

**GOVERNMENT-MANDATED DISCRIMINATORY POLICIES:
THEORY AND EVIDENCE***

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We study an economy with private and public sectors in which workers invest in imperfectly observable skills that are important to the private sector but not to the public sector. Government regulation allows native majority workers to be employed in the public sector with positive probability while excluding the minority from it. We show that even when the public sector offers the highest wage rate, it is still possible that the discriminated group is, on average, economically more successful. The widening Chinese/Malay wage gap in Malaysia since the adoption of its New Economic Policy in 1970 supports our model.

1. INTRODUCTION

Government-mandated discrimination of ethnic or religious groups is a common phenomenon in many places around the world. The most well-known examples are probably the Jim Crow laws in the United States and the South African apartheid system. There are also numerous instances of such policies in other parts of the world (see Sowell, 1990). For example, in many Southeast Asian countries, including Malaysia and the Philippines, Chinese have continuously been the subject of official discrimination ranging from minor harassments, such as special taxes for signs written in Chinese, to more significant measures, such as bans from a wide range of professions, discriminatory taxation, and bans against Chinese-owned retail and trade (see Purcell, 1965).

Surprisingly, there seems to be no uniform relationship between a group's economic performance and whether it is discriminated against by government mandate. Although Blacks in the United States and South Africa have suffered dearly from the discriminatory policies, the overseas Chinese in Southeast Asia is economically more successful than the preferentially treated natives. In Malaysia, for example, the Chinese median income has been roughly twice the Malay median

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income during the post-colonial era. The Jews in Europe are another group that has managed to prosper despite economic restrictions and political persecutions, and there are many other less well-known examples.

What determines the relationship between government-mandated discrimination and economic performance? Are there any systematic reasons for the economic prosperity of overseas Chinese and Jews despite discriminatory policies? In this article, we provide a simple model of the incentive effects of discriminatory policies and show, in a nutshell, that discriminatory policies may serve as a useful device to alleviate an informational free-riding problem among the members of the discriminated group and enhance human capital investments. Hence, government-mandated discrimination could actually be the reason for, rather than an obstacle to, economic success.

The above anecdotes suggest that the preferred groups may not necessarily perform better economically than the discriminated groups. However, a number of other models can also explain wage gaps between groups. The most obvious explanation may be a selection argument: The group that is discriminated against such as overseas Chinese in Southeast Asia and Jews in Europe was a selected sample. Cultural factors independent of economic conditions could presumably also be the explanation. A rather dramatic policy shift that occurred in Malaysia in 1970 provides a useful, though not ideal, social experiment to distinguish the mechanism proposed in our model from these alternative explanations. The ethnic Chinese in Malaysia were discriminated against prior to the implementation of the “New Economic Policy.” However, this policy, implemented when the Nationalistic Pan Malayan Islamic Party ousted a coalition representing the three major ethnic groups (Malays, Chinese, Indians), *increased* the intensity of the preferential policies in favor of the Malays. In Section 2, we provide a relatively in-depth case study of how the more preferential policies in favor of the Malays have affected the Chinese/Malay wage gap. We find that the Chinese/Malay wage gap was decreasing prior to the implementation of the New Economic Policy and started to increase again for cohorts entering the labor market after the policy change. As we said, this case study is not an ideal experiment because at the same time the New Economic Policy was implemented, the Malaysia economy was also experiencing one of the fastest growth spurts—in other words, many other dimensions of the Malaysian economy also changed contemporaneously. In Section 4, we argue that, despite these potentially confounding changes, the experience in Malaysia we document in Section 2 is consistent with our model’s prediction that economic performance may be positively related to the degree of discrimination, but it is difficult to reconcile with alternative explanations.

In Section 3, we consider an economy with two sectors, which we refer to as the private and the public sectors, respectively. The crucial distinction between the sectors is that the government is able to regulate the hiring policies in what we refer to as the public sector. Workers make a costly investment in skills prior to entering the labor market. Skills are crucial for private sector jobs but unimportant for the public sector.

The only friction in the model is that firms do not perfectly observe workers’ skill investment decisions; instead they must rely on noisy signals to make inference

about workers' skills. This leads to an informational free-riding problem since the firms' perception of the fraction of skilled workers in the population is a public good (see also Fang, 2001; Norman, 2003). The public sector jobs are assumed to be attractive in the sense that their wages are higher than the highest equilibrium wages in the private sector.²

We model the government-mandated discriminatory policy as a government regulation that prohibits the minorities from access to public sector jobs, while allowing the native majority workers to be hired on these jobs with positive probability. The probability that majority workers can obtain a public sector job is our measure of the extent of governmental control of the labor market: A higher probability must imply that the public sector is large and vice versa.

Since we assume that the public sector jobs are most attractive, it is clear that, if all native majority workers could be given a public sector job, then the majority would certainly do better than the discriminated minority. The main part of our analysis is to show that when the probability of obtaining a public sector job for the majority is sufficiently small, the minority may, on average, be economically more successful than the majority. The intuition is as follows. The direct effect from being excluded from the highest paying jobs is to reduce the average wage of the minority group. However, the exclusion also creates better incentives to invest in skills valuable in the private sector, which partially alleviates the informational free-riding problem among the group members. The latter, indirect equilibrium effect may dominate the direct effect. The magnitude of the wealth differentials that can be generated by the model can in principle be substantial.

Our model is very stylized and designed to understand the possible benefits a group may enjoy from discriminatory legislation. Naturally, this model will not provide a full explanation as to why certain discriminated groups are so much more successful than others. However, there are several parameters in the model that are suggestive about why discriminatory policies seem to have led to economic hardships for Blacks in the pre-civil rights era United States and South Africa, whereas other groups, like the Chinese in Southeast Asia, enjoyed relative economic success. The extent of the discriminatory policies is crucial in the sense that exclusion can only be beneficial if the government-controlled sector is small enough. As far as we understand, the policies facing Blacks were significantly broader measures than those implemented in Southeast Asia. Moreover, it is necessary that some sector where investments in skills are important is left open for the discriminated group. Again, this seems like a more plausible assumption when considering overseas Chinese.

The remainder of the article is structured as follows. Section 2 briefly discusses the evolution of discriminatory policies and the ethnic wage differentials in Malaysia; Section 3 presents the model and the main result; Section 4 discusses alternative explanations of the Malaysian experience and provides further evidence consistent with our model; finally, Section 5 concludes.

² This assumption is made because it seems more realistic to us that the politically dominant group excludes minorities from the most attractive professions.

2. MOTIVATING OBSERVATIONS

In this section, we briefly examine the empirical fact of how the Chinese–Malay wage gap responded to the government-mandated preferential policies favoring the Malays (the New Economic Policy) that were initiated in 1970. Similar discriminatory policies have been implemented in many other southeast Asian countries, but the size of the Chinese minority in Malaysia (about one-third of the population) makes it an ideal example. The main point of this relatively in-depth empirical examination is to motivate our theoretical model in Section 3. We will discuss alternative explanations for this evidence in Section 4.

2.1. *Political Background.* Malaysia gained independence from British colonial rule in 1957 and became a Muslim country, which, under its constitution, allowed preferential treatment of ethnic Malays over other races. An interesting feature of Malaysian society is that its population is characterized by a diverse ethnic composition resulting from large population movements in the 19th and early 20th centuries. In 1988, about 58% of the population of Peninsular Malaysia were Malays (the *bumiputras* or “sons of the soil”), 32% were Chinese, 10% Indians, and Thais, Eurasians, and others made up less than 1% (Schafgans, 1998).

One of the main issues of contention in pre-independence Malaya was the proposed constitutional plan regarding the relative status of Malays to non-Malays. In 1957, an agreement was reached that the constitution would protect the Malays by entitling them to certain privileges including political power, while at the same time allowing the Chinese to pursue their economic objectives without interference. The three main ethnic political parties formed a coalition known as the Alliance which firmly supported the above formula for racial harmony in post-independence Malaya, and the Alliance won the general elections of 1955, 1959, and 1964.

However, the Malay nationalist and religious sentiment grew over time while the Chinese community sought greater political representation, social reforms, and racial integration. Alternative ideological platforms were offered: the nationalistic Pan Malayan Islamic Party, and the Chinese working-class-supported Democratic Action Party. In the 1969 general election, the Alliance lost ground to these alternative parties, and with it the Alliance’s formula for racial harmony was rejected. Following the election, racial riots ensued, the federal parliament and state assembly were suspended, and state emergency was declared (see chapter 2 of Gomez and Jomo, 1999).

It was against such a political backdrop that the New Economic Policy (henceforth NEP) was announced in 1970. The primary objectives of the NEP were to “eradicate poverty” irrespective of race and to achieve interethnic economic parity between the predominantly Malay Bumiputeras and the predominantly Chinese non-Bumiputeras by “restructuring society” (see chapter 3 of Gomez and Jomo, 1999, for detailed accounts and Yip, 2000, for a summary). To achieve the second objective, wide-ranging preferential policies favoring the Malays were introduced. The major components of these preferential policies include the

following: Licenses to participate in certain economic sectors and subsidies in agriculture are handed out on a racial basis; Malays have easier access to public sector employment; racial quotas are enforced in university admissions; a mandatory minimum of 30% ethnic Malay equity ownership is required in certain types of firms. Under the NEP, the total number of enterprises owned by federal and state authorities grew considerably from 109 in 1970 to 362 in 1975, 656 in 1980, and 1,010 in 1985 (see Gomez and Jomo, 1999, p. 31). We believe that the increase in the number of public enterprises was not simply a proportional reflection of the overall expansion of the Malaysian economy; instead it represented an increase in the relative size of the public sector. Our main evidence for this comes from Jesudason (1989). He documented that Malaysia's public enterprises grew larger relative to its total economy from 1970 to 1988 from several angles. First, he showed (p. 80) that "public sector development expenditure more than doubled in real terms from plan period to plan period," and "as a percentage of GNP, public sector development expenditure averaged around 8 percent annually in the First Malaysian Plan, 11 percent in the Second, 16.3 percent in the Third, and 25.6 percent in the Fourth." Second, he also showed that (p. 84), "State enterprise expansion, at best, was an enormous exchange of assets in which the state paid out cash for existing assets built up by foreign and Chinese sectors. There was little net increase in production and employment, although it met the ethnic goal of having greater control of the economy." Because of the ostensibly pro-Malay bias in public sector hiring, the proportion of non-Malay employment in the public sector declined dramatically under the NEP as the number of federal and state-owned enterprises grew.

