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Statistical discrimination in health care

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Abstract

This paper considers the role of statistical discrimination as a potential explanation for racial and ethnic disparities in health care. The underlying problem is that a physician may have a harder time understanding a symptom report from minority patients. If so, even if there are no objective differences between Whites and minorities, and even if the physician has no discriminatory motives, minority patients will benefit less from treatment, and may rationally demand less care. After comparing these and other predictions to the published literature, we conclude that statistical discrimination is a potential source of racial/ethnic disparities, and worthy of research.

JEL classification: I11; D81

Keywords: Health care disparities; Statistical discrimination; Race

1. Introduction

"Statistical discrimination" refers to how an agent (an employer, a doctor), without intending to discriminate, might apply an otherwise reasonable decision making rule (pay according to productivity, treat according to need), that in practice leads to unequal treatment of members of two ethnic groups. Employers do not observe true productivity, and doctors do not observe true health need. Employers and doctors only observe signals or indicators of these concepts. The process of inferring the true from the signal can cause identical members of the two ethnic groups emitting the same signal to be treated differently. Aigner and Cain (1977), drawing on earlier work of Arrow (1973), Phelps (1972) and others, proposed that (white) employers can more readily interpret signals about productivity from white workers than from black workers. Employers in their model are willing to

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pay expected productivity to all workers, but the Bayesian employer downweights a noisy signal in relation to population mean values. The upshot is that Blacks earn less reward for higher productivity because the employer has a harder time (in comparison to white workers) distinguishing the more from the less productive. In a health care context, a white male doctor might have an easier time interpreting the signal, "doc, it really hurts" from a white male patient than from a black woman patient, or from a Latino woman patient (for whom English may be a second language). This paper begins with this simple observation and then works out the implications of the noisy signal hypothesis for explaining the unequal treatment of minorities in health care.

The literature describing differences in the use of health care resources between Whites and Blacks/Latinos is huge. Not only do minorities appear to receive less and inferior health care than Whites (Williams, 1994; Ford and Cooper, 1995), but they are also less likely to receive higher technology services/procedures (Escarce et al., 1993; Goldberg et al., 1992; Wennecker and Epstein, 1989; Yergan et al., 1987; Williams et al., 1979; Shi, 1999). While some of these differences may be explained by innate health risk differentials or differences in socio-economic status (SES), disparities seem to remain even after controlling for these factors. For example, the fact that Latinos underutilize mental health services, even at higher SES levels has been widely recognized (Ruiz, 1993; Ginzburg, 1991; Vega et al., 1999; Gallo et al., 1995; Sue et al., 1991; Scheffler and Miller, 1989; Wells et al., 1989; Hough et al., 1987). Also, data with good clinical information documents that even in the presence of extensive controls for "need", ethnic minorities get less or inferior care (Peterson et al., 1997; Bach et al., 1999; Shapiro et al., 1999).[1]

There appears to be considerable agreement with the view that "it is time to stop documenting disparities, and to start doing something about them".[2] The theme of the American Public Health Association, November 2000 annual meeting, for example, was "Eliminating Health Disparities". Nonetheless, the impetus to redress inequities and correct the inefficiencies associated with disparities can be better translated into effective policy if the mechanisms by which disparities arise are understood. Morgenstern (1997) points out that the empirical work necessary to quantify the magnitude of disparities is distinct from the work to identify the causes of disparities, a distinction not always kept clear in the literature. Reduced form empirical models can help identify the mediating role of readily measurable system factors, such as geographic access, provider practice patterns, and insurance plans

[1] For example, Bach et al. (1999) study a set of patients with a form of early-stage lung cancer. They find that among these patients only 64% of Blacks undergo surgery compared to 77% of Whites, a clinically significant difference that translates into a likely reduced 5-year survival rate for Blacks. Shapiro et al. (1999), based on a longitudinal sample representative of the adult US population infected with HIV, conclude that black and latino infected adults receive less desirable patterns of care than Whites.

[2] The focus of the present paper is on disparities in health services. There is also concern about disparities in health per se. In its "Initiative to Eliminate Racial and Ethnic Disparities in Health", the US Department of Health and Human Services (1998) makes the following statement: "Compelling evidence that race and ethnicity correlate with persistent, and often increasing, health disparities among US populations demands national attention. Indeed, despite notable progress in the overall health of the nation, there are continuing disparities in the burden of illness and death experienced by Blacks, Hispanics, American Indians and Alaska Natives, and Pacific Islanders, compared to the US population as a whole. The demographic changes that are anticipated over the next decade magnify the importance of addressing disparities in health status. A national focus on disparities in health status is particularly important as major changes unfold in the way in which health care is delivered and financed".

(Gomes and McGuire, 2000). However, these models can neither explain the source of the differences in observable factors nor the disparities that remain once these factors have been controlled for. Identifying the potential role of discrimination in explaining disparities is especially important, but analysis of secondary data can only approach this issue indirectly.

Research employing actor-patients is better suited to ferreting out discrimination. This accords with Altonji and Blank's (1999) view of how to study discrimination in labor markets. Discrimination exists insofar as objectively similar patients of different ethnicities or genders get different recommendations from doctors (Schulman et al., 1999).[3] This empirical manifestation of discrimination can appear from different root causes. "Taste discrimination" (Becker, 1971) cannot be ruled out as an explanation for the results of these studies, but, as we will argue, "statistical discrimination" might be at work as well. As Schulman et al. (1999) put it, "bias may represent overt prejudice on the part of physicians or, more likely, could be the result of subconscious perceptions rather than deliberate actions or thoughts".

When a doctor hears a symptom report from a patient the doctor must make an inference about the likely cause of the problem and what actions should be taken. This recommendation may depend in general on inferences about unobservable variables the doctor makes based on what he/she can see, including gender and race. Matching in a study like Schulman et al.'s can only encompass the "observable" variables. Suppose the doctor believes, based on experience, that men are less likely than women to renew prescriptions for anti-hypertensive drugs because men have more difficulty with the side effects of the drugs. When a treatment choice exists, the doctor is then less likely to recommend the drugs to a man than to a woman, even in an experiment in which a researcher constructs patients who are "objectively identical" except for gender. The researcher cannot control the doctor's inferences about unobserved variables such as likelihood of compliance. These inferences may be made "rationally" and in the best interest of the patient as the doctor sees it; and they may lead to disparities in treatments.

Other work in health services points toward a role for miscommunication as being more of a problem when minority patients talk to their doctors. The importance of accurate communication between physician and patient has been widely recognized in the medical profession.[4] Several studies have found that the quality of communication both in the history-taking segment of the visit and during discussion of the management plan influences

[3] In this study, doctors are presented with recorded interviews of actor patients who differ in sex, race, age, level of coronary risk, type of chest pain and the results of an exercise stress test. Physicians are asked to estimate the probability that he/she has clinically significant coronary disease and to determine whether they wish to refer the patient for cardiac catheterization. The authors find that the race and sex of the patient affects the physicians' decisions about whether to refer patients for catheterization, even after controlling for symptoms, the physicians' estimates of the probability of coronary disease, and patient's clinical characteristics. Similar experiments have been done on the issue of discrimination in mortgage lending and housing rental markets in which objectively similar Whites and Blacks apply for loans or to rent (see Yinger, 1998 and Heckman, 1998 for discussion of the significance of these studies for the effects of discrimination in market equilibrium).

[4] As noted in Woloshin et al. (1995), "the physician–patient relationship is built through communication and the effective use of language. Along with clinical reasoning, observations and nonverbal cues, skillful use of language endows the history with its clinical power and establishes the medical interview as the clinician's most powerful tool".

patient health outcomes (Stewart, 1995). Communicational problems may be particularly exacerbated when doctor and patient belong to different ethnic groups, either because of language, cultural differences or both. Waitzkin (1985) found that SES was one of a set of factors associated with doctors' willingness to talk and listen to patients. Einbinder and Schulman (2000) concluded, on the basis of a review, that race discordant physician–patient relationships affected symptom communication and recognition. There is some evidence that physician–patient matches in ethnicity and language are beneficial to patients in terms of satisfaction with treatment, compliance and quantity of care received (Cooper-Patrick et al., 1999; Sue et al., 1991; Saha et al., 1999; Takeuchi et al., 1995).[5] However, the literature is not unanimous on this point. Chen et al. (2001) compared cardiac catheterization rates among Blacks and Whites (controlling for clinical status), and found lower rates for Blacks among black doctors than among white doctors.

