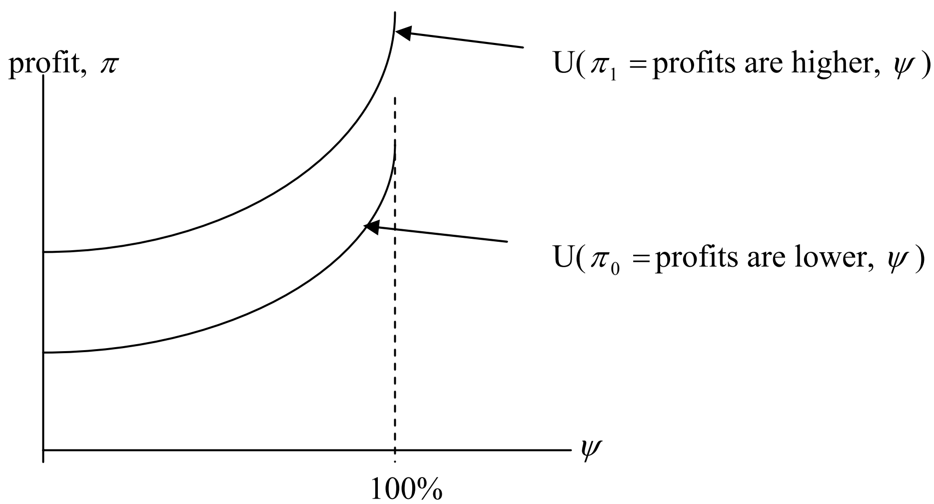
Econ 463 R. Butler 2005 Lecture 16

I. Employer's tastes for discrimination

Assume two kinds of labor: G, for gentiles, and H, for House of Israel. These two types of labor will be assumed to be perfect substitutes in production, so that the total labor used by the firm is L=G+H. Suppose that at least some employers "dislike" employing H. By "dislike employing H workers" we mean that the employer's utility function depends both on profits, π, and on the relative number of H workers employed:

$$U = U(\pi, \frac{H}{H+G}) = U(\pi, \psi), \quad \text{where } \psi = H/(H+G), \text{ and where}$$

$$\frac{\partial U}{\partial \pi} > 0, \quad \frac{\partial U}{\partial \psi} < 0, \quad \frac{\partial^2 U}{\partial \psi^2} > 0.$$ Under these conditions, the indifference curve for the employer will look the following:



We model the employer's incentives to hire relatively more H workers, while holding the total number of workers employed constant. With this assumption as ψ increases, the relative numbers of H and G change so that H+G is constant. This is not crucial to the argument, but it makes it easier to do graphs.

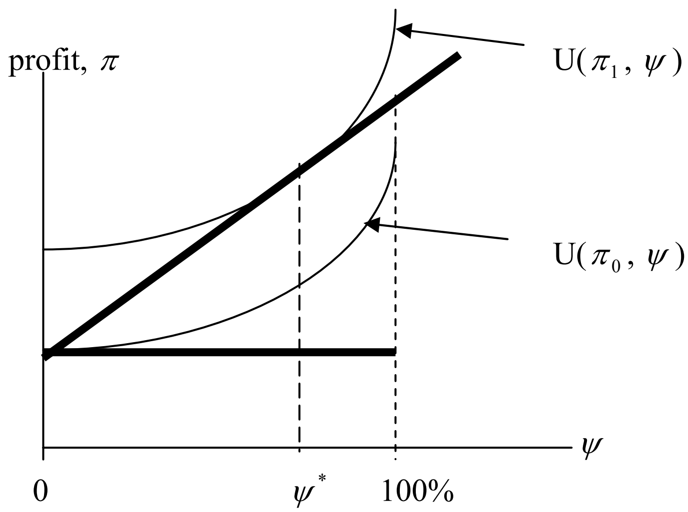
The slope of the indifference curves gives the marginal rate of substitution between profits and additional H workers, that is, how much additional profit the discriminating employer requires to employ another H worker. The discriminating employer will want to be on the highest (most northwestern) indifference curve that they can reach given the production function and demand conditions. We assume that f(.) is the production function, and since H and G are perfect substitutes in production, the profit function can be written as

$$\pi = p * f(H+G) - w_h H - w_g G$$

which can be rewritten as:

$$\pi = \{ p^* f((H+G)) - w_g^*(H+G)\} + [(w_g-w_h)^* (H+G)]^* \psi$$

Holding H+G constant, profits are a linear function of ψ : each incremental increase in the relative number of H workers, ψ , increases profits by the wage difference "w_g-w_h" times the total number of workers. For example, the amount of money saved by hiring relatively more H workers (so if w_g=$12/hour, and w_h=$9/hour, and there are 600 total workers, the net savings from going from ψ =0 to ψ =1 is 600*$3/hour=$1800/hour). The intercept is the profitability if only hire gentiles (G workers) are hired: it is the difference between the revenue (P*f(.)) and costs (workers*wage) when ψ =0. Adding this constraint to the indifference curves we get



