Appearance, Inferences about Credit Quality and Learning

Enrichetta Ravina*
Columbia Business School

Appearance and personal characteristics, such as age, gender, ethnicity and the way a person presents himself have been shown to play a role in many economic exchanges. Various explanations have been proposed for this finding, ranging from 'statistical discrimination', where such variables are surrogates for unobservable characteristics related to the quality of the counterparty, to 'taste-based discrimination', where one or both parties experience disutility from interacting with people belonging to certain groups. This paper reviews the theoretical and empirical literature in this area and investigates whether individuals update their beliefs and attitudes toward such characteristics after they learn about outcomes.
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* e*r2463@columbia.edu,* Department of Finance and Economics.

1. Introduction

Personal characteristics and the way one presents oneself matter in many aspects of life, from getting a job (Bertrand *et* al., 2004) or a loan (Ravina, 2008), to success in relationships, corporate jobs (Rule *et* al., 2008), and politics (Todorov *et* al., 2005; Olivola *et* al., 2010).

Why is it the case that beautiful borrowers are more likely to get a loan and pay lower interest rates, even after controlling for creditworthiness, employment history and a battery of other characteristics related to repayment ability? Why do political candidates' facial features shown for 1 second affect voters' perceptions and predict elections results, even if we like to think that such choices are based on a long reasoned analysis? Why are racial minorities less likely to get a job or a mortgage than a white applicant with the same credentials?

These questions have fascinated not only economists, but also social psychologists and biologists for a long time. Many theories have been suggested as to why these phenomena arise. A leading one is taste-based discrimination, advanced by Becker in 1957. According to this theory, some economic agents dislike interacting with certain groups because of animus and are willing to leave money on the table in terms of lower profits just to avoid such interaction.

Another theory, conceptually different from animus per se, is one based on the prejudice or misperceptions by employers and lenders who believe a certain group to be less qualified even if that is not the case. Each employer has a very limited amount of experience and this can make the phenomenon quite persistent, as it takes a long time for them to update their beliefs, especially if individuals tend to give more weight to evidence confirming their beliefs and disregard evidence against them.

Biology and social psychology focus their attention on the effects of attractiveness on others' perceptions and on success in life. They show that beautiful people are perceived as more cooperative, intelligent and trustworthy. The reason could be that our brain is wired to associate positive characteristics to people with features that are correlated with fitness, health and reproductive ability. As a result, beautiful people are treated better since their childhood and develop more self confidence that helps them being successful in life (Langlois, 2000). These findings beg the question of whether beautiful people are actually on average better, because of their upbringing or genetic reasons, or rather our perceptions lead us to make suboptimal decisions when we treat them favorably in economic exchanges.

Finally, statistical discrimination theories postulate that lenders and employers base their decisions on personal characteristics not because they think they matter per se, but because they are easily observable proxies for harder-to-observe variables correlated with future performance (Arrow, 1973; Phelps, 1972). For example,

since beautiful people do better in the labor market (Hamermesh and Biddle, 1994), it might be optimal to extend them more credit because of their higher repayment ability. Similarly, racial minorities might come from a disadvantaged background which affects the quality of their human capital and their productivity.

Understanding the mechanisms behind the gap in wages and access to credit faced by minorities is very important to design effective economic policies. If the reason why they are disfavored by firms is that their human capital and creditworthiness are worse along unobservable dimensions, like statistical discrimination theories would suggest, then the best policy is to improve their access to education and other tools to increase their human capital. If, on the contrary, minority applicants are intrinsically the same as the other applicants and their worse performance is due to animus, like taste-based discrimination theory postulates, then anti-discriminatory and affirmative action policies might be more effective.

Empirically, it is very difficult to distinguish among these theories. It requires the ability to observe the information used by the lenders and the employers to make decisions, and to measure ex-post performance. The center of the discussion is "whether unobserved characteristics differ across groups and how, and whether personal characteristics are proxy for productivity or proxies for gender/race/…" (Heckman, 1998). This question has been addressed with very detailed field data based on surveys and databases collected by the government, quasi-natural experiments, audit studies and lab experiments, which are illustrated in Section 3 of this paper. Each approach has some advantages and some drawbacks. The opening of new markets, like online lending platforms, has also created new high quality information venues to study these phenomena. While usually the econometrician does not observe all the variables available to a firm making a hiring or a lending decision, in this setting he does. This provides an opportunity to observe lenders acting without any restraint and to measure a large amount of the information they have access to when making their choices.