Culture and ethnicity have also been shown to affect the interpretation of health conditions and other aspects of clinical care. Patients' trust in hospitals and physicians, their perceptions of illness and suffering, their interpretation of lack of improvement and their proclivity to disclose information, among other things, appear all to have ethno-cultural correlation (Berger, 1998; Torres, 1986; Uba, 1992; Meredith and Siu, 1995). Effective communication depends on a willingness to communicate, and national surveys have repeatedly shown that Blacks mistrust their doctors more frequently than Whites (The Commonwealth Fund, 1995; The Henry J. Kaiser Family Foundation, 1999). Other research highlights the incidence of language in the interpretation of symptoms and in the outcomes of the medical encounter. Marcos et al. (1973) found that bilingual Hispanic schizophrenic patients demonstrated more content indicative of psychopathology when interviewed in English rather than Spanish. For members of some groups, no or limited proficiency in English inhibits communication with doctors and other health care workers. In 1990, 14% of Americans 5 years and older did not speak English at home. More than half of these spoke Spanish, and the percent will surely be higher in the 2000 Census numbers.[6]

Motivated by the importance of communication, culture and language in the physician–patient relationship, in this paper we consider the relatively poor communication between members of minority groups and (predominantly) white physicians as a potential fundamental cause of disparities in health outcomes and health services.[7] Before proceeding we want to make three disclaimers. First, by embracing this hypothesis, we do not contend that it is the only form of discrimination that may be present in health care markets. On the contrary, we believe that health care markets, with attenuated competitive forces, could sustain stereotypes and taste discrimination in the long run more readily than labor markets. However, the importance of communication in health care and the particular beliefs, language and expression patterns associated with each ethnic group in the US justifies our concentration on "statistical" discrimination in this paper. Second, we do not study the

[5] Having bilingual and bicultural staff, providing an ethnic atmosphere, having announcements written in ethnic languages, conducting treatment in a more culturally sensitive manner and using culturally appropriate interpersonal styles are some of the characteristics that have been suggested as influential in treatment outcomes for minorities (Takeuchi et al., 1995).

[6] Source: US Bureau of the Census, Census of population (1990), CPHL-96.

[7] Blacks and Latinos constitute 24% of the US population but only 7.5% of physicians and medical students belong to these groups.

determinants of bad communication. While it can be argued that bad communication in the diagnosis stage may result from an unwillingness of the provider to spend enough time with a minority patient (perhaps a prejudice issue), here we set up the model as if imperfect information about minorities where the only reason behind miscommunication. Third, we treat statistical discrimination as a hypothesis. Our tasks in this paper are to work out the implications of the hypothesis, and to lay the groundwork for empirical assessment.

Section 2 introduces the underlying problem that physicians may observe patients' needs with less accuracy if the patient is a minority group member. In the simple context in which a benevolent doctor is called upon to match treatment to need, minorities will experience a poorer match and, anticipating this, may demand less care. The analysis in Section 2 shows how statistical discrimination can account for some salient problems in the health care of minorities, including, (1) minorities use health care less frequently, (2) minorities are more likely to drop out of treatment and (3) existing treatments are less effective for minorities. Statistical discrimination also generates unique predictions about how providers assign treatment to different ethnic groups. While other theories of discrimination expect doctors to provide less health care to minorities always, statistical discrimination predicts that minorities will receive less resources in some cases, but should receive more in some others. In Section 3, we call attention to additional implications of the basic model once we allow for multiple treatments, financial incentives in the physician's objective function and learning. Assessing the quantitative importance of the mechanism of statistical discrimination in accounting for health services disparities is a matter for empirical investigation. Section 4 summarizes some of the empirical implications of statistical discrimination and checks them against published papers dealing with disparities. The conclusion is in Section 5.

2. Ethnicity and a poor match of treatment to need

Before turning to health care, it is worthwhile to briefly review the origin of the idea of statistical discrimination in the labor literature and to compare labor and health care markets in terms of the likelihood of the importance of communication problems in explaining differential economic outcomes for minority workers/patients.

2.1. Statistical discrimination in labor and health care

Two strands dominate the labor literature on statistical discrimination. One of them asserts that differences in wages across ethnic groups are related to the existence of group differences in the quality of employers' information (Phelps, 1972; Aigner and Cain, 1977; Lundberg and Startz, 1983). The other strand attributes differences in earnings to the existence of stereotypes that are self-fulfilling in equilibrium (Arrow, 1973; Coate and Loury, 1993).

The theory of statistical discrimination based on differences in the quality of information initially failed to catch on in labor because it could not explain the central empirical finding in labor markets: controlling for human capital, Blacks receive a lower wage *on average* than Whites (see Cain, 1986, for a review). The simple statistical discrimination story had no implication for mean wage differences, since while high productivity Blacks would tend to be underpaid, low productivity Blacks would be overpaid.[8] Later researchers have incorporated how workers might respond to such wage offers into richer and more complete models of the labor market.[9] The other strand of thinking in labor economics has sought to explain wage disparities using beliefs (stereotype-based statistical discrimination) or transaction cost theory. Coate and Loury (1993) construct a setting in which the employer has ex ante lower beliefs about the average skill of the minority group and show that there might be equilibria in which these stereotypes are self-fulfilled.[10] Lang (1986) proposes a model in which disparities in wages result from the transaction costs that bad communication with minorities imposes on the employer.[11]

Empirical testing of the statistical discrimination hypothesis in labor has only recently received attention. Altonji and Pierret (1997) test for statistical discrimination in an environment in which employers learn over time. They test whether employees' rewards become increasingly related to productivity and decreasingly related to easy-to-observe variables (race, schooling) as experience with the firm increases. They find that firms statistically discriminate based on schooling but not based on race. Neumark (1998)[12] tests statistical versus taste discrimination by comparing the OLS and IV estimates of the effect of race on starting wages, controlling for observed productivity. Oettinger (1996)[13] incorporates

[8] Aigner and Cain (1977) proposed that employer risk aversion could be used to explain lower wages for Blacks. Black wages would deviate from expected productivity more than for white workers, and Blacks might have to accept a lower wage to compensate employers for this risk. This argument based on risk aversion is not persuasive in a labor market with competition among employers.

[9] Lundberg and Startz (1983) incorporate investment in education by workers in Aigner and Cain's model and derive an equilibrium in which firms statistically discriminate on the basis of group membership and groups differ ex post in productivity even though the mean of innate ability is the same for all groups.

[10] Employers' prophecies are self fulfilled through workers' decisions to invest in human capital.

[11] In his approach, Whites and Blacks have more trouble communicating than members of the same ethnic groups. Since Blacks belong to the minority, and employers are mostly White, black workers bear the incidence of these communication costs in the form of lower wages.

[12] Neumark works with data on starting wages, observed productivity and race. His identifying strategy is the following: taste discrimination would require the OLS estimate of the effect of a dummy for Blacks on starting wages to be negative (after controlling by observed productivity). However, if employers base starting wages on expected productivity, and average performance is in practice lower for minority workers, the negative coefficient on the dummy for Blacks might alternatively reflect a bias induced by the negative correlation between Blacks race and an unobservable (by the econometrician) component of expected productivity (stereotype-based statistical discrimination hypothesis). If this were the case, the bias should be eliminated after using instrumental variables. A Haussman test for bias in the OLS estimate is performed. There appears to be some evidence for both men and women that statistical discrimination is partly to blame for the differences in starting wages between minorities and white workers, although the evidence is not very strong statistically.

[13] Oettinger assumes that uncertainty about worker productivity on a given job is resolved as on-the-job performance is observed. In addition, a worker's productivity varies randomly across job matches and new job offers are received periodically. Job mobility is the source of wage growth over time, and a wage gap develops because Blacks' relatively greater uncertainty about the quality of new job offers impedes efficient mobility decisions. The model implies that no wage gap should exist at the time of labor force entry, but that one should develop as time in the labor force accumulates. Another implication is that Blacks should have smaller wage gains from job change than Whites but should have at least as much wage growth as Whites over periods in which no job change occurs. These predictions are tested using a sample of young men from the National Longitudinal Survey of Youth, producing mixed evidence for the model. The main empirical result is that no Black–White gap exists at labor force entry but that one develops as experience accumulates, mainly because Blacks reap smaller gains from job mobility. Evidence opposes his predictions in that Blacks do not appear to have larger returns to job tenure.

time dynamics and job-mobility to the standard statistical discrimination model and tests some new implications of this enhanced model.

