(0.0715)
Observations	6,840	1,470	5,370	3,371	3,469
R-squared	0.036	0.026	0.041	0.040	0.050

Notes: The dependent variable is log real hourly wage. All regressions are fixed effects estimation. All regressions control for year fixed effects, nine occupation dummies, eight industry dummies. Standard errors are robust and clustered at the individual level. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level

The empirical conclusions can be explained with a dynamic model of statistical discrimination. The theory of statistical discrimination (Phelps 1972; Arrow 1973) assumes that at hiring, employers do not have perfect information about a potential worker's skill level. As a result, the employer might use the weighted average between the applicant's group average productivity as an indicator for the applicant's productivity (hence the name statistical discrimination) and a noisy signal from the applicant. In that respect, individuals that belong to the disadvantaged group are less likely to be employed, or be employed in lower-level positions. Arrow (1973) shows that employers would rationally discriminate against the disadvantage group even when the groups are ex-ante identical.

Fryer (1996) developed a dynamic model of statistical discrimination. In his model, Fryer shows that if an employer statistically discriminates against a group of workers in the initial hiring stage, the employer may actually favor the successful members of that group in the promotion decisions. The intuition is that members of the disadvantaged groups need to be more talented to be employed. Therefore, the pool of workers from the disadvantaged group needs to be more talented, on average. The promotion decisions are made after the employer knows the worker, and can more accurately assess the worker's productivity. Therefore, members of the disadvantaged group are more likely to be promoted.

Fadlon (2015) provides evidence from medicine and socioecology disciplines that show that the communication between the worker and the employer is better if the employer and worker are of the same group. Therefore, it is plausible to assume that white employers statistically discriminate against black workers, and that male employers statistically discriminate against female workers. According to Fryer's model, it means that white employers are more likely to promote black workers, and male employers are more likely to promote female workers.

5. Conclusion

The main conclusions found in this paper are the lower promotion likelihood for both male and female employees with a female supervisor compared to a male supervisor and a higher likelihood of promotion for black employees when they have a white supervisor compared to a black supervisor. In addition, we do not find evidence that the return to promotion changes with either the race or gender of the supervisor. That is, the likelihood a worker is promoted is associated with the race and gender of the supervisor, but once promoted the return to promotion does not vary with either the supervisor's race or gender. Since black workers are more likely to have black supervisors, the higher likelihood of being promoted if the supervisor is white might explain some of the racial wage gap. In addition, since female workers are more likely to have female supervisors, the higher likelihood a female worker with male supervisor is promoted might explain some of the gender wage gap.

References

Acosta, Pablo. 2010. "Promotion Dynamics the Peter Principle: Incumbents vs. External Hires." *Labour Economics* 17 (no. 6): 975-986.

Addison, John T., Demet Ozturk Orgul, and Wang Si. 2014. "The Role of Gender in Promotion and Pay Over a Career." *Journal of Human Capital* 8 (no. 3): 280-317.

Arrow, Kennet. 1973. "The Theory of Discrimination." *In: O. Ashenfelter and A. Rees, Eds., Discrimination in Labor Markets, Princeton University Press.*

Barnett, William P., Baron N. James, and Stuart E. Toby. 2000. "Avenues of attainment: Occupational demography and organizational careers in the California civil service." *American Journal of Sociology* 106 (no. 1): 88-144.

Barry, Gerhart A., and George T. Milkovich. 1989. "Salaries, Salary Growth, and Promotions of Men and Women in a Large, Private Firm." *Pay equity: Empirical inquiries* 23-43.

Becker, G. S. 1971. *The Economics of Discrimination.* University of Chicago Press Economics Books.

Bijkerk, Suzanne H, and Ju Silvia Dominguez-Martinez. 2021. "Labor Market Quotas when Promotions are Signals." *Journal of Labor Economics* no. 2 (39): 437-460.

Blau, Francine D., and Jed Devaro. 2007. "New Evidence on Gender Differences in Promotion Rates: An Empirical Analysis of a Sample of New Hires." *Industrial Relations* 46 (no. 3): 511-550.

Cabral, Robert, Ferber A. Marianne, and Carole A. Green. 1981. "Men and Women in Fiduciary Institutions: A Study of Sex Differences in Career Development." *Review of Economics and Statistics* 63 (no. 4): 573-580.

Cannings, Kathy. 1988. "Managerial Promotion: The Effects of Socialization, Specialization, and Gender." *Industrial and Labor Relations Review* 42 (no. 1): 77-88.

Cobb-Clark, Deborah. 2001. "The Determinants of and Payoffs to Internal Promotion for Young U.S. Men and Women." *Research in Labor Economics* 20: 339-372.

Deschacht, Nick. 2017. "Part-Time Work and Women's Careers: A Decomposition of the Gender Promotion Gap." *Journal of Labor Research* np. 2 (38): 169-186.

Fadlon, Yariv D. 2015. "Statistical Discrimination and the Implication of Employer-Employee Racial Matches." *Journal of Labor Research* 36 (no. 2): 232-248.

Fadlon, Yariv, and Sophie Tripp . 2020. "Promotions and Race: An Analysis of Wage Returns and Job Satisfaction." *LABOUR* no. 2 (34): 176-190.

Fryer, Roland G. 2007. "Belief Flipping in a Dynamic Model of Statistical Discrimination." *Journal of Public Economics* 91 (no. 5-6): 1151-1166.