2.2. *Data.* We use the Second Malaysian Family Life Survey (MFLS-2), in particular, survey instrument MF23 administered to men, to analyze the change of wage inequality between the Chinese and the Malays after the implementation of the NEP.³ MFLS-2 was collected between August 1988 and January 1989. It was the sequel to the First Malaysian Family Life Survey (MFLS-1) conducted in 1970, and the geographic coverage of both surveys was restricted to Peninsular Malaysia. It records the occupation category of each job ever held by a male, the date the job started and ended, as well as the starting and ending wage of each job, and the highest education level completed. The data used below are drawn from the "panel," "child," and "new" samples of the survey. The combined sample contains 4,789 men, and restricting attention to those between 18 and 65 leaves us with approximately 3,460 observations. The retrospective employment data are used to construct the total experience of each person. Since only the starting and ending (or 1988) wages of each job held by an individual are observed, we could in principle impute the wage at specific years in the employment history by linear interpolation. However, examining the earnings data reveals that the mean increase in earnings is 10.5% per year for the Malays and 21.2% per year for the

³ The data set was collected by RAND and the National Population and Family Development Board of Malaysia. It is publicly available at <http://www.rand.org/FLS/>.

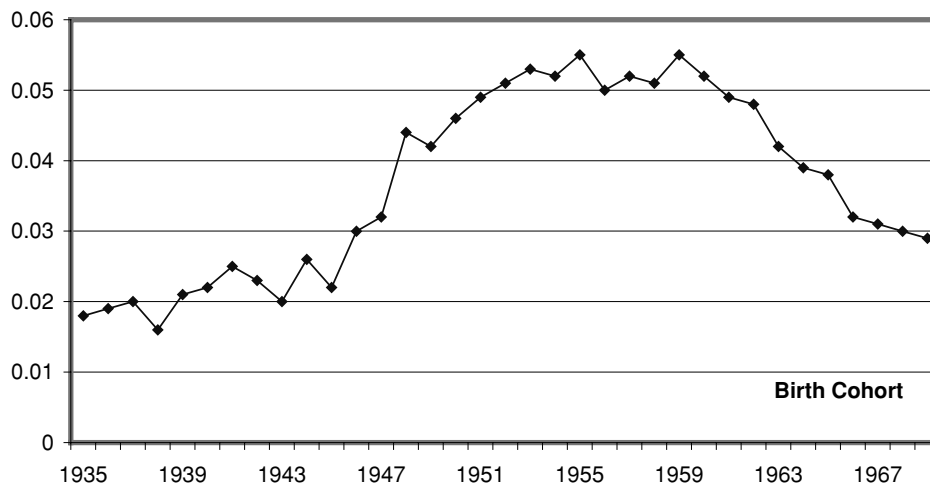


FIGURE 1

PERCENTAGE OF MALAYS IN OCCUPATION "GOVERNMENT OFFICIALS" IN THEIR CURRENT JOB IN 1988

Chinese. In what follows, we will use either the current wage or the most recent starting wage for the years in a specific year during an employment spell.⁴

2.3. Empirical Facts

2.3.1. *Proportion of public sector employment by Chinese and Malays.* We first provide some *crude* estimate of the probability of obtaining public sector employment in Malaysia. In MFLS-2, the only occupational category that can be unambiguously identified as public sector employment is category code 31 "Government Officials." The data code book does not explicitly state what this category exactly includes, but given the other detailed occupation categories (a total of 98 occupation categories) in the data, this is almost surely *only a small subset* of proper public sector employment. Using this downward-biased measure, we find that, including all birth cohorts and all levels of experience, 0.45% of the Malay men and literally *none* of the Chinese men reported working in the occupation of "Government Officials." Figure 1 shows the percentage of Malay men reportedly employed as "Government Officials" in 1988 by birth cohorts. Since birth cohorts prior to 1935 started retiring in 1988, we will restrict our attention to the birth cohorts later than 1935. Although some changes of the percentages in the figure certainly reflect in part the life-cycle nature of public sector employment, it does appear that cohorts from 1946 on are more likely employed as "Government Officials." Together with our earlier accounts from Gomez and Jomo (1999) and

⁴ This would lead to a downward bias in the estimate of the wage ratio between the Chinese and the Malays, but qualitative results regarding the change of the wage ratio are robust to different methods to interpolate the wages during an employment spell.

Jesudason (1989) that the public enterprises dramatically increased after 1970, we are confident that the probability of public sector employment has indeed increased substantially from 1970 for the Malays, but not for the Chinese.

2.3.2. *Wage ratio between the Chinese and Malays.* In MFLS-2, the average income of Chinese men, including all birth cohorts and all levels of experience, is about 1.92 times that of Malays. This is slightly less than the average *household* income ratio of 2.2 between the Chinese and the Malays found in Anand (1983) using the data from the 1970 Post-Enumeration Survey, which is indicative of a reduction in ethnic inequality. However, when we look at the ratio of the average wage between the Chinese and the Malays by birth cohort, a different picture emerges. If the NEP is indeed successful in reducing racial earnings inequality, we should see that at all levels of schooling and experience, the earnings gap should decline. Moreover, the decline should be more pronounced for cohorts that entered the workforce in 1970 and after (birth cohorts from 1950 on), because the Malays in these younger cohorts experience both increased employment and education opportunities because of the NEP. Figure 2 shows the ratio of the average Chinese and the Malays wages by birth cohorts and experience level. We mark the birth cohort 1950 in Figure 2 to indicate that it is the first cohort fully impacted by the NEP in both education and employment. Although Figure 2 does not control for the differences in the years of schooling, controlling for schooling (based on a Mincer wage regression) does not change the qualitative feature of the movement of Chinese/Malay wage ratios. The only effect is that all curves are scaled downward.

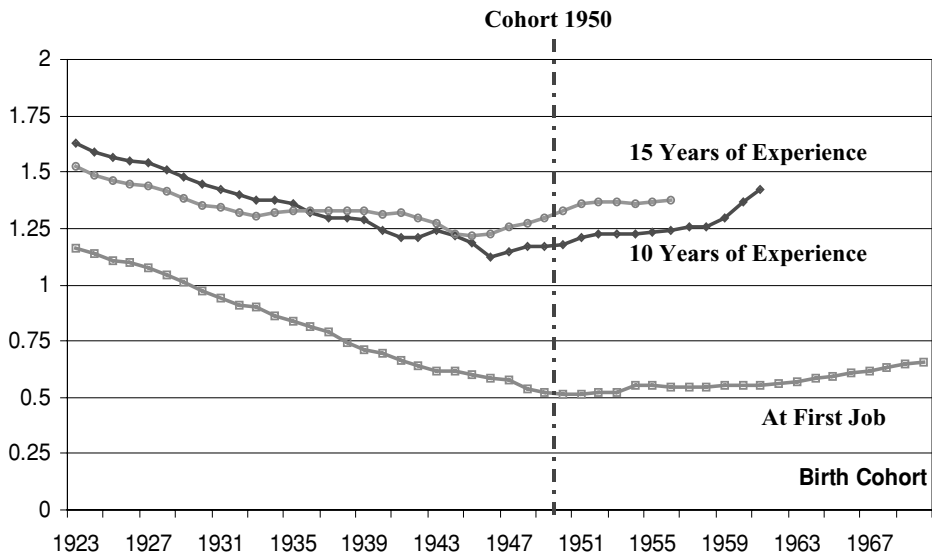


FIGURE 2

RATIO OF MEAN CHINESE AND MALAY WAGES BY BIRTH COHORTS

A very similar curve arises if we do not include men who reported working as “Government Officials.”⁵

A few features are worth commenting on. First, except for the entrants into the labor force, the Chinese–Malay wage ratios were steadily above one at other experience levels. Second, there has been a secular narrowing of the wage gap prior to the NEP at all three experience levels, suggesting a decline in the income inequality between the Chinese and the Malays in the pre-1970 era. This is consistent with Gomez and Jomo’s (1999) finding that, between 1957 and 1970, the interethnic income differences were reduced slightly. Third, and the most surprising, is that the wage gap increased at all three experience levels after 1970. In fact, young Malays enjoyed a slight advantage upon entry into the labor force for cohorts born in the 1940s and early 1950s.⁶ However, this slight advantage disappeared after the NEP. It seems to be a puzzle that, despite the aggressive preferential policies favoring the Malays, the Malay did not achieve significant economic progress relative to the Chinese; if anything, the opposite seems to be true, that is, the NEP reversed the pre-1970 trend of the narrowing wage gaps between the Chinese and the Malays.

3. THEORY

3.1. *The Model*

3.1.1. *The private and public sectors.* Consider an economy with two sectors, called respectively the *private* and the *public* sector.

The private sector consists of two (or more) competitive firms, indexed by $i = 1, 2$. Firms are risk neutral and maximize expected profits, and are endowed with a technology that is complementary to workers’ skills. A skilled worker can produce $\beta > 0$ units of output, and an unskilled one will, by normalization, produce 0.

The public sector offers a fixed wage g to any worker who is hired, but there is rationing of public sector jobs: The probability of getting hired in the public sector if a worker applies is given by $\rho^j \in [0, 1]$, where $j \in \{A, B\}$ is the worker’s ethnic identity. In our analysis below, we treat ρ^j as the government’s policy parameter. Government-mandated discriminatory policies are simply modeled by the assumption that $\rho^A \neq \rho^B$.

We call the minority group A and let B label the majority. We say that group A is discriminated by government mandate relative to majority group B if $\rho^A < \rho^B$.^{7,8}

⁵ We followed Yip’s (2000) econometric procedure in calculating the wage ratios.