The theory of statistical discrimination based on differences in the quality of information is the antecedent of this paper about health disparities. Although many of the assumptions used here are based on the work by Aigner and Cain (1977), there is a crucial distinction between their model and this one that has to do with the consequences of a bad match for the parties in the exchange. In Aigner and Cain's model, wages are money, a good with a roughly constant marginal utility, to both workers and employers. In a social utilitarian sense, paying "too much" to one worker is then balanced by paying "too little" to another. Health care, by contrast, is a diverse set of treatments that needs to be *matched* with patient needs to be useful. Giving one patient too much (or even the wrong) medication does not "balance out" giving another patient too little. A bad match stemming from poor communication between patient and doctor can leave minority patients worse off *on average* in comparison to their majority-group patient counterparts. Once this feature is incorporated into a model of statistical discrimination, as we will see, we have a theory that may explain disparities in treatments and outcomes in health care. These implications are parallel to those obtained in labor models dealing with matches of workers' skills to jobs (Rothschild and Stiglitz, 1982; Lundberg, 1991; Lang, 1993).

There is an important difference between health care markets and labor markets that, we believe, makes statistical discrimination based on race/ethnicity more interesting and powerful in health than in labor: the informational and communication problems in health care are simply more severe than in labor markets. A worker–employer relationship is long-term and often involves many repetitions of the same exchange. In health, patients make intermittent contact with providers about idiosyncratic problems. Phelps (1997) regards health care providers as operating a "job shop", in which the task of the doctor is to design the treatment to the requirements of the "job" — the health care needs presented by the patient in a particular state of ill health. Information collection through interviews and testing is costly, and there are simply limits on what can be known in advance. Dating from Arrow's (1963) "Uncertainty and the Welfare Economics of Medical Care", information issues have been the *sin qua non* of health economics. In his book on *Doctors' Decisions*, Eisenberg (1986) argues that the presence of uncertainty is the door through which complex non health-benevolent motivations of doctors can come into play. Information imperfections are regarded as being behind the enormous geographic variations in rates of health care procedures observed in the US (Phelps, 2000).

Additionally, while in labor the assumption that productivity of Blacks is observed with less precision has not been subjected to close empirical scrutiny, there are plenty of studies in health (studies of language and ethnic matches, and research relating communication skills to outcomes) that address the issue and test it explicitly.

2.2. Statistical discrimination and a poor match of treatment to needs

In this section, we introduce the idea of statistical discrimination in health care use. Doctors have imperfect information about the patient's real needs for treatment. They have "priors" about what is wrong with patients, and revise these priors following contact with a particular patient. The more reliable is the information conveyed to the doctor in this contact, the greater will be the weight the doctor puts on the new information relative to the prior. Patients do not know how sick they are, but need a doctor to interpret their symptoms.

Consider two groups of patients, White and Black, and one white physician. The terms White and Black are used as simplifications for patients belonging to the majority group and patients belonging to a minority group, respectively. There is one illness and the physician can recommend only one type of treatment. There is a continuum of severities, which we denote by Z, identically distributed in the black and white populations. The physician communicates better with Whites, and hence better understands their symptom reports. The physician makes a decision about whether to treat the patient or not. A strategy consists of choosing a threshold of observed severity (the signal) above which treatment is recommended and below which it is not.

The doctor observes a signal, S, which reveals (with noise) the patient's condition:

$$S = Z + \varepsilon \tag{1}$$

where ε is an error term, or noise. We assume that Z is normally distributed with mean μ and variance σ_Z^2. The noise, ε, is also normal with mean 0 and variance σ_ε^2, and is independent of the level of severity. Let $g(S)$ be the distribution of S. Since S is the sum of two normals, it is itself normal with expectation μ and variance $\sigma_S^2 = \sigma_Z^2 + \sigma_\varepsilon^2$.

Once the doctor observes S, he uses Bayes' rule to update his priors about the likelihood of the patient's severity. The updated distribution given the signal S is normal with expectation $(1-\beta)\mu + \beta S$ and variance $(1-\beta)\sigma_Z^2$, where $\beta = \sigma_Z^2/(\sigma_Z^2 + \sigma_\varepsilon^2)$. The higher the variance of the noise, the lower the weight the doctor puts on the signal and the higher the weight on the population expected severity. To make things simple, we assume that there is no noise ($\varepsilon = 0$ always) in the communication between the white patient and the white doctor. Thus, for Whites, $\beta = 1$ and the signal indicates perfectly the level of severity of the patient. In the case of Blacks, however, β will be lower than 1: the doctor will downweight the signal and estimate the severity for a black patient to be a weighted average of the signal and the population mean. [14]

Individuals derive utility from the consumption of goods and from health status. To simplify things, we assume that these two utilities are separable, so we shall only refer to the health component of utility. We assume that an individual with severity Z has a utility of $-aZ$, if he does not receive treatment and a utility of $-b$, if he does get treatment. The term b represents any monetary cost equivalent (time cost, health risk, or dollar costs) that may result from taking the treatment. Since individuals all have the same utility after treatment ($-b$), our assumption means that treatment completely eliminates the negative effects of illness. A patient with severity Z benefits $aZ - b$ from treatment. Given a level of Z, both patients and doctors know the value of treatment.

[14] We assume that the doctor has no immediate devices available to improve his understanding of the patient's signal. In other words, our model does not allow the doctor to invest more in objective screening instruments when the noise of the signal is higher. It would be interesting in further research to analyze the empirical implications of relaxing this assumption.

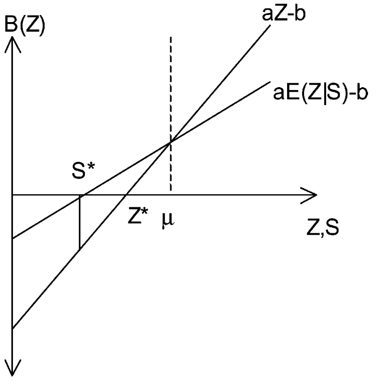

Fig. 1. Thresholds chosen by a benevolent doctor when treatment is beneficial to the average patient.

In this section, we assume that the doctor is benevolent and decides about treatment to maximize each patient's expected benefit from treatment. [15] We also assume that all patients visit the doctor irrespective of the benefits they can anticipate from treatment (we modify both of these assumptions later on).

Given a patient with signal S, the benefit that the doctor expects the patient to derive from treatment is

$$\mathrm{EB}(S) = aE(Z|S) - b = a[(1-\beta)\mu + \beta S] - b \tag{2}$$

A benevolent doctor seeks to set S^* (the threshold signal above which he will recommend care) so as to maximize the expected benefit in the population of potential patients. [16] The optimal S^* is obtained by setting Eq. (2) equal to 0. [17]

$$S^{*\mathrm{opt}} = \frac{b - a(1-\beta)\mu}{a\beta} \tag{3}$$

This implies that the doctor will recommend treatment to all those Blacks with a signal $S > S^{*\mathrm{opt}}$. In the case of Whites, since $\beta = 1$, the threshold will be set at $Z^* = b/a$ and the doctor will recommend treatment to all those patients with $Z \geq Z^*$.

[15] Because utility is linear, maximizing the benefit from treatment is equivalent to maximizing utility. An additional implication of linearity is that the doctor values the loss of mismatching treatment to needs symmetrically (a marginal loss because a "sick" patient is not being assigned to treatment has the same weight as a marginal decrease in benefits due to the assignment of a "healthy" patient to treatment). An interesting extension would be to study the decision making of the physician when his loss function is not symmetric (either because treatment has asymmetric implications or because the physician's likelihood of being sued is higher in one of the situations).

[16] By population of patients, we mean all the individuals who receive a certain sickness signal (irrespective of their decision to seek care or not). For instance, if the doctor is a cardiologist, the population could be all those individuals with chest pain. Since the doctor maximizes each patient's benefit from treatment, under the assumption held so far that all patients make a visit, he is maximizing welfare for the whole population of patients.