If the wages of H and G workers are identical, then the slope of the profit function is flat as given in the lower, dark horizontal constraint. The discriminating employer will hire, in this case, only G workers and ψ =0. If the wages of G workers exceed those of H workers, then the constraint slopes upward as pictured in the dark constraint sloping up at about a 45 degree angle. In this case, the wage difference compensates the discriminating employer for her tastes for discrimination, so that the employer hires H workers until the net benefit of additional H workers (the slope of the darkened budget line) just equals the net costs (the disutility of the employer from hiring H workers, as given by the slope of the indifference curve). With the wage difference implicit in the dark budget line that is just tangent to the $U(\pi_1, \psi)$ indifference curve, the optimal proportion of H workers is ψ *.

If the employer has higher tastes for discrimination, then how does this affect the equilibrium level of House of Israel workers hired?

If the employer has linear rather than convex indifference curves, than what will happen?

To solve this same problem mathematically, choose ψ to maximize the utility function

$U(\pi,\psi)$ where π = { p* f((H+G)) – w_g*(H+G)} + [(w_g-w_h)* (H+G)]* ψ ,

or max (w.r.t. ψ)= U({p* f((H+G)) – w_g*(H+G)} + [(w_g-w_h)* (H+G)]* ψ }, ψ)

((holding H+G constant), and get the first order condition that:

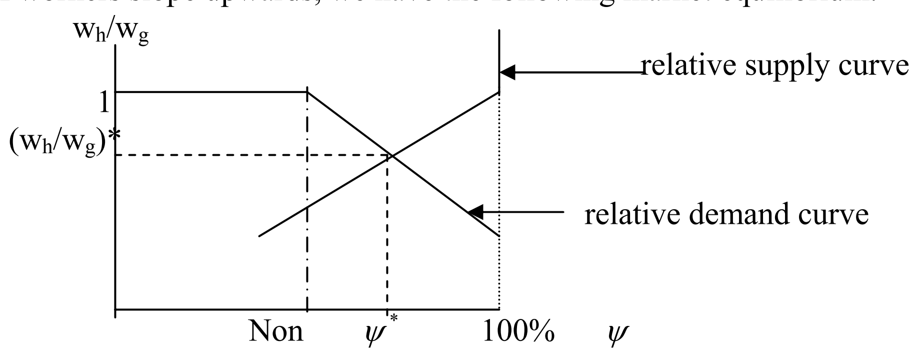
$$U_\pi * (w_g - w_h) * (H+G) + U_\psi = 0$$, or upon rearranging, we get

$$w_g = w_h - \frac{U_\psi}{U_\pi * (H+G)}$$ or

$$w_g = w_h + D_h$$

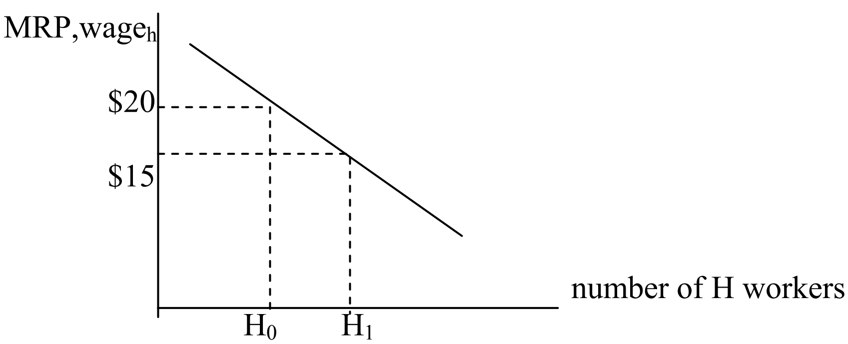
where $D_h = -\frac{U_\psi}{U_\pi * (H+G)}$. D_h is the monetary value of the employer's taste for discrimination (minus the marginal rate of substitution, or the change in profits necessary for the employer to hire relatively more H workers).

The market for H workers with employer tastes of discrimination. For employers with U_ψ =0, D_h=0 and the employer is indifferent between hiring G and H workers at the same wage rate. H workers would seek employment at D_h=0 firms first, and would be paid the same there initially as G workers. After all the D_h=0 firms were exhausted, the H workers would next sort themselves into firms with the smallest D_h values, then the next smallest D_h values, etc. As more H workers are employed by increasingly discriminatory employers, their relative wage falls. Assuming the relative supply curve of H workers slope upwards, we have the following market equilibrium:



where there is assumed to be enough non-discriminating employers to accommodate up to a ψ =Non level of relative employment. Up to that point, H and G workers are paid the same so that the ratio of their wages (on the vertical axis) equals one. Then the relative wage, w_h/w_g,, falls as additional H workers enter the market and get work with employers with increasingly large tastes for discrimination. As they do so (and compete with other H workers in the market for jobs), their relative wage will fall.