⁶ This is consistent with Schafgan’s (1998) finding, applying semiparametric methods to the whole sample, that there is no indication of “discrimination” against Malays after controlling for schooling.

⁷ We treat ρ^j as exogenous in our analysis. In a more realistic setup, one can imagine that there is a limited number of public sector vacancies and the probability of being employed in the public sector equals the ratio of the vacancy and the number of applicants. The main insight of this article is robust to such a formulation. In fact, in our leading example, every worker wants public sector employment, justifying the assumption.

⁸ The relative size of group A is irrelevant in our model, so the discriminated group is referred to as the minority only to make the language less awkward.

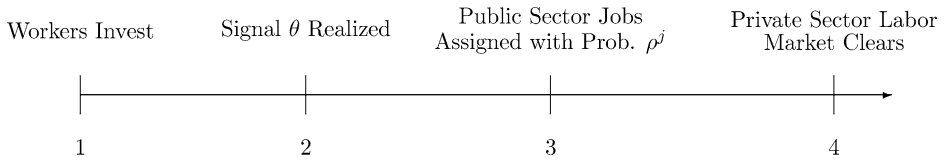


FIGURE 3

TIMING OF THE EVENTS

The “public sector” in our article is a *metaphor* for the part of the economy that the government can control with legislation. That is, industries where the government can control, either through direct ownership or through professional licensing, should all be considered as part of our government sector. The parameters (ρ^A, ρ^B) will, to some degree, represent the extent of the government’s control of the economy.

Workers who apply for but are unsuccessful in obtaining public sector employment can return to and obtain a job in the private sector without waiting.

3.1.2. *Workers.* For each ethnic group $j \in \{A, B\}$, there is a continuum of workers with mass λ^j in the economy. Workers are heterogeneous in their costs, denoted by c , of acquiring the requisite skills for the operation of the firms’ technology. The cost c is private information of the worker. We assume that it is distributed according to a Uniform $[0, 1]$ distribution in the population of both groups.⁹

Workers are risk neutral and do not care directly about whether they work in the public or private sector. If a worker of cost type c receives wage w , her payoff is $w - c$ if she invests in skills and w if she does not invest.

3.1.3. *Timing of events and information structure.* It is useful to divide the events in this economy into four stages that we now detail. The timing of events is summarized in Figure 3.

In the first stage, each worker in group j with investment cost $c \in [0, 1]$ decides whether to invest in the skills. This binary decision is denoted by $s \in \{0, 1\}$ where $s = 0$ stands for no skill investment and $s = 1$ for skill acquisition. If a worker chooses $s = 1$, we say that she becomes *qualified* and hence she can produce β units of output in the private sector; otherwise she is *unqualified* and will produce 0. We write the skill acquisition profile for group j as $S^j : [0, 1] \rightarrow \{0, 1\}$.

It is important that skill acquisitions are *not* perfectly observed by the firms. However, in the second stage, the worker and the firms observe a noisy signal $\theta \in \{h, l\} \equiv \Theta$ about the worker’s skill acquisition decision.¹⁰ We assume that a

⁹ Our qualitative results are valid for general continuous distributions.

¹⁰ Models of statistical discrimination usually assume that signals are distributed according to a continuous density f_q if the worker invests in skills and f_u if she does not, and that f_q/f_u satisfies the strict monotone likelihood ratio property. We could also follow this route, but prefer the binary formulation for its simplicity.

high signal h (and a low signal l , respectively) reveals a qualified (an unqualified, respectively) worker correctly with probability $p > 1/2$. That is,

$$\Pr[\theta = h | s = 1] = \Pr[\theta = l | s = 0] = p > 1/2$$

Note that the signal distributions are identical for both groups.

In the third stage, after observing the noisy signal θ , each worker decides whether to apply for the public sector job. If applying, she is accepted for employment in the public sector with probability ρ^j where j is her ethnic identity.

If she did not get employed in the public sector, she will, in the fourth stage, return to the private sector, where firms compete for her service by posting wage offers. Firm i 's wage offer schedule, denoted by $w_i^j : \Theta \rightarrow \mathbb{R}_+$, can depend on the worker's ethnic identity j and her test signal $\theta \in \Theta$. After observing the wage offers, she decides which firm to work for, clearing the private sector labor market.

3.1.4. *Discussion of the assumptions.* Now we discuss some of our modeling choices.

- Output is not contractible in our model. The informational externality that is driving our results would disappear if workers could be made residual claimants on output, so this assumption is important. One way to justify this assumption is that workers are engaged in team production and only the aggregate, but not the individual, output can be observed by the firm.
- The informational externality would also disappear if the workers can access the production technology. In our model we rule this out by assuming that only the firms have access to the technology. One way to justify such an assumption is to appeal to “entrepreneurial ability” as necessary for successful operation of a firm and identify firms with entrepreneurs. Alternatively, one could imagine that there is a minimum efficient scale of production and the workers are financially constrained or that the operation of the technology requires some technical know-how that only the firms have access to.
- We assume that the skill investment decision is made before the public sector employment lottery is conducted. This timing assumption is crucial for our results. Otherwise, the preferential policy for the majority in the public sector would not adversely affect their skill investment incentives. This seems to be a reasonable assumption since employment often starts after human capital investments are already chosen.
- We assume that if a worker is unsuccessful in obtaining public sector employment, she can immediately return to the private sector to find a job. Moreover, since the noisy signal is realized before public sector jobs are allocated, workers know exactly what wage they would get in the private sector. These assumptions are made in order not to build in any disguised “matching costs” in the public sector. In other words, our choice of timing guarantees that a worker has nothing to lose from applying for a public sector job if the wage is higher there than the wage she would get in the private sector.

- Both the public sector wage g and the probability of obtaining public sector employment ρ^j are independent of θ . These extreme assumptions are made so that our main idea can be conveyed in the simplest possible fashion. The results are robust to alternative assumptions as long as “luck” (i.e., the public sector job lottery) is more important in the public sector than in the private sector.
- We do not have between-group interactions in this model for simplicity. Between-group interactions can be introduced either through an aggregate production function as in Moro and Norman (2004) or through an explicit modeling of the public sector rationing. We choose not to introduce such interactions because the main insights of the article are better conveyed in a bare-bone model.

3.2. *Equilibrium.* Since the two groups in the model do not interact, we will analyze the equilibrium for each group separately. A *Perfect Bayesian Nash Equilibrium* (PBNE) for group j consists of a skill acquisition profile $S^j(\cdot)$, job application and offer acceptance decisions by group j workers, together with firm wage offer schedules $w_i^j(\cdot)$, such that every player optimizes against other players’ strategy profile for a consistent belief system.¹¹

We first analyze the equilibrium wage offers in the fourth stage. A private firm observing a group j worker with a signal $\theta \in \{h, l\}$ must form a belief about the probability that the worker is qualified. We now analyze the firm’s belief as follows.

Suppose that at the end of the first stage, a proportion π^j of the group j population is qualified. Then in the second stage, a total measure $p\pi^j + (1 - p)(1 - \pi^j)$ of workers receives signal h , among which a measure $p\pi^j$ is qualified and a measure $(1 - p)(1 - \pi^j)$ is unqualified. Similarly, a total measure $(1 - p)\pi^j + p(1 - \pi^j)$ of workers receives signal l , among which a measure $(1 - p)\pi^j$ is qualified and a measure $p(1 - \pi^j)$ is unqualified. In the third stage, each worker observes his signal. In equilibrium, all group j workers with the same signals must make identical decisions about whether or not to apply for public sector employment regardless of whether they are qualified or not (unless they are indifferent, in which case a decision independent of qualifications is still optimal). This absence of selection in job applications follows from the continuation payoff in the fourth stage being independent of skills. Hence, we conclude that, the proportion of qualified workers among group j members with signal θ in the fourth stage is unaffected by their public sector job application decision in the third stage, even though the total mass of group j workers with signal θ in the fourth stage may be different from that in the third stage.

Therefore, if the proportion of qualified workers in group j at the end of the first stage is π^j , then in the fourth stage, when a firm sees a group j worker with a signal θ , its posterior belief that this worker is qualified, denoted by $\Pr[s = 1 \mid \theta; \pi^j]$ where $\theta \in \{h, l\}$, is given by

¹¹ Due to the noise in the signal, there are no off-the-equilibrium histories for the firms to observe, so beliefs are fully determined by Bayesian updating. The only place where “perfectness” enters the analysis is that workers in the private sector choose firms optimally after any history of play.

$$\begin{aligned}
 \Pr[s = 1 | \theta = h; \pi^j] &= \frac{p\pi^j}{p\pi^j + (1-p)(1-\pi^j)} \\
 \Pr[s = 1 | \theta = l; \pi^j] &= \frac{(1-p)\pi^j}{(1-p)\pi^j + p(1-\pi^j)}
 \end{aligned}
 \tag{1}$$

exactly as if there were no public sector. Note that in (1), the proportion of investors π^j serves as the prior in the application of Bayes' rule. Standard arguments show that the "Bertrand"-type competition between firms for the workers implies that in the fourth stage, each worker will be offered a wage equal to his expected productivity in equilibrium (see, e.g., Moro and Norman, 2004). Hence, in the fourth stage, the equilibrium wage for group j workers with signal $\theta \in \{h, l\}$ when the proportion of qualified workers in group j is π^j , denoted by $w_\theta(\pi^j)$, is

$$\begin{aligned}
 w_h(\pi^j) &= \beta \Pr[s = 1 | \theta = h; \pi^j] = \frac{\beta p \pi^j}{p\pi^j + (1-p)(1-\pi^j)} \\
 w_l(\pi^j) &= \beta \Pr[s = 1 | \theta = l; \pi^j] = \frac{\beta(1-p)\pi^j}{(1-p)\pi^j + p(1-\pi^j)}
 \end{aligned}
 \tag{2}$$

The public sector job application decision in the third stage is now easy to analyze. A group j worker with signal θ applies for the public sector job if $w_\theta(\pi^j) < g$ and does not apply if $w_\theta(\pi^j) > g$. If $w_\theta(\pi^j) = g$, then she is indifferent and the expressions below assume that indifferent workers apply for the public sector jobs. Note that both $w_h(\cdot)$ and $w_l(\cdot)$ in (2) are monotonically increasing in π^j . Defining $\hat{\pi}_\theta$ as the solution to $w_\theta(\hat{\pi}_\theta) = g$ for $\theta \in \{h, l\}$, i.e.,

$$\hat{\pi}_h = \frac{g(1-p)}{g(1-p) + p(\beta - g)}, \quad \hat{\pi}_l = \frac{gp}{gp + (1-p)(\beta - g)}
 \tag{3}$$

We can conclude that a group j worker with signal θ applies for a public sector job if and only if $\pi^j \leq \hat{\pi}_\theta$.