[17] The optimal threshold depicted in Eq. (3) can be obtained equivalently from maximizing the utility of the whole population of patients, that is, maximizing $\int_{-\infty}^{S^*}[-aE(Z|S)]g(S)\,\mathrm{d}S - \int_{S^*}^{\infty} bg(S)\,\mathrm{d}S$, where $g(S)$ is the density of S.

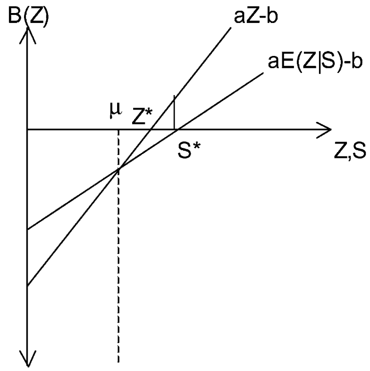

Fig. 2. Thresholds chosen by a benevolent doctor when treatment is not beneficial to the average patient.

The level of the threshold set by the doctor depends on the capability of the physician of diagnosing the patient's severity. An increase in the noise content of the signal can either increase or decrease the threshold, depending on how the average gross benefit from treatment, $a\mu$, compares with the costs of treatment, b. From Eq. (3), $(\partial S^{*\text{opt}}/\partial\beta) = (a\mu - b)/a\beta^2$. When $a\mu > b$ (Fig. 1), the average person in the population benefits from treatment on balance, and the threshold the doctor sets decreases with the noise of the signal. Blacks have a lower threshold than Whites, and a higher fraction of Blacks are recommended treatment. When, on the contrary, $a\mu < b$ (Fig. 2), the average person does not benefit from treatment on balance, the threshold increases with the noise. In this case, fewer Blacks are recommended for treatment than Whites. [18]

The presence of more noise for Blacks implies that the well-meaning doctor makes more mistakes in the decision about treatment than for Whites. This has a fundamental implication for the analysis of disparities: treatment produces a better outcome for Whites on average. The average expected benefit in the population is given by $\overline{\text{EB}}(S^*) = \int_{S^*}^{\infty} \text{EB}(S)\, g(S)\, \mathrm{d}S$. After some manipulation, which involves using the expectation of a truncated normal, the average expected benefit turns out to be

$$\overline{\text{EB}}(S^*) = [a\mu - b]\left[1 - \Phi\left(\frac{S^* - \mu}{\sigma_S}\right)\right] + a\beta\sigma_S\phi\left(\frac{S^* - \mu}{\sigma_S}\right) \tag{4}$$

where Φ is the standard normal distribution and ϕ the standard normal density. It can be easily shown that, with a doctor deciding about treatment in the best interests of the patient,

[18] The distribution of the signal depends also on the noise, so to correctly compare the effect of noise on the share of patients treated, it is necessary to work with the standardized distribution of S:

$$\frac{\partial}{\partial\beta}\left(\frac{S^* - \mu}{\sigma_S}\right) = \frac{a\mu - b}{2a\beta^{3/2}\sigma_Z}.$$

In other words, Blacks have a lower standardized threshold than Whites when the treatment benefits the average patient and a higher standardized threshold when treatment is not beneficial to the average patient. After this standardization, a change in the threshold is equivalent to a change in the share of patients treated.

the average expected benefit increases with β

$$\frac{\partial \overline{\mathrm{EB}}(S^{*\mathrm{opt}})}{\partial \beta} = \frac{\phi(\cdot)}{2\beta^{1/2}}(a\sigma_Z) > 0 \tag{5}$$

Intuitively, the group with the noisier signal is mismatched more frequently and benefits less on average from visiting the doctor. This observation will come into play in the next section where we take account of how anticipation of a poor match may affect patient behavior.

The idea that miscommunication results in a worse match of treatment to needs has received empirical support in the medical and psychiatric literature. Most of the studies reviewed by Stewart (1995) demonstrate a correlation between effective physician–patient communication and improved patient health outcomes.

2.3. Demand response to a poor match

Demand here consists of the decision to seek care or not. So far, we have assumed that all patients seek care. We now allow patients to decide to seek care based on the cost to them of going to care, and on the benefits they anticipate receiving once in contact with the doctor. The expected benefit from seeking care is given by (4) evaluated at $S^{*\mathrm{opt}}$. We showed in Section 2.2 that at the optimum severity threshold, the expected benefit is lower for Blacks.

Assume patients have a cost of seeking care equal to $c \geq 0$. This cost is distributed among Whites and Blacks according to the same distribution $h(c)$. The patient seeks care from the doctor if the expected benefit exceeds the cost. This implies that the share of patients seeking treatment is $\int_0^{\overline{\mathrm{EB}}(S^{*\mathrm{opt}})} h(c)\,\mathrm{d}c$. Since $h(c) \geq 0$ and $(\partial \overline{\mathrm{EB}}/\partial \beta) > 0$, the share will always be lower for the group with the noisier signal.[19] Intuitively, the inability to understand the patient makes the physician's recommendation less valuable on average and black patients react to this by demanding less health care.[20]

This rational response by patients to statistical discrimination can lead to a disparity in the mean treatment delivered to Whites and Blacks. While on the one hand this could be said to be due to a demand response, it is worth keeping in mind that preferences of Whites and Blacks are the same in our model — the lower demand results from the less effective health care that Blacks anticipate receiving.[21]

There is plenty of empirical evidence that minorities have lower rates of health care use than Whites. Andersen et al. (1981) show that, even after controlling for need, SES and other

[19] Because the doctor is benevolent and the patient anticipates the doctor's behavior, $\overline{\mathrm{EB}}(S^{*\mathrm{opt}})$ is always non-negative.

[20] The benevolent physician may be aware of the low demand by Blacks, but there is nothing the physician can do to improve the expected benefit from the match and thereby induce more Blacks to seek treatment.

[21] Cultural beliefs may differ across ethnic groups leading to differences in demand for other reasons. Berger (1998) states that African Americans are more likely to believe that hospitals and physicians have a profit motive in treatment choices. Torres (1986) shows that less acculturated Puerto Ricans equate lack of prompt improvement with failure of treatment and are more inclined to disregard expert advice after symptom relief. Uba (1992) makes the case that beliefs about the inevitability of suffering and lack of familiarity with western diagnostic techniques might be a barrier to access to health care and compliance for southeast Asians.

characteristics, Latinos make less use of preventive exams and appear more dissatisfied with each aspect of care than the total population. Gallo et al. (1995) find that African Americans and Latinos are significantly less likely than Whites to have consulted with a specialist in mental health, even accounting for coincident psychiatric disorder, gender and other relevant covariates. Scheffler and Miller (1989) show that insured Blacks and Latinos have lower probabilities of specialty mental health use when compared with Whites after controlling for a number of variables. The same result is found in Padgett et al. (1994). Snyder et al. (2000) show that Asians and Pacific Islanders report worse access to health care than the rest of the population.

Following the same reasoning for follow up care as for care initiation, minority patients might also refuse to comply with their physicians' recommendations once contact with a physician has been initiated — missing follow up appointments, refusing surgery, or not taking prescribed medications. Studies focused on the benefits of ethnic matches have concluded that patients express higher satisfaction with the care received when treated by a physician of their same race/ethnicity (Cooper-Patrick et al., 1999), obtain more preventive care (Saha et al., 1999) and stay in the treatment longer (Takeuchi et al., 1995; Sue et al., 1991).

In Sections 2.2 and 2.3, we have separately addressed supply and demand behavior. Within the simple approach taken here, considerations of a demand and supply equilibrium do not alter any of our findings. The key assumptions are that the patient cost parameter c is independent of severity and patients have no knowledge of their own severity. Altering these assumptions would enable us to link this model to the other strand of the statistical discrimination literature in labor. If physician expectations about black and white patients depend only on the patients that seek care, doctors might hold beliefs in "stereotypes" that could be self-confirming in equilibrium.[22] Even in the absence of "stereotyping behavior", if the assumption that patients are unaware of their own severity were relaxed, our model would predict that minorities should seek care at more advanced stages of their disease, a fact which has been documented in the empirical literature (Eley et al., 1994; Balcazar et al., 1992; Kogan et al., 1994).[23]

3. Multiple treatments, financial incentives and learning

In this section, we modify some of the assumptions we have worked with so far and derive new implications of the statistical discrimination hypothesis. Allowing for more

[22] Such as: black patients are more severe; black patients are non-compliant and others (van Ryn and Burke, 2000).