Finally, an interesting question that few studies have analyzed due to lack of data is whether lenders and employers learn over time about the value of using easily observable characteristics in their decision making process. How long does it take for them to (at least partially) correct their mistakes? Does the speed of learning depend on the lenders' characteristics, or on their experiences in the market? Are certain types of lenders and employers more likely to fall victims of these biases?

The studies that have addressed these issues seem to agree that in the case of race the updating is non-existent, or too slow to be detected over the sample periods analyzed, suggesting evidence of taste-based discrimination (Altonji and Pierret, 2001). On the contrary, the evidence on beauty indicates that experience and sophistication decrease the likelihood that lenders over-extend credit to at-

tractive borrowers who turn out, all else equal, more likely to default. These results are in line with theories of stereotypes and misperceptions that get corrected over time, albeit slowly.

The remainder of the paper is organized as follows. Section 2 covers the theoretical explanations that have been proposed over time to address the reasons why personal characteristics of the applicant affect employers and lenders decisions, once the observable quality of the candidates has been taken into account. Section 3 reviews the empirical literature testing the theories, focusing on the main empirical strategies, their strengths and drawbacks and the main results. Section 4 takes a closer look at whether lenders and employers learn about the relationship between observable characteristics and unobserved quality over time.

Section 5 concludes.

2. Theoretical Explanations

In this section, I explore the main theories why easily observable personal characteristics affect many economic decisions, either per se or as a proxy for other more difficult to observe features of the counterparty that are believed to be related to future performance.

2.1. Taste-Based Discrimination a la Becker

One of the first economics studies investigating why age, gender, and other personal characteristics play a role in economic exchanges is Becker's (1957) theory of taste-based discrimination.

According to this theory, some lenders/employers suffer a disutility from interacting with people belonging to certain groups and are willing to leave money on the table in terms of lower workers' productivity, or lower loan returns, in order to avoid such interaction. For example, some employers may not want to hire minorities or unattractive workers, and by restricting the pool of workers they consider, they might miss out on good workers and forego some profits as a consequence of that. Such employers are aware that the workers they discriminate against are as productive as the others and that not hiring them might result in a loss of profits. Nevertheless, they are not willing to change their policies.[1] Similarly, some lenders might avoid lending or charge higher rates to minorities and unattractive borrowers because of bigotry, or an unconscious bias, even though, ex-post, controlling for observable characteristics, the default rates of minorities/unattractive borrowers and similar non-discriminated borrowers are

[1] An alternative is that the other employees or the customers being discriminatory and leading the firm to prefer white and male applicants.

the same. Doing so leads to missed opportunities to lend to good borrowers and might also generate adverse selection among minority borrowers that are willing to take a loan at these higher rates.

Empirically, this theory predicts that minority borrowers and employees are less likely to get loans and be hired and, conditionally on being accepted, they will display higher loan profitability/productivity because the threshold they need to overcome is higher than the one set for white applicants with similar characteristics.

Finally, this theory begs the question of why if agents are profit-maximizing and the markets competitive, the discriminatory firms are not driven out and taste-based discrimination doesn't disappear in the long-run. The reasoning goes that if there is heterogeneity in the degree of discrimination across employers, then the non-discriminatory employers would drive out the others because they would be willing to hire good discriminated-against workers at a slightly lower wage and would get the best workers. Becker points out that only if there are enough non-discriminatory firms to hire all the minority workers discrimination will disappear. Otherwise, unless there is an infinitely elastic supply of entrepreneurs and therefore their income is zero, they can spend their resources in any way they prefer, including paying to decrease the probability of interacting with the discriminated group. In this case, discrimination will survive even if markets are competitive. Subsequent research also shows that introducing search costs in these models, so that workers face a cost when searching for firms which could hire them, leads to the result that the full distribution of firms' taste for discrimination matters and not only the preferences of the marginal firm. This friction makes discrimination much tougher to eliminate (Black, 1995). The same results ensue if it is the firm and not the worker who faces a search cost (Bowlus and Eckstein, 2002).