A worker's incentive to acquire skills in the first stage comes from the subsequent expected wage differential between a qualified and an unqualified worker. The wage differential arises because qualified workers are more likely to draw the high signal. Denote the expected wage, before the realization of the signal, for a qualified and an unqualified worker from group j , by $W_1(\pi^j, \rho^j)$ and $W_0(\pi^j, \rho^j)$, respectively, where π^j is the fraction of qualified workers in group j and ρ^j is the probability of a group j worker being assigned a job in the public sector if one applies. They are given by

$$\begin{aligned}
 W_1(\pi^j, \rho^j) &= p \cdot \max\{w_h(\pi^j), \rho^j g + (1-\rho^j)w_h(\pi^j)\} \\
 &\quad + (1-p) \cdot \max\{w_l(\pi^j), \rho^j g + (1-\rho^j)w_l(\pi^j)\} \\
 W_0(\pi^j, \rho^j) &= (1-p) \cdot \max\{w_h(\pi^j), \rho^j g + (1-\rho^j)w_h(\pi^j)\} \\
 &\quad + p \cdot \max\{w_l(\pi^j), \rho^j g + (1-\rho^j)w_l(\pi^j)\}
 \end{aligned}
 \tag{4}$$

where the max operator in (4) represents the workers' optimal decision of whether or not to apply for a public sector job. The incentive to invest in skills for group j workers, denoted by $I(\pi^j, \rho^j)$, is equal to the gain in expected wage from skill investment in the first stage relative to not investing, and is given by

$$\begin{aligned}
 (5) \quad I(\pi^j, \rho^j) &= W_1(\pi^j, \rho^j) - W_0(\pi^j, \rho^j) \\
 &= (2p - 1)\{(1 - \rho^j)[w_h(\pi^j) - w_l(\pi^j)] \\
 &\quad + \rho^j[\max\{w_h(\pi^j), g\} - \max\{w_l(\pi^j), g\}]\}
 \end{aligned}$$

Alternatively, we can use $\hat{\pi}_\theta$ defined in (3) and, after noting that $\hat{\pi}_h < \hat{\pi}_l$, rewrite $I(\pi^j, \rho^j)$ as

$$(6) \quad I(\pi^j, \rho^j) = \begin{cases} (2p - 1)(1 - \rho^j)[w_h(\pi^j) - w_l(\pi^j)] & \text{if } 0 \leq \pi < \hat{\pi}_h \\ (2p - 1)\{(1 - \rho^j)[w_h(\pi^j) - w_l(\pi^j)] + \rho^j[w_h(\pi^j) - g]\} & \text{if } \hat{\pi}_h \leq \pi < \hat{\pi}_l \\ (2p - 1)[w_h(\pi^j) - w_l(\pi^j)] & \text{if } \hat{\pi}_l \leq \pi \leq 1 \end{cases}$$

Figure 4 graphically illustrates the function $I(\pi^j, \rho^j)$ for $\rho^j = 0$ and $\rho^j = 0.5$.

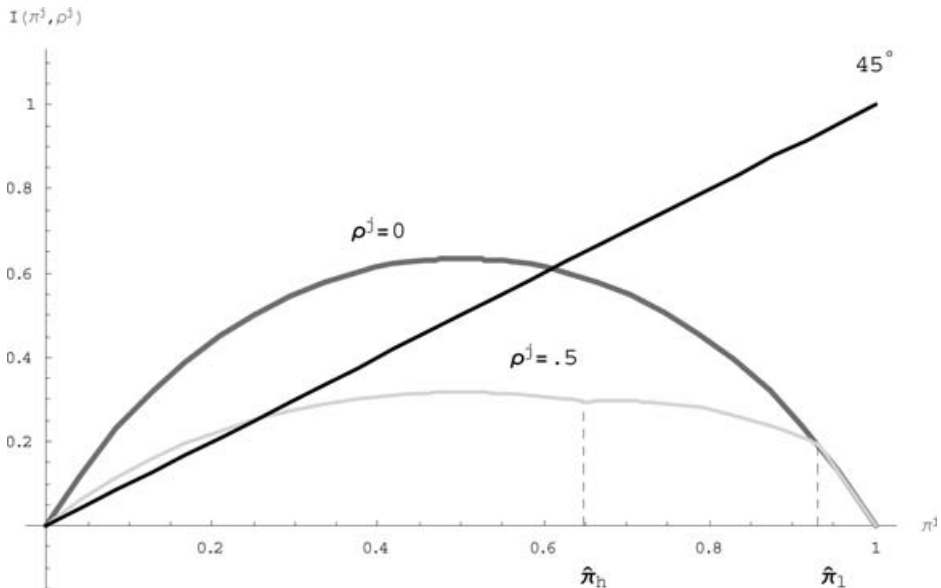


FIGURE 4

AN ILLUSTRATION OF THE FUNCTION $I(\pi^j, \rho^j)$ FOR $\rho^j = 0$ AND $\rho^j = 0.5$

The fact that a worker’s incentives for the skill investment is a function of π^j , the proportion of qualified workers in the population of group j workers, is the source of *informational externality*. The reason for the informational externality is obvious: The firms’ perception about the proportion of qualified workers in the group j population, which serves as the prior in the Bayesian updating, is a *public good*. An individual’s skill investment and his group “reputation” π^j are complements when π^j is low; that is, when π^j is low a worker’s incentive to invest increases in π^j . On the other hand, when π^j is high, an individual’s skill investment and his group “reputation” π^j become substitutes, and an individual will engage in *informational free riding*, which is best illustrated by an extreme case. Suppose that every worker in the economy invests in skills. Then, regardless of what signal the firms observe, every worker is paid β , so there is no incentive to acquire skills at all, that is, $I(1, \rho^j) = 0$.

The incentive to invest depends also on ρ^j , the probability of public sector employment for group j workers, which is the reason for a government-mandated preferential (or discriminatory) policy in the public sector to matter for the private sector labor market in our model. Indeed, a higher probability of public sector jobs will unambiguously decrease the investment incentives if $\pi < \hat{\pi}_l$ because

$$(7) \quad \frac{\partial I(\pi^j, \rho^j)}{\partial \rho^j} = \begin{cases} -(2p - 1)[w_h(\pi^j) - w_l(\pi^j)] < 0 & \text{if } \pi < \hat{\pi}_h \\ (2p - 1)[w_l(\pi^j) - g] < 0 & \text{if } \hat{\pi}_h \leq \pi < \hat{\pi}_l \\ 0 & \text{otherwise} \end{cases}$$

The intuition is simple: The public sector does not give any advantage to qualified workers over unqualified workers.

It is also easy to see that the function $I(\cdot, \rho^j)$ is continuous in π^j , and satisfy

$$(8) \quad I(0, \rho^j) = I(1, \rho^j) = 0$$

The reason is as follows: If the perception is that no one (respectively, everyone) in group j is qualified, then the firms will offer a wage equal to 0 (respectively, β) to all group j workers regardless of their signals, implying that there is no advantage to be qualified.

Using the investment incentives characterized in (6), it is clear that, in the first stage, a group j worker with cost c will invest in skills if and only if $c \leq I(\pi^j, \rho^j)$. By the assumption that c is uniform over $[0, 1]$ it follows that the proportion of workers that invest as a best response is $I(\pi^j, \rho^j)$, so an equilibrium for group j is fully characterized by a fraction of investors $\pi^{j*} \in [0, 1]$ that solves

$$(9) \quad \pi^{j*} = I(\pi^{j*}, \rho^j)$$

The reason that we may ignore the fact that $I(\pi^j, \rho^j)$ may possibly be larger than unity is that this is only relevant at the upper endpoint, where (8) assures that $I(1, \rho^j) = 0$. For any $\rho^j \in [0, 1]$, the existence of at least one PBNE for group j follows from the mean value theorem. For notational simplicity, we write $\Omega(\rho^j)$ as

the set of equilibrium levels of π^{j*} , namely the set of fixed points of Equation (9). It is easy to see that $0 \in \Omega(\rho^j)$ for all ρ^j , that is there is a trivial equilibrium whenever the investment is costly for all agents. If there exist positive elements in $\Omega(\rho^j)$, we say that there are *nontrivial equilibria* for group j under policy parameter ρ^j ; we will denote the set of nontrivial equilibria for group j under policy parameter ρ^j as $\Omega^+(\rho^j)$.

3.3. *Main Result.* Suppose that in the economy, a minority ethnic group, say group A , is subject to government-mandated discrimination in the sense that $\rho^A = 0$, whereas the majority native group, group B , obtains public sector jobs with probability $\rho^B > 0$. The main result of the article compares the economic performances between the two groups, and shows that the discriminated group A nevertheless may be economically more successful than the preferred group B .