[23] Another issue that would have to be raised if this assumption were relaxed is the distinction between individual patients and population of patients in the doctor's objective function (whether the physician is oriented to maximize the "public health" or oriented to maximize the health of those patients that come to visit him). In our model, because patients are unaware of their own severity, they do not react to the physician's choice of a threshold. This implies that it is the same for the doctor to maximize each individual's benefit as it is to maximize the benefits of the whole population of patients, since his choice would not affect the number of people that come to see him. If the assumption of ignorance about own severity were relaxed, then it would be crucial to distinguish one objective from the other.

than one treatment generates predictions about the distributions of the "treatment portfolios" recommended by the physician to Whites and Blacks. Considering self-interest on the part of the physician can explain issues as why minorities suffer a bigger impact when the payment system changes from fee-for-service (FFS) to prospective payment. Finally, the application of the statistical discrimination hypothesis to issues of learning seems straightforward, important, and testable.

3.1. Supply behavior with multiple treatments

When there is more than one treatment available to treat a certain disease, the model can be used to make predictions about the differential shares that certain treatments will have in the physician's recommendations to Whites and Blacks. As uncertainty about the underlying severity of the patient increases, we should expect the physician to place more weight on those treatments usually recommended to patients with "average" signals and less weight on those beneficial only to patients with unusual characteristics.

Suppose that there are j alternative procedures that can be used to treat a certain condition. Under perfect information, each treatment j provides a benefit of $a_j Z_i - b_j$ to an individual with severity Z_i.[24] Treatments differ here in their slope (a_j) and in their adverse effects (b_j). The effect of treatment on a particular patient will depend on his severity. A treatment with a very low slope but with also very low adverse effects might be adequate to treat a person who is mildly sick, but not one with a very high degree of severity. The linearity of expected benefits allows us to order treatments according to their expected benefit across different segments of severity. Since signals are normally distributed, the physician's choice problem can be represented as an ordered probit model, an approach we elaborate upon in Appendix A.1. Fig. 3 illustrates the physician's optimal choice for the case of three available treatments.

Let $\mathrm{EB}_j(S)$ be the expected value of treatment j for a patient with a signal S

$$\mathrm{EB}_j(S) = a_j E(Z_i|S) - b_j = (a_j\mu - b_j) + a_j\beta(S - \mu) \tag{6}$$

Denote as $\bar{S}_{jk}$ the signal at which treatments j and k have the same value:

$$\bar{S}_{jk} = \frac{(b_k - b_j) - (a_k - a_j)(1-\beta)\mu}{(a_k - a_j)\beta} \tag{7}$$

The derivative of this cutoff with respect to β equals

$$\frac{\partial \bar{S}_{jk}}{\partial \beta} = \frac{-(\bar{S}_{jk} - \mu)}{\beta} \tag{8}$$

If the cutoff is at the left of the mean severity (like $\bar{S}_{12}$ in Fig. 3), an increase in uncertainty (a decrease in β) will shift it leftwards. If the cutoff is at the right of the mean severity

[24] A reinterpretation of the gross benefits from treatment, aZ, is necessary at this point. In Section 2.2, we treated aZ as the exact benefits that a person needed to return to a state of complete health. We now assume that the utility before treatment is $-a_0 Z$ and the utility after treatment j is $-a_{1j} Z - b$, with $a_0 > a_{1j}$. That is, $a_j = a_0 - a_{1j}$, denotes the patient's gross gain in utility from undertaking treatment j, a gain insufficient to return the patient to a state of perfect health.

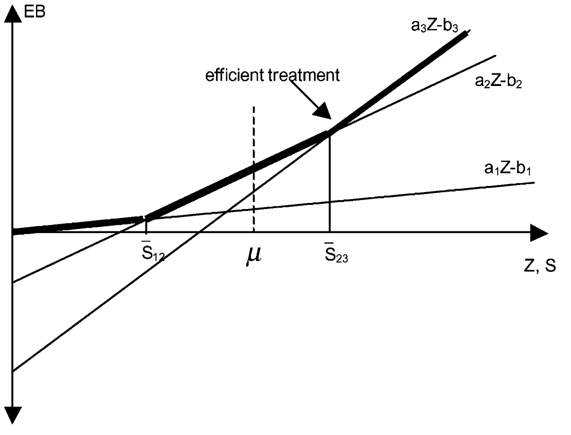

Fig. 3. Physician's optimal choice for the case of three treatments.

(like $\bar{S}_{23}$ in Fig. 3), an increase in uncertainty will shift it to the right. The further away the threshold from the mean, the higher the magnitude of its shift.

The direction and magnitude of these shifts in the thresholds imply that the group with a higher noise (Blacks) will have a lower share of those treatments beneficial to individuals in the extremes of the severity distribution (too sick or almost healthy patients) and a higher share of treatments that benefit mostly patients with average severity signals (see Appendix A.1 for a more formal statement of the above proposition). Empirically, this may suggest that doctors will less frequently recommend new technologies to minorities and might be less likely to switch away from out-dated treatments. [25]

3.2. *Financial incentives and the physician's supply*

Debate in the health economics literature concerns the motives governing physician behavior and the mechanisms physicians possess to determine the type and quantity of treatment used by patients. The empirical evidence is very strong that physicians can influence the care their patients receive, and that the physician's personal economic welfare affects their treatment decision. [26] Here we take account of physician self-interest in a simple way and assume that doctors have a utility function in which the doctor's utility is a linear

[25] Stern and Trajtenberg (1998) in a similar approach to that taken here, show that when the idiosyncratic term (in our case, the signal) is distributed extreme value, a worse diagnosing ability on the part of the doctor (lower β) leads the doctor to recommend a more concentrated "portfolio" of drugs. We are not able to make such a statement with an ordered probit model, since here, the thresholds that determine market shares are completely independent of the underlying distribution of severity (they depend only on treatments' slopes and intercepts). With extreme value idiosyncratic terms, it can be shown that treatments more beneficial to the average patient get higher shares in the physician's portfolio. In order for us to get a result similar to Stern and Trajtenberg's, it might be necessary to work with a multinomial probit model.

[26] This is not to say that profits are the only thing that matters to physicians, only that profits matter some (see McGuire, 2000 for a review of the theoretical and empirical literature on physician behavior).

combination of profit and patient's benefits (Ellis and McGuire, 1986). Specifically, we say that when treating a patient, the physician derives utility $\Pi + w\mathrm{EB}$ where Π is the physician's profit, EB the expected benefit of the patient, and w is the weight on patient benefit relative to profit. We expect $0 < w < 1$, although our conclusions do not depend on w falling in this range. Both profit and expected benefit are a function of treatment. We have already described the manner in which expected benefit depends on treatment for white and black patients.

The relation between profit and treatment is governed by the payment system in which the physician works. In a traditional FFS payment system, a physician is paid more the more treatment is provided. Payments generally exceed variable costs, so that a physician's profits are higher the more treatment is provided. Increasingly, however, physicians are paid by more complex mechanisms that discourage physicians from supplying as much care as they would under FFS. A capitation contract is one extreme form of contract that includes supply-side cost sharing (Newhouse, 1996). Supply-side cost sharing exists when physician profits fall when more treatment is provided at the margin. We will represent the effect of a change in the payment system by analyzing the effect of a change in the profit the physician receives when the patient gets treatment. Since treatment is a yes/no decision, we can normalize the physician's profit to be zero when no treatment is provided and let Π (positive or negative) be the profit the physician gains by providing treatment.

The doctor, maximizing the weighted sum of profit and patient expected benefit, will choose a threshold of observed severity for white and black patients and treat those with severity above the threshold. The expression to be maximized with respect to S^* is

$$\int_{S^*}^{\infty} \{\Pi + w[aE(Z|S) - b]\} g(S)\,\mathrm{d}S = \Pi\left[1 - \Phi\left(\frac{S^* - \mu}{\sigma_S}\right)\right] + w\overline{\mathrm{EB}}(S^*) \qquad (9)$$

In the extreme case of no noise (Whites), the threshold is set at $Z^{**\mathrm{opt}} = -\Pi/wa + b/a = Z^{*opt} - \Pi/wa$. When $\beta < 1$ (Blacks), the threshold becomes $S^{**\mathrm{opt}} = [-\Pi/w + b - a(1-\beta)\mu](1/\beta a) = S^{*\mathrm{opt}} - \Pi/w\beta a$.