George-Levi, Gayle, Limor Golan, and Robert A. Mil. 2015. "Promotion, Turnover, and Compensation in the Executive Labor Market." *Econometrica* 83 (no. 6): 2293-2369.

Giuliano, Laura, Jonathan Leonard, and David Levine. 2005. "Do Race, Gender, and Age Differences Affect Manager-Employee Relations? An Analysis of Quits, Dismissals, and Promotions at a Large Retail Firm." *Paper 18. Center for Responsible Business, University of California Berkeley.*

Hartmann, Heidi I. 1987. *Internal Labor Markets and Gender: A Case Study of Promotion.* Washington, D.C.: Brookings Institution.

Hersch, Joni, and Kip W. Viscusi. 1996. "Gender Differences in Promotions and Wages." *Industrial Relations* 35 (no. 4): 461-472.

Lang, Kevin. 1986. "A Language Theory of Discrimination." *Quarterly Journal of Economics* 101 (no. 2): 363-382.

Lewis, George B. 1986. "Gender and Promotions: Promotion Chances of White Men and Women in Federal White-Collar Employment." *Journal of Human Resources* 21 (no. 3): 406-419.

McCue, Kristin. 1996. "Promotions and Wage Growth." *Journal of Labor Economics* 14 (no. 2): 175-209.

Mohsen , Javdani, and Andrew McGee. 2019. "Moving Up Or Falling Behind? Gender, Promotions, and Wages in Canada." Industrial Relations." *Industrial Relations* 58 (no. 2): 189-228.

Olson, Craig A., and Brian E Becker. 1983. "Sex Discrimination in the Promotion Process." *Industrial and Labor Relations Review* 36 (no. 4): 624-641.

Paulin, Elizabeth A., and Jennifer M.. Mellor. 1996. "Gender, Race, and Promotions within a Private-Sector Firm." *Industrial Relations* 35 (no. 2): 276-295.

Petersen, Trond, and Ishak Saporta. 2004. "The opportunity structure for discrimination." *American Journal of Sociology* 109 (no. 4): 852-901.

Phelps, Edmund S. 1972. "The Statistical Theory of Racism and Sexism." *American Economic Review* 62 (no. 4): 659-661.

Pitts, J. D, Pitts, J. D., S. Orozco-Aleman, S Orozco-Aleman, and J Rezek. 2014. "The Role of Supervisors in the Determination of Wages and Wage Gaps." *Applied Economics* 46: 28-30.

Powell, Gary N., and Anthony D. Butterfield. 2010. "Investigating the "Glass Ceiling" Phenomenon: An Empirical Study of Actual Promotions to Top Management." *Women and Management* 223-241.

Ragan, James F., Jr, and Carol Horton Tremblay. 1988. "Testing for Employee Discrimination by Race and Sex." *Journal of Human Resources* 23 (no. 1): 123-137.

Ransom, Michael, and Ronald L. Oaxaca. 2005. "Intrafirm Mobility and Sex Differences in Pay. ." *Industrial and Labor Relations Review* 58 (no. 2): 219-237.

Sicilian, Paul, and Adam J. Grossberg. 2014. "Does Supervisor Gender Affect Wages?" *Empirical Economics* 46 (no. 2): 479-499.

Spurr, Stephen J. 1990. "Sex Discrimination in the Legal Profession: A Study of Promotion." *Industrial and Labor Relations Review* 43 (no. 4): 406-417.

Zemsky, Peter, Athey Susan, and Christopher Avery. 2000. "Mentoring and Diversity." *American Economic Review 90* 90 (no. 4): 765-786.

Zhang, Hong. 2019. "Gender Difference in Promotions: New Evidence from the Internal Labor Market in China." *Applied Economics* no. 56 (51): 6021-6033.

Appendix

Table A1: Supervisor Selection Equation

	Female Supervisor; Female Employees	Female Supervisor; Male Employees	White Supervisor; White Employees	White Supervisor; Black Employees
Father's education	-0.00145	-0.00758	0.00344	-0.01128**
	(0.01407)	(0.01664)	(0.01454)	(0.00924)
Mother's education	-0.01200	-0.02572***	0.05795***	-0.01506
	(0.0149)	(0.00798)	(0.01205)	(0.03135)
Number of children	0.1292***	0.05017	-0.16465***	-0.13095**
	(0.04493)	(0.07151)	(0.04348)	(0.07417)
Married	0.01312	-0.3489***	0.08237	-0.21236
	(0.07013)	(0.1003)	(0.07500)	(0.15899)
College	0.17032**	0.01004	-0.1654	0.21701
	(0.08326)	(0.1044)	(0.9073)	(0.16142)
Black	0.00422	0.1786		
	(0.090945)	(0.1133)		
Female			0.06015	0.3750**
			(0.07491)	(0.15067)
Union	-0.15700	0.1278	-0.2339***	0.07246
	(0.11165)	(0.1079)	(0.09518)	(0.16383)
Observations	3,588	3,480	5,161	1,907

Notes: All regressions control for year fixed effects, nine occupation dummies, eight industry dummies, AFQT, hours worked each week, age, age squared, tenure, tenure squared, a union dummy, a metropolitan dummy, number of employees, and number of employees squared. White's robust standard errors are in parenthesis.
* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level