3.3.1. *Equilibrium for groups A and B.* We first analyze the equilibrium outcomes for the discriminated group A . From (5), group j workers' incentive to invest when $\rho^A = 0$ can be rewritten as

$$(10) \quad I(\pi^A, 0) = (2p - 1)[w_h(\pi^A) - w_l(\pi^A)]$$

Simple calculations show that the function $I(\cdot, 0)$ is strictly concave in π^A , with maximum obtained at $\pi^A = 1/2$. The equilibrium condition (9) for group A is simply

$$(11) \quad I(\pi^A, 0) = (2p - 1)[w_h(\pi^A) - w_l(\pi^A)] = \pi^A$$

LEMMA 1. *When $\rho^A = 0$, the necessary and sufficient condition for the existence of a unique nontrivial equilibrium for group A is*

$$\beta > \frac{p(1 - p)}{(2p - 1)^2}$$

The intuition for Lemma 1 is as follows. To induce the workers to invest in skills, the wage differential that depends on the productivity of a qualified worker, β , and the precision of the signal, p , has to be sufficiently large. The threshold $p(1 - p)/(2p - 1)^2$ is decreasing in the precision of the noisy signals p . Indeed when the signal is perfect, when $p = 1$, any economy with positive β will admit a nontrivial equilibrium. We will henceforth focus on nontrivial equilibrium whenever it exists.¹²

Next, we impose a restriction on the parameters that simplifies the analysis tremendously.

¹²The trivial equilibrium exists because the lower bound of the support for c is 0. If c can take on negative values, albeit with arbitrarily small probability, then the trivial equilibrium can be eliminated, justifying the selection.

ASSUMPTION 1. $(2p - 1)^2\beta = 1/2$.

Assumption 1 insures that the unique nontrivial equilibrium with $\rho^A = 0$ is given by $\Omega^+(0) = 1/2$, which yields an important algebraic convenience. The reason that this simplifies the analysis is that the restriction makes sure that the equilibrium is at the point where incentives are maximized, i.e., $\partial I(1/2, 0)/\partial \pi^A = 0$, which in turn makes the comparative statics easier to handle. As shown in Subsection 3.3.3, we can relax this assumption, but the cost of doing so is that our main results can only be demonstrated numerically rather than analytically. Assumption 1 is satisfied, for example, by $p = 2/3$ and $\beta = 9/2$.

Now we analyze the equilibrium for the preferred majority group B under Assumption 1, assuming that ρ^B is sufficiently close to 0. We first specify how the public sector wage g compares with wages in the private sector. To make our results interesting, we will assume that g is higher than all private sector wages. Recall that all group A workers are hired in the private sector since $\rho^A = 0$. Under Assumption 1, $\pi^{A*} = 1/2$ in the nontrivial equilibrium; thus group A workers with signal h receive wage $p\beta$ and those with signal l receive $(1 - p)\beta$. Thus we assume:

ASSUMPTION 2. $g > p\beta$.¹³

Given Assumption 2, one can imagine that a government controlled by the political majority notes that the public sector pays higher wages and is under their control, and mandates a preferential policy in favor of the politically influential group.¹⁴

From expression (7), we know that group B workers' investment incentive function $I(\cdot, \rho^B)$ is uniformly below that of group A . Thus, in any nontrivial equilibrium for group B , the proportion of qualified workers π^{B*} will be less than $\pi^{A*} = 1/2$. This statement holds without Assumptions 1–2. Now we establish the necessary and sufficient condition for the existence of nontrivial equilibrium for group B when $\rho^B > 0$:

LEMMA 2. *Under Assumptions 1–2, if $\rho^B > 0$, then there exists a unique nontrivial equilibrium if and only if $\rho^B < 1 - 2p(1 - p)$. Moreover, $\Omega^+(\rho^B) < 1/2$.*

The intuition for Lemma 2 is straightforward. Recall that $I(\cdot, \rho^B)$ shifts downward as ρ^B increases. Thus if ρ^B is too high, the slope of $I(\cdot, \rho^B)$ at $\pi^B = 0$ would be smaller than 1, which means that $I(\cdot, \rho^B)$ will intersect with the 45° line only at the origin, resulting in a trivial equilibrium only.

¹³ Besides the theoretical reason we mentioned in Footnote 2, there is also some truth in this assumption. Anand (1983, pp. 230–36) listed mean monthly wages of close to 100 occupation categories. The mean monthly wages of the category “Government administrators” ranked among the top five, only slightly lower than “Architects and engineers” and “Workers in religion.”

¹⁴ It is also useful to point out that Assumption 2 implies that $\hat{\pi}_h$, the threshold fraction of qualified workers in the group above which a worker with signal h will not apply for public sector jobs—defined in formula (3)—is larger than 1/2. We use this implication in the proof of Lemma 2.

3.3.2. *Economic performance comparison for small ρ^B .* Now we compare the economic performance for the discriminated minority group A and preferred majority group B when ρ^B is positive but sufficiently close to zero.

When ρ^B is sufficiently small, we know from Lemma 2 that there is a unique nontrivial equilibrium $\Omega^+(\rho^B)$ characterized as the solution to

$$(12) \quad \Omega^+(\rho^B) = I(\Omega^+(\rho^B), \rho^B) = (1 - \rho^B)I(\Omega^+(\rho^B), 0)$$

where the second equality follows from (6) since we know from our earlier discussion that $\Omega^+(\rho^B) \leq \Omega^+(0) = 1/2$, and Assumption 2 implies that $\hat{\pi}_h > 1/2$. That is, in the range of possible equilibrium proportions of qualified group B workers, g is high enough so that everyone applies for public sector employment, implying that the incentive to invest is the same as the incentive to invest without public sector employment, scaled down with the probability of private sector employment $1 - \rho^B$.

Hence,

$$(13) \quad \frac{d\Omega^+(\rho^B)}{d\rho^B} = -I(\Omega^+(\rho^B), 0) + (1 - \rho^B) \frac{\partial I(\Omega^+(\rho^B), 0)}{\partial \pi^B} \frac{d\Omega^+(\rho^B)}{d\rho^B}$$

Under Assumption 1, $\Omega^+(0) = 1/2$ and since $\partial I(1/2, 0)/\partial \pi^B = 0$ (this is the main algebraic convenience from Assumption 1), we then have

$$(14) \quad \left. \frac{d\Omega^+(\rho^B)}{d\rho^B} \right|_{\rho^B=0} = -I(\Omega^+(0), 0) = -\frac{1}{2}$$

The intuition for why an increase in ρ^B will decrease the equilibrium proportion of skilled workers in group B is simple. As the probability of landing a public sector job that does not require skills increases, the informational free-riding problem is exacerbated because it makes it harder for individuals to *commit* to skill investment. That is, the skill investment cost for the marginal investor decreases as a result of the increase in ρ^B .¹⁵

For any ρ^B within a small neighborhood of 0, the expected wage in the unique nontrivial group B equilibrium for a qualified and an unqualified worker before the test signal is realized, $W_1(\Omega^+(\rho^B), \rho^B)$ and $W_0(\Omega^+(\rho^B), \rho^B)$ as defined in (4), are

$$(15) \quad \begin{aligned} W_1(\Omega^+(\rho^B), \rho^B) &= \rho^B g + (1 - \rho^B)[pw_h(\Omega^+(\rho^B)) + (1 - p)w_l(\Omega^+(\rho^B))] \\ W_0(\Omega^+(\rho^B), \rho^B) &= \rho^B g + (1 - \rho^B)[(1 - p)w_h(\Omega^+(\rho^B)) + pw_l(\Omega^+(\rho^B))] \end{aligned}$$

¹⁵ We are grateful to an anonymous referee for correctly pointing out that the *source* of the information free riding is the inability of investors to commit to invest in skills due to its imperfect observability. Preferential access to the public sector jobs further weakens the commitment ability.

We now totally differentiate $W_1(\Omega^+(\rho^B), \rho^B)$ and $W_0(\Omega^+(\rho^B), \rho^B)$ with respect to ρ^B and evaluate them at $\rho^B = 0$. We can obtain, after some simplifications

$$\begin{aligned}
 (16) \quad & \left. \frac{dW_1(\Omega^+(\rho^B), \rho^B)}{d\rho^B} \right|_{\rho^B=0} \\
 & \quad \text{Direct Effects} \\
 & = g - [pw_h(\Omega^+(0)) + (1 - p)w_l(\Omega^+(0))] \\
 & \quad \text{Indirect Effect} \\
 & + (1 - \rho^B) \left. \frac{d[pw_h(\Omega^+(\rho^B)) + (1 - p)w_l(\Omega^+(\rho^B))]}{d\rho^B} \right|_{\rho^B=0}
 \end{aligned}$$

When the government marginally increases ρ^B from 0, there are two *direct effects*: first, the group will now have a higher degree of access to a higher paying public sector, captured by the term g in (16); second, they will less likely enter the private sector, resulting in a wage loss captured by the term $-[pw_h(\Omega^+(0)) + (1 - p) \times w_l(\Omega^+(0))]$ in (16). However, as ρ^B increases from 0, it also *reduces* the incentives of skill investment, which will in turn lower the expected wages in the private sector. We call this the *indirect effect*, captured by the second term in (16).

Recall that under Assumption 1, $\Omega^+(0) = 1/2$. Thus

$$[pw_h(\Omega^+(0)) + (1 - p)w_l(\Omega^+(0))] = [p^2 + (1 - p)^2]\beta$$

Therefore the total direct effects are $g - [p^2 + (1 - p)^2]\beta$. Note that the direct effects are always positive since

$$g - [p^2 + (1 - p)^2]\beta = g - [p + (1 - p)(1 - 2p)]\beta > g - p\beta > 0$$

where the last inequality follows from Assumption 2.

For the indirect effect, note that

$$\frac{dw_h(1/2)}{d\pi^B} = \frac{dw_l(1/2)}{d\pi^B} = 4p(1 - p)\beta$$

and recall from (14) that $d\Omega^+(0)/d\rho^B = -1/2$. Thus, the indirect effect is given by

$$\begin{aligned}
 & (1 - \rho^B) \left. \frac{d[pw_h(\Omega^+(\rho^B)) + (1 - p)w_l(\Omega^+(\rho^B))]}{d\rho^B} \right|_{\rho^B=0} \\
 & = p \frac{dw_h(1/2)}{d\pi^B} \frac{d\Omega^+(0)}{d\rho^B} + (1 - p) \frac{dw_l(1/2)}{d\pi^B} \frac{d\Omega^+(0)}{d\rho^B} \\
 & = -2p^2(1 - p)\beta - 2p(1 - p)^2\beta \\
 & = -2p(1 - p)\beta
 \end{aligned}$$

Note that the indirect effect is always negative because an increase in ρ^B from 0 invariably reduces the equilibrium proportion of skilled workers in group B .