In comparison to the benevolent doctor, the threshold is shifted leftwards for both Blacks and Whites (more patients treated) if the doctor derives a positive profit at the margin from recommending treatment ($\Pi > 0$), and rightwards in the opposite case (Fig. 4).

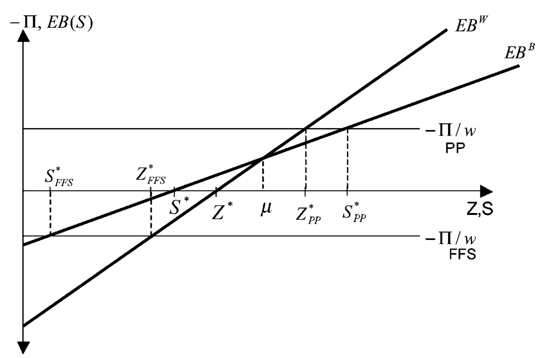

Fig. 4. Thresholds chosen by a self-interested doctor when treatment is beneficial to the average patient.

The first implication of statistical discrimination in this context is that the magnitude of the change in the threshold will be higher for the group with higher noise (at lower β). The signal threshold for Blacks changes more than the threshold for Whites when the payment system changes, even after controlling for the variance of each group's signal distribution.[27] The shift in the threshold for Blacks will be magnified in response to a profit incentive because the doctor (in response to a decrease in profit with respect to the treatment decision) has a higher "target" average severity contingent on the signal. To attain this new target, the signal threshold must be increased more the higher the noise in the signal.

A change in the threshold is not of course the same as a change in the number of patients treated; the variation in the probability of treatment depends on the thickness of the distribution of patients in the range of the signal threshold compared to the severity threshold for Whites. Let ρ be the fraction of patients assigned treatment

$$\rho = \int_{S^{**\mathrm{opt}}}^{\infty} g(S)\,\mathrm{d}S = 1 - \Phi\left(\frac{S^{**\mathrm{opt}} - \mu}{\sigma_S}\right) \tag{10}$$

It is easy to verify that supply increases with Π.[28] We are interested in the relationship between the supply response to profits and the quality of the signal, β

$$\frac{\partial}{\partial\beta}\left(\frac{\partial\rho}{\partial\Pi}\right) = \frac{\phi((S^{**\mathrm{opt}} - \mu)/\sigma_S)}{2\sigma_Z^3 wa\beta^{1/2}}[(S^{**\mathrm{opt}} - \mu)^2 - \sigma_S^2] \tag{11}$$

The sign of this expression depends on the type of technology being used by the physician, which determines the location of the threshold in the signal range. The basic distinction is between technologies that have thresholds within one standard deviation from the mean severity, $(S^{**\mathrm{opt}} - \mu)^2 < \sigma_S^2$, and technologies with thresholds further from one standard deviation away from the mean, $(S^{**\mathrm{opt}} - \mu)^2 > \sigma_S^2$. In the former case, the doctor responds to a financial incentive by changing supply at higher rates to Blacks than to Whites. The opposite occurs in the case of technologies with thresholds nearer the extremes of the distribution of severity.

Several papers have tried to study the effects of managed care on the amount of care recommended to minorities. In Gomes and McGuire (2000) and Tai-Seale et al. (2001) minorities appear to suffer most when the payment system moves from FFS to managed care. While this result is consistent with statistical discrimination, it does not constitute strong evidence for our ideas. A good test of statistical discrimination requires that more information about the technologies be used to predict whether minorities would receive care more or less frequently than Whites.

A second implication of introducing financial incentives is that, contrary to the benevolent case, the decisions about treatment will not necessarily be more beneficial to Whites. At

[27] $$\frac{\partial}{\partial\beta}\left[\frac{\partial}{\partial\Pi}\left(\frac{S^{**\mathrm{opt}} - \mu}{\sigma_S}\right)\right] = \frac{1}{2wa\beta^{3/2}\sigma_Z} > 0,$$

the standardized threshold for Whites changes less than the standardized threshold for Blacks in response to a financial incentive.

[28] $$\frac{\partial\rho}{\partial\Pi} = \frac{\phi((S^{**\mathrm{opt}} - \mu)/\sigma_S)}{\sigma_Z w\beta^{1/2} a} > 0.$$

the optimum, the change in average expected benefit when noise decreases (β increases) is given by

$$\frac{\partial \overline{\mathrm{EB}}(S^{**\mathrm{opt}})}{\partial \beta} = \frac{\phi((-\Pi/w + b - a\mu)/a\sigma_Z \beta^{1/2})}{2a\beta^{3/2}\sigma_Z} \times \left[a^2\beta\sigma_Z^2 + \left(\frac{\Pi}{w}\right)^2 + \left(\frac{\Pi}{w}\right)(a\mu - b) \right] \tag{12}$$

Two different forces are at work in the above expression: the effects of uncertainty and the distortions introduced by financial incentives. As predicted by the theory of the second best, once a distortion exists, adding a second distortion does not necessarily worsen the equilibrium. In the presence of self-interest on the part of the physician, the existence of miscommunication between the doctor and a minority patient does not necessarily imply that the minority patient will fare worse from treatment than a white one. Although Blacks still benefit less than Whites from most treatments, in the case of some particular treatments the introduction of financial incentives neutralizes the distortion introduced by the presence of imperfect information. Table 2 in Appendix A.2 describes the different ranges for which the outcome will be lower for Blacks under each payment system. As we can appreciate from this table, the detrimental effect of miscommunication on welfare is still powerful: despite some exceptions, it seems likely that treatments are less effective for minorities on average.

3.3. Learning

In the analysis in Section 2, we treat the communication problem between the doctor and the patient as given. Neither the physician nor the patient can take any action to improve communication, nor does communication change for any other reason. Clearly, however, if communication is a problem for one or both parties in an exchange, they will have an interest in improving it. One direction for extending our basic model would be to introduce an "investment" that could be made by the patient or the doctor in better understanding the other party. For a patient, if language is the underlying issue, this might take the form of bringing a relative along on a visit. A physician could invest by willing to spend a longer time with patients with whom there is a communication problem. The physician could also change the nature of information collection and substitute more "objective" tests for patient self-reports where possible. Still, if learning and communication are more costly between doctors and minorities than between doctors and Whites, in equilibrium, after any investments have been made to reduce communication problems, we should not expect the investments to completely equalize the ability to communicate. Taking learning into account should not, therefore, alter the central message of our paper.

The possibility of learning has many empirical implications that might help in assessing the importance of statistical discrimination. The most direct and obvious test would be to see if doctors react to minorities in a way that is consistent with minorities being subject to worse communication. Assuming that incremental information has more value when the level of information is less, a doctor would be led to use more diagnostic and other tests for minorities to substitute for direct communication. There is another force at work, however; if the "cost" of information is higher, a doctor might react by being less willing to spend time collecting it. We might therefore predict that a physician would tend to use less or more of his/her own time in collecting information (depending on how the balance of the above forces work out in the clinical context), but, where possible, call for more testing in the case of minorities.

If statistical discrimination is a result of bad quality of communication between physician and patient, we should expect communication to improve as the physician increases the interaction/experience with patients of other ethnic groups. In other words, the more a particular physician treats a certain ethnic group, the more he learns about this group's health beliefs, language and communication habits. Learning may make the physician more "fluent" in a general sense and result in fewer diagnostic misunderstandings. Altonji and Pierret (1997) use the idea of learning to test for statistical discrimination in the labor market by assuming that a particular employer learns over time about the true productivity of each employee. This argument cannot be applied straightforwardly to health markets. A doctor sees many more patients than an employer sees new employees or candidates, but the relationship with each patient is less extensive. This implies that a doctor may not have enough encounters with a single patient to "learn" about this patient's communication skills, perceive his signals with less noise, or identify his real health needs. However, since the problem of statistical discrimination due to miscommunication occurs between members of different ethnic groups, by having enough encounters with patients of other ethnic populations, a doctor may learn how to interpret signals and beliefs and apply this learning to each individual case. An interesting empirical application lies in the study of the length of the relationships between physicians and patients of different ethnic groups. If doctors with more experience with minorities are better prepared to interpret these patients' signals, we should observe these doctors (together with minority doctors) sustaining longer term relationships with minority patients. Inexperienced white doctors would face, on the other hand, a higher turnover of minority patients and less treatment response from them. A possible implication is that these doctors interpret the lack of response to care as an innate attitude of a particular group of individuals and not as group members' reaction to poor communication. These kinds of interpretations could give rise to stereotypes that may eventually be self-confirmed (Balsa and McGuire, 2001).