The equilibrium diagrammed immediately above should be a short-run result, as discrimination should self-destruct in the long run. Firms are paying less to H workers than they are to equally productive G workers. They would increase their profits if they expanded their use of H workers. (If there were constant returns to scale in production, a single non-discriminator should be able to drive all the discriminator firms out of the market.) Even discriminating firms with decreasing returns to scale are hiring too few H workers. The marginal product of workers in a discriminating firm is given below, assuming that the relative wage, $(w_h/w_g)^*$ =.75. For example, gentiles (G workers) are making $20/hour at a job, that equally productive house of Israel (H workers) are only paid $15/hour for. (The $5 difference just compensates the discriminator for her tastes of discrimination.) The wage of H workers is $15, but the firm acts as the wage for H workers is $20/hour:



Only H_0 house of Israel-workers are employed by this discriminating firm—even though house of Israel workers get paid $15/hour (and so the firm should employ H_1 of them), the firm acts as if the wage of H workers is $20 ($15 plus the $5 for tastes of discrimination). H_0 house of Israel workers is an inefficient efficient number to employ, given their relatively low costs. Firms employing H workers more efficiently (not acting as if there are tastes of discrimination) will drive discriminators out of business. In the long run, competitive markets should make discriminating firms disappear.

II. Employee's tastes for discrimination

Assume that the employer has no tastes for discrimination, but that G workers have a dislike of working with H workers, so there are indifference curves like those 3 and 4 diagrams up (with wage on the vertical axis, the fraction of H workers on the horizontal axis, and indifference curves slope upward again). This generates a tastes for discrimination coefficient, like those for the employer above: if G workers with tastes for discrimination have to work with H workers, they demand a compensating wage for their discriminatory tastes (they act as if their wages are lower than they actually are: if G workers get paid $18, they act as if their wage is only $15 when they work with H workers and the G-workers tastes for discrimination is $3). Mathematically,

$$w_g^{H\,co-workers} = w_g^{H-free} + D_h^{ee}$$

where D_h^{ee} are the gentiles tastes for discrimination when they have to work with house of Israel workers.

It is intuitive, and easy to show that the competitive outcome will be to segregate G and H workers when they are perfect substitutes. So instead of wage discrimination, the outcome ought to be employment segregation (any firm that hires only H or only G workers, will have lower costs than firms that hires both and has to pay a premium to G workers because of they dislike of H workers).

III. Measuring "tastes" of discrimination using regression analysis

We'll talked about Gentiles vs. House of Israel workers so far, but the discussion carries over to race and gender as well: Serbs may not like working with Croats, women may not like hiring men, Hispanics may have tastes for discrimination against whites, etc. Let's examine the differences in incomes between whites and Hispanics. If we initially assume that Hispanics and whites are equally productive, then there are effective tastes of discrimination against Hispanic workers if their wages are relatively lower than whites:

$$W_w = W_h + D$$

where D is the market taste for discrimination (D>0), W_w=wages of whites, and W_h=wages of Hispanics. In the following regression

$$W = \beta_0 + \beta_1 \text{hispanic}$$

where HISPANIC is a binary (dummy) variable which equals 1 when the individual is Hispanic and 0 otherwise, standard regression results are that β_0 estimates the average white wage and β_1 is an estimate difference between hispanic and white salaries. β_1 would be negative if there were effective tastes for discrimination given that whites and Hispanics are equally productive.

Since people are probably not equally productive, we either have to
a) assume that all differences between races (such as location, choice of education, choice of occupation and years of schooling, family size, etc.) are a result of some forms of discrimination, so none of these things need to be included in this last regression regression, or b) control (as best as we can) for the other differences that would "legitimately" lead to wage differentials.

The (a) strategy is embodied in some populist statements about race differences—any differential outcome is considered the result of a market handicaps and not the result of individual choices. Strategy (b) in which we attempt to hold productivity differences constant, can be pursed by modifying the model somewhat to account for differences in productivity. A model that allows for wage differences due either to productivity differences or to discrimination is as follows:

$$W_w - W_h = MP_w - MP_h + D$$

If Hispanics and whites have the same marginal productivity in the labor market, then $MP_w = MP_b$ and this last equation is the same as the one two equations up. If D=0 so that there is no effective market discrimination, the equation immediately above simply is the standard condition that relative wages are proportional to productivity.