Hence the net effects of a small increase in ρ^B from 0 on the expected wage of skilled workers are given by

$$(17) \quad \left. \frac{dW_1(\Omega^+(\rho^B), \rho^B)}{d\rho^B} \right|_{\rho^B=0} = \overbrace{\{g - [p^2 + (1-p)^2]\beta\}}^{\text{Direct Effects}} \overbrace{-2p(1-p)\beta}^{\text{Indirect Effect}} = g - \beta$$

Therefore, for skilled workers the wage-reducing indirect effect will dominate the wage-increasing direct effects if $g < \beta$.

Analogously, we can get

$$(18) \quad \begin{aligned} & \left. \frac{dW_0(\Omega^+(\rho^B), \rho^B)}{d\rho^B} \right|_{\rho^B=0} \\ &= \overbrace{g - [(1-p)w_h(\Omega^+(0)) + pw_l(\Omega^+(0))]}^{\text{Direct Effects}} \\ &+ \overbrace{(1-\rho^B) \frac{d[(1-p)w_h(\Omega^+(\rho^B)) + pw_l(\Omega^+(\rho^B))]}{d\rho^B}}^{\text{Indirect Effect}} \Big|_{\rho^B=0} \\ &= \overbrace{g - 2p(1-p)\beta}^{\text{Direct Effects}} \overbrace{-2p(1-p)\beta}^{\text{Indirect Effect}} \\ &= g - 4p(1-p)\beta \end{aligned}$$

Note again the direct effects of a marginal increase in ρ^B on $W_0(\Omega^+(\rho^B), \rho^B)$ is always positive and the indirect effect is always negative. The negative indirect effect dominates the positive direct effects if $g < 4p(1-p)\beta$.

To summarize (17) and (18), a marginal increase of ρ^B from 0 will decrease the expected wages of both skilled and unskilled workers in group B whenever $g < \min\{4p(1-p)\beta, \beta\} = 4p(1-p)\beta$. We thus have proved the following proposition:

PROPOSITION 1. *Under Assumptions 1-2, if moreover $g < 4p(1-p)\beta$, then the expected wage of both qualified and unqualified group A workers are higher than those of respective group B workers if $\rho^A = 0$ and $\rho^B > 0$ is sufficiently small.*

To satisfy the condition $p\beta < g < 4p(1-p)\beta$ in Proposition 1, the precision of the test signal p has to be less than $3/4$. That the precision in the signal cannot be too high for the negative indirect effect to dominate should be intuitive: A beneficial net effect from being excluded from the public sector can only occur if the informational free-riding problem in the private sector is severe enough, and the higher p , the less severe this problem is.

Proposition 1 is a comparison of expected wages, for both qualified and unqualified, between the discriminated minority group A with $\rho^A = 0$ and the preferred majority group B with $\rho^B > 0$. To conduct a full welfare comparison, we need to take into account the skill investment costs. We divide all workers into two sets according to their skill investment cost c . The first set consists of workers whose skill investment cost c is such that their skill investment decisions are not affected by whether they are group A or B members. For these workers, Proposition 1 immediately implies that group A workers are economically better off than their group B counterparts. The second set consists of workers whose skill investment cost c is such that they would invest in skills if they belong to group A , but would not invest in skills if they belong to group B [this set of worker types is not empty because in equilibrium $\Omega^+(\rho^B) < \Omega^+(0)$]. Group A workers in this set invest in skills, but they had the *option* not to invest. So by their *revealed preference*, their expected welfare (net of skill investment cost) must be higher than the expected wage of group A unqualified workers, which is the same as their expected welfare because unqualified workers do not incur skill investment cost. The latter, however, is higher than that of group B unqualified workers by Proposition 1. Thus group A workers in this set are also always economically better off than their group B counterparts.¹⁶ To summarize,

PROPOSITION 2. *Under Assumptions 1–2, if moreover $g < 4p(1 - p)\beta$, then group B workers of all skill investment cost types are economically worse off than their group A counterparts if $\rho^A = 0$ and $\rho^B > 0$ is small.*

3.3.3. *More general economic performance comparison.* In this section, we argue that Propositions 1 and 2 are valid without Assumptions 1–2. First, for group A where $\rho^A = 0$, we can find the unique nontrivial equilibrium, if it exists, directly by solving Equation (11) without Assumption 1. The unique solution in $(0, 1)$ is

$$(19) \quad \Omega^+(0) = \frac{1}{2} \left\{ (1 + \beta) - \frac{\sqrt{1 + (2p - 1)^2 \beta(\beta - 2)}}{2p - 1} \right\}$$

Note that $\Omega^+(0)$ given by expression (19) is always less than 1, but to guarantee that it is positive, it must be the case that $\beta > p(1 - p)/(2p - 1)^2$, confirming Lemma 1.

For group B where $\rho^B > 0$, in general the incentive function $I(\cdot, \rho^B)$ given by (6) may not be globally concave in π^B , but we know that for $\rho^B > 0$, any nontrivial equilibrium must be smaller than $\Omega^+(0)$. If we further assume that $\Omega^+(0) < \hat{\pi}_h$ where $\Omega^+(0)$ and $\hat{\pi}_h$ are, respectively, given by (19) and (13), then arguments analogous to those in the proof of Lemma 2 can show that there exists a unique

¹⁶ An interesting question is why the Malay majority would have implemented a policy that ultimately hurt itself. The natural answer is that the negative indirect effect of preferential policies in favor of the Malays was quite subtle and difficult to forecast; whereas the direct beneficial effects were obvious.

nontrivial equilibrium if and only if $\rho < 1 - p(1 - p)/(2p - 1)^2\beta$. We summarize the above discussion as:

LEMMA 3. For any $\rho^B > 0$, if $\Omega^+(0) < \hat{\pi}_h$ holds where $\Omega^+(0)$ and $\hat{\pi}_h$ are, respectively, given by (19) and (3), then there exists a unique nontrivial equilibrium for group B if and only if $\rho^B < 1 - p(1 - p)/(2p - 1)^2\beta$.

The condition $\Omega^+(0) < \hat{\pi}_h$ plays the role of Assumption 2 in Subsection 3.3.1 (in fact, if $\Omega^+(0) = 1/2$, the assumption $\Omega^+(0) < \hat{\pi}_h$ reduces to the condition $g > p\beta$). In general, it requires that

$$g > \frac{\Omega^+(0)p\beta}{[1 - \Omega^+(0)](1 - p) + \Omega^+(0)p}$$

Though the above inequality looks rather complicated, once one takes into account that $\Omega^+(0)$ is given by (19), it involves only the primitives of the economy.

One can analytically solve for the unique nontrivial equilibrium when it exists, and it is given by

$$\begin{aligned} &(20) \\ &\Omega^+(\rho^B) \\ &= \frac{1}{2} \left\{ 1 + \beta(1 - \rho^B) \right. \\ &\quad \left. - \frac{\sqrt{(2p - 1)^2[1 + \beta^2(1 - \rho^B) + 2\beta(1 + \rho^B)]^2 + 4[p(1 - p)(4\beta + 1) - \beta]}}{2p - 1} \right\} \end{aligned}$$

Again it can be readily verified that if we plug in $\rho^B = 0$ in the expression $\Omega^+(\rho^B)$ above, we immediately get the expression $\Omega^+(0)$ in (19). Since (20) fully characterizes the unique equilibrium for any $\rho^B > 0$ for economies satisfying the condition $\Omega^+(0) < \hat{\pi}_h$, we can in principle proceed as in Subsection 3.3.2 at this point.

Not surprisingly, it is impractical to try to get analytical results from (20), but the following numerical example demonstrates that the main result of Subsection 3.3.2 is robust. Set $\beta = 3$, $p = 0.73$, and $g = 2.5$. When $\rho^A = 0$, we can numerically calculate that in the unique nontrivial equilibrium $\Omega^+(0) = 0.61$ and the private sector wage for workers with high signal $w_h(\Omega^+(0)) = 2.43$ and $w_l(\Omega^+(0)) = 1.1$ and $\hat{\pi}_h = 0.65$.

It can be easily verified that all the conditions in Lemma 3 are satisfied. Hence we use the formula given by (20) to calculate the nontrivial equilibrium when ρ^B is positive. We then plot the expected wages of qualified and unqualified workers in the nontrivial equilibrium associated with different levels of ρ^B according to (15). Figure 5 demonstrates that indeed, the expected wages for qualified and unqualified workers are both declining as ρ^B increases provided that ρ^B is not too large. By continuity, there is an open set of economies in which small positive probability of public sector employment makes all group B workers economically worse off than their group A counterparts.

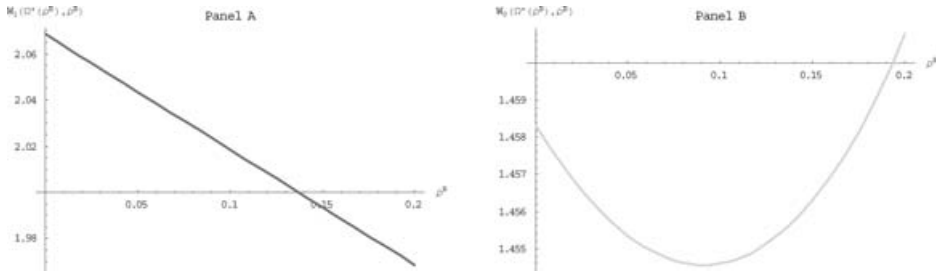


FIGURE 5

EXPECTED WAGE OF QUALIFIED (PANEL A) AND UNQUALIFIED (PANEL B) GROUP B WORKERS AS A FUNCTION OF ρ^B : $\beta = 3$, $p = 0.73$, $g = 2.5$

3.3.4. *Summary.* In this section, we presented and solved a simple model to illustrate the idea that giving a group preferential access to high paying public sector jobs may dampen the incentives for skill investment valuable in the private sector. If the informational free-riding problem in the private labor is sufficiently severe, it is possible that the adverse indirect effect due to the exacerbated informational free riding may dominate the favorable direct effects.

