

# Economics Department 2006 Honors General Exam

## Suggested Solutions for Micro Section

April 23, 2006

### 1 Question 3

This question is about the impact of discrimination in the marketplace. You are expected to produce a formal, mathematical model, not just to discuss this verbally.<sup>1</sup>

#### 1.1 If some employers dislike hiring minorities, what will be the impact of those discriminatory tastes on the wages and employment of minorities and on the profits of employers?

We model the employer's taste for discrimination in the following way. When faced with a wage for a minority,  $w_M$  an employer acts as though faced with a wage  $p_M(1 + d)$  where  $d > 0$  is a measure of the employers taste for discrimination. A profit maximizing employer chooses inputs such that

$$\frac{MP_j}{MP_i} = \frac{w_i}{w_j}$$

If the employer has a taste for discrimination, this condition becomes

$$\frac{MP_j}{MP_i} = \frac{w_i(1 + d_i)}{w_j(1 + d_j)}$$

where  $d_i$  is the measure of the employer's discrimination towards factor  $i$ . It is immediately clear that the employer will earn lower profits as factor choices that take into account tastes for discrimination are sub-optimal. Further, if the firm's production function has decreasing marginal returns to factor inputs, employers that dislike hiring minorities will have a lower demand for minorities.

If minorities  $M$  and non-minorities  $L$  are perfect substitutes in the production function, then employers with a taste for discrimination will hire non-minorities if and only if  $w_M(1 + d) \leq w_L$ . Minorities will only be hired at a wage level strictly below that of non-minorities.

#### 1.2 How would this change if some employers like hiring minority applicants?

If there are some employers that favor hiring minorities, which we can model by  $d < 0$ , the same analysis implies that these firms will have below optimal profits and a higher demand for minorities.

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<sup>1</sup>Solutions based on Becker, The Economics of Discrimination

### 1.3 Will either type of discriminatory employer survive in the market in the long run?

Consider a model of a single competitive industry in which minorities and non-minorities are perfect substitutes. Further, assume that the supply is fixed and given by  $S_M$  and  $S_L$  respectively with  $S = S_L + S_M$  and the production function of any potential firm is identical to the production function of the industry given by  $Y = F(S)$ . If all employers have a taste for discrimination  $d$ , then the full employment equilibrium condition is given by,

$$p_X \frac{dF(S)}{dS} = w_L = w_M(1 + d)$$

with a strictly lower wage rate for minorities. However, if there is a distribution of  $ds$  across employers or potential employers then employers with  $d = 0$  will hire only  $M$  at the lower wage  $w_M$  and realize higher profits. If the production function is homogenous or there are enough potential employers with  $d = 0$ , then employers with  $d > 0$  will not survive in the long-term.

### 1.4 If customers, rather than employers, care about whether products are produced by minorities, what will this do to minority wages and employment, and to employer profits? What does this say about whether market forces are likely to eliminate discrimination?

We model a consumer's taste for discrimination in a similar manner. When faced with a price  $p_M$  for a good produced by a minority, a consumer with a taste for discrimination acts as though the price is  $p_M(1 + d)$ . Suppose that it takes  $k$  employees to produce one unit of marketable good, then a profit maximizing employer (with no taste for discrimination) is indifferent between hiring minorities and non-minorities if and only if

$$p_M - kw_M = p_L - kw_L$$

Further, consumers are indifferent between goods made by minorities and those made by non-minorities if and only if

$$p_L = (1 + d)p_M$$

This implies that if goods made by minorities are purchased in equilibrium then the price for these goods will be strictly less than for those made by non-minorities. This in turn implies from the firm's indifference condition that the wage for minorities is strictly lower than the wage for non-minorities.

In contrast to the case of employer discrimination, market forces are not likely to eliminate the effects of consumer discrimination. When we considered employer discrimination, we assumed that  $M$  and  $L$  were perfect substitutes in production in the sense of marketable output, though  $M$  might also produce dis-utility for their employer. Thus, if not all employers have a taste for discrimination, employers with no taste for discrimination may be able to out compete those employers with discrimination. However, in this case  $M$  and  $L$  are no longer perfect substitutes in the production of marketable goods and perfect competition among firms will not eliminate discrimination.

## 2 Question 4

Consider a modified prisoners dilemma game of the form:

	Be Nice	Cheat
Be Nice	5,5	6,0
Cheat	0,6	1,1

In each cell, the first number refers to Player As payoff, and the second refers to Player Bs.

## 2.1 What are the Nash equilibria of this game?

The strategy 'Cheat' is a dominant strategy for both players and thus {Cheat, Cheat} is the only nash equilibrium of the game.

## 2.2 If the game is repeated by the same two players, and payoffs in the second period equal payoffs in the first period times a discount factor $d$ then what are the Nash equilibria of this new two-stage game? What are the subgame perfect equilibria of this game? How does $d$ determine the set of equilibria?

We assume  $d > 0$  throughout. Using backward induction, the only sub-game perfect nash equilibrium is given by

$$\{Cheat, (Cheat \rightarrow Cheat, BeNice \rightarrow Cheat)\}.$$

The set of SPNE does not depend on the discount factor  $d$ . However, for low values of  $d$ , there also exists non subgame perfect nash equilibria that involve a non-credible, off the equilibrium path, promise to play the action 'Be Nice' in the second period. Specifically, for  $d \leq 1/5$  a symmetric NE exists, given by the strategy profile

$$\{Cheat, (Cheat \rightarrow Cheat, BeNice \rightarrow BeNice)\}.$$

Further, any mixed combination of the subgame perfect strategy and the non- subgame NE strategy also forms a non-subgame perfect NE. Note that in all equilibria, players exhibit non-cooperative play in both periods.

## 2.3 What sort of strategy commitments would players like to make if they could?

Players would like to be able to commit to cooperate in future periods. Consider the 2 period example above. If both players could credibly commit to playing 'Be Nice' contingent on their cooperation in the first period (and 'Cheat' otherwise), then for  $d \geq \frac{1}{4}$  cooperation in both periods could be sustained in equilibrium. To show that this is an equilibrium, we consider the payoffs from deviating. A deviator will earn  $6 + d$  while equilibrium play yields  $5 + 5d$  and the former is greater if and only if  $d < \frac{1}{4}$ .

## 2.4 Speculate on how the game (without strategy commitments) would change if there are more periods. How about if the number of periods is infinite?

Using the same backwards induction argument, for any finitely repeated game the only subgame perfect nash equilibrium will involve non-cooperative play in all periods. In the case of an infinitely repeated game, the folk theorem implies that for discount factors close to 1, equilibria exist for all pairs of feasible and individually rational payoffs. In particular, an equilibrium that yields cooperative play in all periods can be sustained for large enough  $d$ . The symmetric grim trigger strategy given by play 'Be Nice' if the other player has never played 'Cheat', play 'Cheat' otherwise gives equilibrium play of {Be Nice, Be Nice} for all  $d \geq \frac{1}{5}$ .