The learning idea could similarly be studied by comparing areas or communities. Suppose community A experiences an increase in the number of Latinos treated over a certain period of time (relative to Whites), whereas community B experiences no significant variation in the amount of minorities treated relative to Whites. We should expect doctors to place less weight on "average treatments" recommended to Latinos (relative to the share of those treatments for Whites) as more is learned about minorities' signals in community A, but we should not expect those relative shares to change significantly in community B. A difference-in-difference approach would allow us to control for practice styles particular to each community.

Physicians also learn about the applicability of health care technologies. In the early phase of introduction of a new technology, it might be viewed as suitable only for patients with special characteristics. If these characteristics are more readily observed by a physician among Whites, then diffusion should begin more rapidly among Whites than Blacks. Once a technology has become generally accepted, we should see a “catch up” in application to minority populations.

4. Empirical relevance of the statistical discrimination hypothesis

In the previous sections, we proposed a model in which miscommunication in the clinical encounter resulted in disparities in the use of health resources between minorities and Whites. We reiterate at this stage that we do not claim that statistical discrimination is the only relevant force behind disparities. On the contrary, we believe that disparities stem from a complex interaction of phenomena that need to be studied carefully before addressing any particular policy. The quantitative importance of the statistical discrimination hypothesis in accounting for differential patterns of health care use by minorities, relative to other plausible explanations, needs to be assessed empirically. The statistical discrimination hypothesis seems particularly rich in implications, which, though not in itself making the hypothesis any more likely to be correct, does make it a good candidate for empirical research. In this section, we comment on how the existing literature bears on our central hypothesis, summarize some of the testable implications we have identified so far, and suggest some empirical work that may do a better job than the literature to date at shedding light on the mechanisms by which disparities arise.

4.1. Statistical discrimination and documented evidence on health disparities

Throughout the paper, we cited some empirical work that might provide support for the statistical discrimination hypothesis. In this subsection, we make a slightly more general review of the literature documenting disparities and interpret the validity of the statistical discrimination hypothesis in the light of this evidence.

The set of literature that best supports the role for statistical discrimination is that which shows treatment differences in situations where the patient report is the only or primary factor that the physicians can use, as in mental health care, for instance. In a study of Medicaid recipients with depression, Melfi et al. (1998) find that Blacks are less likely to receive a medication when they first have an indication of depression, even though there is evidence of a higher responsiveness to antidepressants for Blacks than Whites. Furthermore, when Blacks do receive medication, it is more likely to be a tri-cyclic antidepressant than the newer selective serotonin reuptake inhibitor. Blacks are also less likely to receive a second medication and more likely to discontinue prematurely medication. Sleath et al. (1998) find also that Blacks are less likely than Whites to receive prescriptions for one or more psychotropic medications, but take a further step and use audio-tapes of the medical encounters to analyze the relation between interracial communication and differences in prescriptive behavior. They find that patient expression of emotional symptoms influences psychotropic prescribing to both White and non-white patients, but physician perceptions of patients’ emotional health only significantly influence psychotropic prescribing to white patients.[29] Their finding suggests that the physician does not perceive and treat the mental health of non-white and white patients in a similar fashion, what might help explain why non-Whites are found to have lower rates of psychotropic drug use than Whites.

The statistical discrimination hypothesis provides also an explanation for the differences in demand patterns that have been observed for different ethnic groups. We already cited in Section 2.3, a set of studies showing that minorities initiate care and comply with treatment at lower rates than Whites (Andersen et al., 1981; Gallo et al., 1995; Scheffler and Miller, 1989; Padgett et al., 1994; Snyder et al., 2000). Slight variations to the model in Section 2.3 could also help explain why minorities seek care at more severe/advanced stages of their disease (Eley et al., 1994; Balcazar et al., 1992; Kogan et al., 1994).

In spite of there being indirect evidence supporting the miscommunication hypothesis, we recognize that an important body of the disparities literature deals with areas of medical care in which communication may not be as relevant an explanation. Cardiac care is one of the most frequently studied areas of Black–White differences. Although at some stages of treatment, patient–doctor communication may well matter, some studies have examined rates of invasive procedures when disease has been evaluated with coronary angiograms. Maynard et al. (1986) report on data from the late 1970s and find that controlling for clinical status by angiography and other factors, Blacks are less likely to be recommended for bypass surgery, and are less likely to agree to surgery given they are recommended. In more recent data about heart disease also confirmed by angiography, Blacks were less likely to have bypass surgery or any revascularization procedure, controlling for insurance status, SES, and other factors (Peterson et al., 1997; Hannan et al., 1999). Certainly, other diseases and papers about disparities in their treatment do not fit into the communication theory.[30] For instance, the racial differences found in Schulman et al. (1999) can hardly be attributed to miscommunication since the study was designed to minimize communication problems.[31] Most probably, the disparities found in those investigations stem from other sources.

Finally, a basic distinction between taste and statistical discrimination is that the latter hypothesis does not necessarily predict that minorities should receive less than Whites. The available empirical evidence shows that disparities exist in some areas, such as cardiac care, cancer surgical treatment, and HIV/AIDS therapy, but not in other areas, such as diabetes care and cancer screening (Mayberry et al., 2000). In attention to this evidence,

[29] The authors used logistic regressions to predict psychotropic prescribing. They run separate regressions for white and non-white patients, using as controls demographic variables, patient expression variables and physician perception variables (the patient sample was 45% non-white). Patient expression variables were constructed using the Patient Symptom Expression coding tool, which measured the extent to which patients actually expressed various physical, emotional and social problems during the taped encounter. Physicians' perceptions of the patient's physical, emotional and social health were assessed through questionnaires. For Whites, both patient expression of emotional symptoms and the physician's rating of the patient's emotional health were significant predictors of psychotropic prescribing; for non-Whites the only variable that significantly influenced physician psychotropic prescribing was patient expression of emotional symptoms.

[30] For a review of the disparities literature organized by disease area, see Mayberry et al. (2000).

[31] Actors were used in this study because they were considered better able than patients to express a consistent range of emotions and to read the scripts verbatim for recording. The interviews were recorded at a single studio, with the actors following a particular set of directions for each script. The hand motions used by the actors were identical for each script, the actors were dressed in identical gowns, and the camera position was the same for all interviews.

some researchers have suggested that the cost of care might be an important consideration in clinical decisions for ethnic minority groups. If we interpret the parameter b in our model as a parameter representing the shadow price of treatment for a particular doctor, then the model predicts that Blacks should be assigned at lower rates to treatments that are not cost-effective for the average patient (cardiac care, cancer surgical treatment, HIV/AIDS therapy) and the opposite when treatments are cost-effective for the average person in the population (diabetes care and cancer screening).

4.2. *Directions for future research*

A lot of research needs yet to be done to identify the empirical importance of the statistical discrimination hypothesis. One direction for research is to test the driving assumption of the model: the communication between minorities and doctors is worse than it is for Whites. A number of papers already referred to document poor communication between doctors (or other health care providers) and members of minority groups, lending some initial support to this idea. Our work here, however, suggests focusing research on the question of the doctor's inference on the basis of what is observed. Many of the empirical implications of statistical discrimination result from the downweighting of the signal in the case of the group with the noisy communication. Testing this directly, in the form of asking whether doctors bother to collect less (subjective) information from minorities, rely more on (objective) tests, respond less in assessed severity to reported symptoms, and so on, appears to be worthwhile.

Most tests for disparities or for "discrimination" in the literature check to see if the mean levels or rates of treatment are lower for minorities than for Whites. These investigations, while valuable, do not emphasize the "match" issue at the heart of the statistical discrimination mechanism. Some implications of a poor match for patient and doctor behavior are summarized in Table 1. In some cases, there are qualifications on these predictions that we omit from the table. For each prediction, we either cite an article or articles as examples of research that bears on the prediction, or we suggest an empirical strategy for future research. We do not claim to have systematically surveyed the enormous literature on patterns of health care use by Whites and minorities. The articles cited are put forward only as examples, not as representative findings.