In fact we employ regression analysis in a rather indirect way in order to control for relative productivity, and hence be able to "isolate D." Consider a list of variables that influence the productivity of the worker (say education, job experience, and possibly other demographic and industrial information), and denote this matrix of factors by X. We estimate wage equations (by OLS) for Hispanics and whites as follows:

$$W_w = X_w \beta_w \quad \text{and} \quad W_h = X_h \beta_h$$

where the subscripts "w" and "h" are for whites and Hispanics respectively, and Hispanics and whites have possibly different job (and demographic) characteristics. Then we can do the following decomposition of log wage differences (corresponding to equation n5)

$$W_w - W_h = (X_w - X_h)\,\beta_w + X_h(\beta_w - \beta_h)$$

since the "β_i" can be interpreted as the market returns to the attributes X_i, the first right hand side term is interpreted as the difference in marginal productivities while the second right hand term is interpreted as a measure of D. What is being assumed about discrimination when this interpretation is taken?

This last difference (usually done for log wages, see below) using the vector of sample means (X) and vector of estimated regression coefficients (β) is called the "Oaxaca decomposition." For the Oaxaca decomposition, if all the slope regression coefficients are zero (but the hispanic intercept is different than the white intercept), then the decomposition is just

$W_w - W_h = D$, or $W_w = W_h + D$
as we had before.

If $\beta_w = \beta_h$, then $(X_w - X_h)\,\beta_w + X_h(\beta_w - \beta_h)$, the right hand side of the Oaxaca decomposition, becomes $(X_w - X_h)\,\beta_w$ so that all racial differences in wages are just productivity differences, not discriminatory differences.

Oaxaca Decomposition when we have log(wages) as the dependent variable. In this case we simply reformulate tastes for discrimination as relative tastes ($\widetilde{D}$, relative to the wages of Hispanics for instance), so that

$$\widetilde{D}_h = \frac{D_h}{w_h} \text{, so that } w_w = w_h + D_h = w_h(1+\widetilde{D}_h)$$

Now take naturual logs of both sides to get

$$\ln W_w = \ln W_h + \ln(1+\widetilde{D}) = \ln W_h + \widetilde{D}$$

where the second equality is an approximation when D is a fraction close to zero (ln (1+x) = x , approximately, when x is close to zero). Then its apparent that the percentage or log difference in wages is an estimate of the taste for discrimination when workers are otherwise identical. To bring in productivity differences, then we let MP=marginal productivity, and note that

$$\frac{W_w}{W_h} = \frac{MP_w}{MP_h} \cdot (1+\widetilde{D})$$

Now taking natural logs we get

$$\ln W_w - \ln W_h = \ln MP_w - \ln MP_h \quad + \quad \ln(1+\widetilde{D})$$

which works nicely with the Oaxaca decomposition:

$$\ln W_w - \ln W_h = (X_w - X_h)\,\beta_w \quad + \quad X_h(\beta_w - \beta_h)$$

(where the estimated β-vector comes, of course, from the model with the log(wage) as the dependent variable, rather than just the wage as was the case in the examples above).

output for the decomposition in a particularly simple specification (ut_cps_oaxaca.sha), looking at male/female wage differences:
female regressions:

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 84 DF	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
AGE	0.69124E-03	0.6168E-02	0.1121	0.911	0.012	0.0114	0.0045
EDUC_ATT	0.15542	0.3622E-01	4.291	0.000	0.424	0.4363	0.3552
CONSTANT	3.7739	0.4887	7.722	0.000	0.644	0.0000	0.6403

male regression:

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 104 DF	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
AGE	0.21974E-01	0.5451E-02	4.031	0.000	0.368	0.3637	0.1296
EDUC_ATT	0.52366E-01	0.2386E-01	2.194	0.030	0.210	0.1980	0.1156
CONSTANT	4.6595	0.3420	13.62	0.000	0.801	0.0000	0.7548

Using the means from a STAT procedure outputs, we have

$$\ln W_m - \ln W_f = \quad [(X_m - X_f)\,\beta_m] \quad + \quad \{X_f(\beta_m - \beta_f)\}$$

6.1733 – 5.8943 = [(age_m – age_f)*beta_m_age +(educ_m –educ_f)*beta_m_educ]+
{1*(int_m – int_f) + age_f*(beta_m_age-beta_f_age)+educ_f*(beta_m_ed-beta_f_ed)}
=[(36.703-36.369)*.02197 + (13.691-13.411)*.0524] +
{ 1*(4.6595-3.7739) + 36.369*(.02197-.00069123)+13.411*(.05236-.15542)}
=[.00734+.01467] +{.88560+.77393+ -1.38214}=[.02201] + {.27739}

On the left-hand side above, there is about at 28 percent difference in the wages between men and women in utah in 1999; the decomposition on the right hand side suggests that almost all of this difference is due to discrimination. A better model, controlling for occupation and industries, would probably reduce this differential significantly. But you get the idea of how to do this sort of analysis.