Throughout the section we have assumed, for simplicity, that the skill investment costs in the population follows a Uniform $[0, 1]$ distribution. If instead, the cost distribution is given by a general continuous CDF $J(\cdot)$, then the equilibrium condition for an arbitrary policy parameter $\rho \in (0, 1)$ will become $\pi = J(I(\pi, \rho))$. Qualitatively, the analysis of the more general case is very similar. First, we notice that $\Omega^+(0)$ is a nontrivial equilibrium given distribution J for any J satisfying $J(I(\Omega^+(0), 0)) = I(\Omega^+(0), 0)$. If J is weakly concave, $\Omega^+(0)$ continues to be the unique nontrivial equilibrium. For the local analysis, all that matters is the density of costs evaluated at $c = \Omega^+(0)$. Hence, if we restrict attention to symmetric distributions with support on $[0, 1]$ it follows that for any distribution with density $J'(\frac{1}{2}) > 1$ the indirect effect will be larger than in the Uniform case, whereas the effect will be smaller if $J'(\frac{1}{2}) < 1$. This should make it clear that our results are not an artifact of the Uniform distribution.

Our analysis also sheds light on the determinant of the relationship between a group's economic performance and whether it is discriminated against by government mandate that we mentioned in the Introduction. In our simple model, it is ρ^j : If $\rho^A = 0$, then for group A to be economically more successful than group B, $\rho^B > 0$ cannot be too high; if ρ^B is sufficiently high, group B would benefit from preferential treatment by the government. Using the interpretation of ρ^j as the degree of coverage of the government-mandated discriminatory policies, we provide a unifying theme to understand the divergent economic performances of the Blacks, Chinese, and Jews in their respective "hostile" environments. In Southeast Asian countries, for example, the native majority gave themselves preferential treatment in the public sector and elite professions after their independence in the NEP (see Sowell, 1990). However, there are natural capacity constraints for such positions, so that not every applicant can be given a job (more evidence below).

Blacks in the United States under Jim Crow and in South Africa under apartheid, however, are excluded from a much broader range of professions.¹⁷

Up to now we have shown that giving a group preferential access to the public sector jobs may make them economically worse off since its negative incentive effects on skill investment may dominate the positive direct effect due to the higher wages from the public sector jobs. Although we have shown the results qualitatively, we emphasize that the magnitude of the effect could be substantial as well, depending on the support and shape of the investment cost distribution.¹⁸

3.4. *Related Literature.* Being driven by a signal extraction problem, our model is most closely related to models of statistical discrimination following Arrow (1973), Phelps (1972), and, more recently, Coate and Loury (1993). This literature tries to understand how discrimination can arise as an equilibrium phenomenon, which is usually rationalized in models with multiple equilibria. In contrast, discrimination is by government *mandate* in this article. Although informational externalities similar to those in models of statistical discrimination are crucial for our results, multiplicity of equilibria is not central to our analysis. There is also some recent work on the relationship between ethnic discrimination, migration, and human capital investments that relates to our work. In particular, Katz and Rapoport (2001) point out that the risk of future ethnic discrimination (resulting in more uncertainty about future earnings) and migration possibilities tend to make the option value of education larger for the minority than for the majority.

This article is also related to the affirmative action literature, notably Coate and Loury (1993) and Moro and Norman (2003). In these papers an affirmative action policy is modeled as an equal treatment employment quota, whereas here the policy is “anti-affirmative action” in the sense that the government mandates unequal treatment of different ethnic groups. Both papers also investigate the incentive effects of labor market policies and point out that such incentive effects may lead to surprising, *possibly unintended*, consequences.

Coate and Loury (1993) show that affirmative action in the form of employment quota may lead to so-called patronizing equilibrium in which the incentives of the Blacks to invest in skills may be reduced. However, since the wages are exogenous in their model, the Blacks will obtain welfare gains even with a lower incentive to invest. In contrast, in Moro and Norman (2003), wages are endogenously determined as in this article and they show that affirmative action typically improves incentives to accumulate human capital for the disadvantaged group even though the welfare effects may be perverse.¹⁹ In our article, preferential treatment of the

¹⁷ Another crucial difference is that the Blacks in pre-civil rights era America or South Africa under apartheid probably were excluded from sectors where skill investment was important, whereas our assumption that the government excludes the minority from sectors where skills are less important seems more realistic in the case of the overseas Chinese in Asia.

¹⁸ The details are available from the authors upon request.

¹⁹ The source of the potential perverse welfare effect in the Moro and Norman (2003) model is that the determination of equilibrium wages changes qualitatively with a quota, whereas here the welfare effects are driven by effects on skill investment incentives.

majority will unambiguously lower their incentives of skill investment and may lead to a lower economic welfare. Another major difference between our article and Coate and Loury (1993) and Moro and Norman (2003) is that they both focus on the employers' profit-maximizing reaction to affirmative action employment quota, and the workers' investment incentives change only because firms' hiring policies change. In our model, the government itself implements an affirmative action policy, and both the workers and firms directly respond to the government mandate. Finally, it is worth emphasizing that neither Coate and Loury (1993) nor Moro and Norman (2003) can generate the perverse welfare effects when the minority is excluded from the highest paid job.

4. ALTERNATIVE EXPLANATIONS AND ADDITIONAL EVIDENCE

Our simple model could explain the seemingly puzzling relationship between the Chinese/Malay wage gap and the degree of preferential treatment of the Malays. Our explanation is that the NEP itself provides adverse incentives to invest in unobservable skills. As true in almost all inquiries in social science, there are alternative explanations that could be consistent with an existing set of empirical regularities. In this section, we attempt to evaluate alternative explanations. We argue that the potential alternative explanations do not seem to easily explain the empirical patterns of the Chinese/Malay wage ratios we documented in Section 2. We therefore think that the mechanism proposed in our article is, at the least, a more plausible explanation than the most obvious alternatives.

4.1. *Evaluating Alternative Explanations*

4.1.1. *Immigration.* The first obvious alternative explanation is that immigrants are a selective sample of individuals. Using U.S. data, Borjas (1987, 1994) found that immigrant earnings "overtake" that of native workers within 15 years after controlling for socioeconomic characteristics. Since there seems to be no particular reason for immigrants to accumulate more human capital than native workers, this evidence suggests that immigrants are more "able" and "diligent." Although it is certainly possible that immigrants in the United States are more likely to have these productive traits, it does not seem to be the case for Chinese immigrants to Malaysia. We do not have any hard evidence in this regard, but narratives of the Chinese migration to the Malay Peninsula claim that the vast majority of the immigrants were sojourners doing manual labor in the mines and on plantations. For example, Sowell (1990, p. 46) states that the Chinese immigrants, when first arriving at Malaysia, were "initially largely illiterate as well as destitute," whereas the education for Malays was provided for free by the colonial government.²⁰

The selection argument also seems implausible in this particular case for the simple reason that the Chinese have been in Malaysia for so long. Almost 30% of

²⁰ See Purcell (1965, pp. 276–81) for details on differences in the availability of schooling during the first half of the 20th century. Interestingly, free education was also given to the children of Tamil laborers, whereas Chinese schools initially received no support.

the population was ethnically Chinese already by 1921 (see Purcell, 1965, p. 224). The majority of the Chinese population are thus second-generation immigrants and beyond, so it seems that any genetic differences between the first-generation Chinese immigrants and the native Malays should have been depressed by mean reversion.

One may also argue that the narrowing of the Malay/Chinese wage gap before 1970 could be caused by an influx of poor Chinese immigrants after Malaysian independence. This is actually not the case. As we said already, most Chinese immigrants to Malaysia arrived before 1921. In fact, the Communist government imposed restrictions on emigration after they took over mainland China in 1949. As a result, very few Chinese emigrated to Malaysia after 1950, precisely the period of time when the Malay/Chinese wage gap was narrowing.

4.1.2. *Culture.* A second possible explanation for the wage gap is that cultural factors unrelated to the local economy make the Chinese minority economically more successful than the majority. Studies of U.S. immigrant earnings seem to suggest that cultural differences are important, and there is no a priori reason why Malaysia should be any different.²¹ We do indeed think that it is very plausible that the wage gap has something to do with cultural differences. However, although a theory based on cultural differences may “explain” the differences in income levels between the Chinese and the Malays, it would be silent about why the ethnic wage gap in Malaysia is inversely related to the degree of preferential treatment of the Malays under the NEP, unless one assumes that the NEP coincided with a sudden change in either the Chinese or the Malay cultures.²² It is also hard to reconcile the culture explanation with the observation that, at the same time as the ethnic Chinese economy achieved rapid growth during the 1970s in the Philippines and other Southeast Asian countries, the propagation of Chinese language and culture started on its swift trend downward (see Juan, 1996, p. 15).

Moreover, although it is convenient to attribute the success of overseas Chinese and Jews to their unique culture, our view is that this explanation is at best incomplete. Culture is not exogenous; it evolves, presumably at least partially in response to changes in the economic environment. Unless cultural differences are explained as an equilibrium phenomenon, there is a danger that “culture” becomes a catch-all explanation of seemingly puzzling economic disparities.

At a more general level, however, we do not consider our model and endogenous social norms as competing explanations. Instead, we can, with some stretching, also consider our article as a simplistic model of endogenous culture specifically

²¹ The view that cultural differences are important is often supported by appeal to the large persistence in relative performance between different ethnic groups among second and third generation immigrants (see Borjas, 1992, 1994). Combined with the perception (supported by, e.g., Becker and Tomes, 1986) that there is a rather small correlation between acquired skills of parents and children, this suggests that groups somehow differ. Borjas (1992) attributes this to cultural differences modeled by introducing “ethnic capital” as an input in human capital formation. More directly related to the ethnic Chinese, Landa (1999) proposes a theory of Chinese merchant success, based on the premise that the Confucian code of ethics facilitate cooperation.