5. Conclusions

This paper provides an explanation of discrimination in health care (discussed under the title of "statistical discrimination") in which differences in treatment rates arise from relatively poor communication between a minority patient and a health care provider. The model implies that minorities fare worse than Whites from health care services because they are more likely to be mismatched to treatments. Unlike other hypotheses of discrimination, the model predicts that minorities may or may not receive fewer resources than Whites, the sign of the difference depending on the type of treatment being considered.

We believe that it is unlikely that the persistent and disturbing disparities in health and health care use in the US and other countries can be traced to one source. Something so complex as the social determinants of health status and health care utilization will not be fully

Table 1
Empirical implications of statistical discrimination

Implication	Sample of previous research/empirical strategy
Poor outcomes for minorities: Poor communication leads to bad match of treatment to needs. Severity is less correlated with treatment for minorities	Stewart (1995) reviews studies that assess the importance of communication between physician and patient. Most of the studies demonstrate a correlation between effective communication and improved health outcomes
Minorities initiate care less frequently: Lower anticipated benefit lowers initiation	Snyder et al. (2000) show that Asians and Pacific Islanders report worse access to health care than any other population group
Minorities continue care (comply) less frequently: At any stage of treatment, poor communication implies lower expected benefit	Sue et al. (1991) show that patients matched with a therapist of their same ethnicity or language have a higher return rate to psychotherapy and stay in treatment longer
Physicians act differently as a result of miscommunication: The accuracy with which the doctor perceives the patient's symptoms has a direct effect on his prescription behavior	Sleath et al. (1998) show that physicians perceive and treat the mental health of non-white and white patients in a different fashion, which might help explain why non-Whites have a lower rate of psychotropic drug use
Supply to minorities could be greater or less than supply to Whites: Supply decisions weighted more to needs of average benefit in the population. Treatments usually beneficial will be more frequently given to minorities	No research. Empirical strategy: Compare rates of use for technologies at different stages of their diffusion
When multiple treatments are available, minorities tend to get less frequently new treatments: With more uncertainty doctors place higher weight in treatments known to benefit the average patient and less on those treatments with unknown/high adverse effects	Stern and Trajtenberg (1998) show that doctors with worse diagnosing skills prescribe a more concentrated drug portfolio than doctors with better diagnosis skills. No research comparing treatment choices across different groups
Physician's responses to supply side cost sharing and managed care different for minorities: Whether the managed care effect will be stronger or not for minorities may depend on the type of technology being used	Gomes and McGuire (2000) show that Managed Care reduces total health care resources more for Blacks and Latinos than for Whites. No research making the distinction between technologies
Differences in care received more pronounced for conditions that require better communication (e.g. mental health vs. pregnancy)	No research. Empirical strategy: Analyze whether the differences studied above are more pronounced (perhaps by interaction terms) for conditions that require better communication skills
Fewer and more vague diagnoses recorded on claims for minorities	No research. Empirical strategy: compare the fraction of 5 vs. 4 digits ICD-9 diagnoses codes used for minorities and Whites
Doctors could react to worse communication by investing more in objective measures	No research. Empirical strategy: Study whether white doctors increase the use of diagnosis devices when screening minority patients
Differences between Whites and minorities will be less when treated by providers with more experience with minorities: Providers learn to communicate better with experience	Waitzkin (1985) finds that the amount of time the physician spends in informing the patient and the language used by the physician to explain improve as the patient–doctor relationship develops over time

illuminated by developing the implications of a single underlying premise. Nonetheless, as we have shown, the premise of a "noisier signal for minorities" is extremely rich, in the sense that communication problems can account for a range of the empirical findings associated with disparities.

Statistical discrimination has particular implications allowing for empirical work testing for the existence and quantitative importance of communication-based disparities in health care use. The preliminary evidence is persuasive enough that the hypothesis of statistical discrimination should be subject to empirical tests. We intend to begin some of that work ourselves, but have provided the extensive list of implications in Table 1 to suggest lines of work to other researchers. Accurate diagnosis of the cause of at least some part of the social ill of health disparities would be an important contribution of health services research towards finding effective ways of distributing the benefits of health care treatments more efficiently and fairly.

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Appendix A

A.1. The physician's portfolio of treatments recommended to Blacks will place more weight on the average treatment

Note that since S is distributed normal, the shares of each treatment j in the physician's portfolio, s_j, are given by

$$s_j = \Phi\left(\frac{\bar{S}_{j,j+1} - \mu}{\sigma_S}\right) - \Phi\left(\frac{\bar{S}_{j-1,j} - \mu}{\sigma_S}\right) \tag{A.1}$$

A change in the noise between doctor and patient will have the following effect over shares:

$$\frac{\partial s_j}{\partial \beta} = \frac{-\phi((\bar{S}_{j,j+1} - \mu)/\sigma_s)}{2\beta}\left(\frac{\bar{S}_{j,j+1} - \mu}{\sigma_S}\right) + \frac{\phi((\bar{S}_{j-1,j} - \mu)/\sigma_s)}{2\beta}\left(\frac{\bar{S}_{j-1,j} - \mu}{\sigma_S}\right) \tag{A.2}$$

We can see from the above expression that treatments that are optimal to the average patient (treatments with lower thresholds at the left of μ and upper thresholds at the right of μ) will increase their shares in the physician's portfolios as noise increases ($\partial s_j/\partial \beta < 0$). Treatments that are efficient either at the lower end of the distribution or at the upper tail of the distribution of severity will decrease their shares as noise increases. For treatments in between, the change in the share will depend on the interaction of two counteracting effects: more noise increases the range of severity signals to which the treatment is applied, but these signals are pushed away from the mean, and hence each severity level has now a lower density. It can be shown that for treatments nearer to the mean, the gain due to the wider range of severity signals will surpass the loss due to the lower probability at each point and the share of these treatments will increase. The opposite will occur for treatments located nearer to the tails of the distribution.

A.2. Comparative outcomes of care for Blacks and Whites under different payment systems and types of treatments

When the treatment is beneficial to the average patient, $a\mu > b$ and the payment system is FFS, $\Pi > 0$, both imperfect communication and financial incentives push the doctor towards increasing services. In this case, Blacks continue to fare worse than Whites from treatment. If, on the other hand, the payment system is prospective, $\Pi < 0$, two opposite forces interact: uncertainty pushes the doctor towards decreasing the threshold for Blacks, but financial incentives push him towards increasing the threshold. The net expected benefit depends on the relative magnitude of these opposing effects. Blacks will still be worse off than Whites for treatments that provide the average patient with small net benefits, since in these cases, the effect of the mismatch is not strong enough to compensate for the distortions introduced by financial incentives (Table 2).

Suppose now that the treatment is not beneficial to the average patient: a benevolent physician would assign Blacks to treatment at a lower rate than Whites. This effect is reinforced if the payment system is prospective, since the doctor has the incentive to under provide care. Blacks in this case will have a lower expected benefit than Whites. However, under a payment system that rewards a doctor with higher profits when treatment is provided, the incentive to increase care neutralizes in part the effects of a bad match. Again, the smaller the net benefit that an average patient obtains from treatment, the higher the likelihood that Blacks will fare worse than Whites.

Table 2

	Fee for service $\Pi > 0$: overprovision to Blacks and Whites	Prospective payment $\Pi < 0$: underprovision to Blacks and Whites
$a\mu - b > 0$: treatment beneficial to the average patient–doctor overprovides to Blacks	Outcome of treatment is lower for Blacks	Outcome of treatment is lower for Blacks if $a\mu - b < \frac{a^2\sigma_Z^2\beta + (\Pi/w)^2}{(-\Pi/w)}$, otherwise, Whites fare worse
$a\mu - b < 0$: treatment not beneficial for the average patient–doctor underprovides to Blacks	Outcome of treatment is lower for Blacks if $b - a\mu < \frac{a^2\sigma_Z^2\beta + (\Pi/w)^2}{(\Pi/w)}$, otherwise, Whites fare worse	Outcome of treatment is lower for Blacks

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