²² We also note that the same Confucian heritage that is sometimes considered beneficial for overseas Chinese was blamed for the backwardness of China in the 1950s (see, e.g., Needham, 1956).

designed to understand the success of minority groups in “hostile” environments. That is, discrimination leads to a culture favoring investments in skills useful for private sector enterprises. As in Cole et al. (1992), externalities are crucial, but the externalities are generated from different sources. In Cole et al. (1992), the externality results from nonmarket interactions (matching with marriage partners being their leading example), whereas in our article, it is the informational externality that arises in the firms’ inference about the workers’ skill.

4.1.3. *Malaysian economic growth.* A third explanation is that the widening of the Malay/Chinese wage gap since 1970 was related to the overall economic growth in Malaysia as a result of its export-oriented development strategy. Maybe the Chinese benefited more from the expansion in high-growth export sectors. This explanation is quite plausible, but it begs the question of why the Malays were not benefiting more from the overall expansion given the ostensibly pro-Malay economic policies. Our model in fact provides a possible story in this regard.

4.2. *Further Remarks*

4.2.1. *Income inequality.* Following the adoption of more preferential policies to the majority group, our model predicts that the income inequality among the preferred group will increase. This implication is supported by the evidence in Malaysia. Sowell (1990, p. 48), citing the study by Puthuchearry (1983), stated that: “Income inequality among Malays increased under preferential policies, with the income share of the top 10 percent rising from 42 percent to 53 percent of all income received by Malays.” This pattern, Sowell states, was “by no means confined to Malaysia.”

4.2.2. *Overseas Japanese.* Our model provides an alternative explanation to the experience of overseas Japanese on the mainland United States and Hawaii. As Sowell (1996, p. 119) states: “Ironically, the Japanese on the mainland, who historically faced more discrimination, as well as wartime internment, achieved higher incomes and occupational levels than those in Hawaii. The Japanese in Hawaii were also much more active politically, and by 1971 had a majority in the state legislature.” Sowell explains this phenomenon through immigration selection: “Historically, the Japanese who immigrated to Hawaii came from poorer regions and poorer classes in Japan than did those who went to the U.S. mainland,” but he failed to explain why such a pattern of immigration selection emerged. This phenomenon, however, can be naturally explained by our model.

5. CONCLUSION

Some minorities, notably overseas Chinese in Southeast Asia and Jews in Europe, have performed economically better than the native majorities, despite being subject to government-mandated discriminatory policies. We provide a simple explanation based on the incentive effects generated by preferential policies. The economy we study has private and public sectors in which workers invest in

imperfectly observable skills that are important to the private sector but not to the public sector. A law allows the native majority to be employed in the public sector while excluding the minority from it. Even when the public sector offers the highest wage rate, it is still possible that the discriminated group, on average, is economically more successful. The reason is that the preferential policy will indirectly lower the majority's incentive to invest in imperfectly observable skills by exacerbating the informational free-riding problem in the private sector labor market. We also present evidence from the evolution of the Chinese/Malay wage ratio after the implementation of NEP that is consistent with our model. We evaluate alternative explanations based on immigration selection and cultural differences, and conclude that they face some difficulties to reconcile with the evidence. At the minimum, our model complements the most commonly invoked explanations based on immigration selection and cultural differences.

Our analysis also provide a unifying theme to understand the divergent economic performances of the Blacks, Chinese, and Jews in their respective "hostile" environments. Our simple model suggests that *the degree of coverage* of the government-mandated discriminatory policies is the key to determining whether such policies are likely to make the discriminated group better or worse off economically. In Southeast Asian countries, for example, the native majority gave themselves preferential treatment in the public sector and elite professions after their independence in the NEP (see Sowell, 1990). However, there are natural capacity constraints for such positions, so that not every applicant can be given a job. Blacks in the United States under Jim Crow and in South Africa under apartheid, however, are excluded from a much broader range of professions.

The economic forces emphasized in our model can be applied in other settings. For example, more generous welfare benefits may decrease the incentives of skill investment, which in turn will indirectly lower single mothers' labor market opportunities due to a more pessimistic view of single mothers' skills by employers. Under some conditions, higher welfare benefits may induce such a negative indirect labor market response that overshadows the positive benefit from the higher welfare benefit itself, and make single mothers ex ante worse off.²³

APPENDIX

PROOF OF LEMMA 1. Simple algebra can show that $I(\cdot, 0)$ is strictly concave in π^A , hence $I(\cdot, 0)$ crosses the 45° line at most twice. Since 0 is already a fixed point, there is at most one nontrivial equilibrium. Since $I(1, 0) = 0$, a nontrivial equilibrium exists if and only if

$$\frac{\partial I(0, 0)}{\partial \pi^A} = \frac{(2p - 1)^2 \beta}{p(1 - p)} \geq 1$$

which is equivalent to the condition stated. ■

²³ Fang and Silverman (2004) have presented an alternative theory based on time inconsistent preferences.

PROOF OF LEMMA 2. Under Assumption 2, $\hat{\pi}_h$ as defined in (3) is larger than $1/2$. Hence for all $\pi^B \leq 1/2$, the investment incentive function in (6) is given by

$$I(\pi^B, \rho^B) = (2p - 1)(1 - \rho^B)[w_h(\pi^B) - w_l(\pi^B)] = (1 - \rho^B)I(\pi^B, 0)$$

Therefore any nontrivial group B equilibria must lie in the interval $(0, 1/2]$ when $\rho^B > 0$. Uniqueness follows from the strict concavity of $I(\cdot, \rho^B)$ in the interval $(0, 1/2]$. Nontrivial equilibrium exists if and only if $\partial I(0, \rho^B)/\partial \pi^B > 1$, and simple algebra yields that

$$\frac{\partial I(\pi^B, \rho^B)}{\partial \pi^B} = (1 - \rho^B) \frac{(2p - 1)^2 \beta}{p(1 - p)} = \frac{(1 - \rho^B)}{2p(1 - p)}$$

where the last equality follows from Assumption 1. Hence $\partial I(0, \rho^B)/\partial \pi^B > 1$ if and only if $\rho^B < 1 - 2p(1 - p)$. ■

REFERENCES

- ANAND, S., *Inequality and Poverty in Malaysia: Measurement and Decomposition* (Oxford: Oxford University Press, 1983).
- ARROW, K. J., "The Theory of Discrimination," in O. Ashenfelter and A. Rees, eds., *Discrimination in Labor Markets* (Princeton: Princeton University Press, 1973).
- BECKER, G. S., AND N. TOMES, "Child Endowments and the Quantity and Quality of Children," *Journal of Political Economy* 84 (1986), S143–62.
- BORJAS, G. J., "Self-Selection and the Earnings of Immigrants," *American Economic Review* 77 (1987), 531–53.
- , "Ethnic Capital and Cultural Mobility," *Quarterly Journal of Economics* 107 (1992), 123–50.
- , "The Economics of Immigration," *Journal of Economic Literature* 32 (1994), 1667–1717.
- COATE, S., AND G. C. LOURY, "Will Affirmative Action Policies Eliminate Negative Stereotypes?" *American Economic Review* 83 (1993), 1220–40.
- COLE, H. L., G. J. MAILATH, AND A. POSTLEWAITE, "Social Norms, Savings Behavior and Growth," *Journal of Political Economy* 100 (1992), 1092–1125.
- FANG, H., "Social Culture and Economic Performance," *American Economic Review* 91 (2001), 924–37.
- , AND D. SILVERMAN, "On the Compassion of Time-Limited Welfare Programs," *Journal of Public Economics* 88 (2004), 1445–70.
- GOMEZ, E. T., AND K. S. JOMO, *Malaysia's Political Economy: Politics, Patronage and Profits*, 2nd edition (Cambridge: Cambridge University Press, 1999).
- JESUDASON, J. V., *Ethnicity and the Economy: The State, Chinese Business and Multinationals in Malaysia* (Oxford: Oxford University Press, 1989).
- JUAN, G. B., *Myths about the Ethnic Chinese "Economic Miracle"* (Manila: Kaisa Para Sa Kaunlaran, Inc., 1996).
- KATZ, E., AND H. RAPOPORT, "Macroeconomic Instability, Migration, and the Option Value of Education," CREDPR Working Paper, No. 21, 2001.
- LANDA, J. T., "The Law and Bioeconomics of Ethnic Cooperation and Conflict in Plural Societies of Southeast Asia: A Theory of Chinese Merchant Success," *Journal of Bioeconomics* 1 (1999), 269–84.
- MORO, A., AND P. NORMAN, "Affirmative Action in a Competitive Economy," *Journal of Public Economics* 87 (2003), 567–94.

- , AND —, “A General Equilibrium Model of Statistical Discrimination,” *Journal of Economic Theory* 114 (2004), 1–30.
- NEEDHAM, J., *Science and Civilization in China, Volume 2: History of Scientific Thought* (Cambridge: Cambridge University Press, 1956).
- NORMAN, P., “Statistical Discrimination and Efficiency,” *Review of Economic Studies* 70 (2003), 615–27.
- PHELPS, E. S., “The Statistical Theory of Racism and Sexism,” *American Economic Review* 62 (1972), 659–61.
- PURCELL, V., *The Chinese in Southeast Asia*, 2nd edition (London: Oxford University Press, 1965).
- PUTHUCHEARY, M., “Public Policies Relating to Business and Land,” in Robert B. Goldmann and A. Jeyaratnam Wilson, eds., *From Independence to Statehood* (London: F. Pinter, 1983).
- SCHAFFGANS, M. M. A., “Ethnic Wage Differences in Malaysia: Parametric and Semiparametric Estimation of the Chinese–Malay Wage Gap,” *Journal of Applied Econometrics* 13 (1998), 481–504.
- SOWELL, T., *Preferential Policies: An International Perspective* (New York: William Morrow and Company, 1990).
- , *Migration and Cultures: A World View* (New York: Basic Books, 1996).
- YIP, C. S., “Patterns of the Ethnic Wage Differential in Malaysia,” Mimeo, University of Pennsylvania, 2000.