The review of the empirical work in section 3 does indeed show that evidence of taste based discrimination has been indeed found in many settings where the assumption that markets are competitive seems plausible.

2.2. Statistical Discrimination a la Arrow and Phelps

An alternative theory of why personal characteristics matter in various realms of life, ranging from employment to political elections, personal relationships and access to credit, is that they are easily observable proxies for characteristics related to the unobservable quality of the counterparty (Arrow, 1973, 1998; Phelps, 1972).

For example, racial minorities are more likely to come from disadvantaged family backgrounds, low quality schools, and poor areas. All these characteristics affect workers' investment in human capital and productivity, and, although difficult to measure directly, are easily proxied by belonging to a minority. Similarly, better looking people have been shown to do better in the labor market (Ham-

mermesh *et* al., 1994 and 1998), and therefore all else equal to have a higher ability to repay and for this reason they might be extended more credit.

Employers and lenders make use of these easily observable characteristics to screen potential workers and borrowers based on the way, in their experience, these variables correlate to ex-post outcomes in the labor market, credit markets or other settings they think are informative of the future performance of the prospects in the specific case they are facing. On average, their assessments will turn out to be right and the average and marginal accepted discriminated applicant will be lower quality than a non-discriminated applicant with similar observable characteristics.

Empirically, this theory predicts that minority borrowers and employees will fare worse than similar white applicants, because of lower values of characteristics unobservable or hard-to-observe for the employers and the lenders, but easily proxied by race, gender or looks. Similarly to taste based discrimination theories, these applicants will be less likely to be hired and lent money to, and conditionally on being accepted, they will pay higher rates and get lower wages. Differently from Becker's theory though, they will default more often and have lower productivity than white applicants with similar characteristics because they are worse on unobservable dimensions.

If this theory is true, it is still possible that in a given setting employers and lenders are mistaken in their assessments of the relationship between unobservable quality and personal characteristics that proxy for it and that the returns from hiring a discriminated applicant or extending credit to him are higher/lower than expected. This relationship might also evolve over time because employers and lenders' treatment might change the incentives faced by discriminated applicants in acquiring human capital and exerting effort, and in the degree of moral hazard they display in credit markets. In both cases, since each lender and employer has only limited experience interacting with such applicants, it might take a long time for them to update their views.

Section 3 contains various studies testing this theory and more complex versions of it based on the same intuition. They provide evidence in support of this theory, but they can rarely account for the full gap between the treatment of the discriminated group and the rest of the population.

2.3. Stereotyping and Perceptions

Another leading strand of theories on why personal characteristics matter in economic exchanges, and in other areas of life, lays at the intersection of the economics, social psychology, and biology literatures.

The theories in social psychology and biology focus more on beauty and its effects on perceptions and individual performance, rather than on appearance and personal characteristics more generally. They aim at understanding why attractive people are perceived more positively.

One of them is the *fitness-related evolutionary theory*, according to which attractiveness is indeed correlated with fitness, health and reproductive ability, and people have learnt over centuries to recognize these signs. For this reason, there is a universal standard of beauty, valid across cultures and times, and more attractive people are indeed on average healthier and more successful. Langlois (2000) provides a detailed meta-study of the literature supporting this view.

This theory would explain why beautiful people are more successful in many realms of economic activity and is validated to the extent that we find that more attractive people are more productive, even abstracting from the fact that they are perceived as being so and that teachers and parents tend more to them because of their perceived higher potential in evolutionary terms. Testing these claims is very difficult, as it requires disentangling perceptions from actual productivity and being able to measure ex-post performance under all else equal conditions, i.e. when everyone makes the same investment in human capital and receives the same attentions irrespective of his personal characteristics. One setting in which economists have gotten close to this ideal, albeit at the cost of other drawbacks, is laboratory experiments, and many of them are reviewed in section 3 below.

Two other theories are the *socialization and the social expectancy theories*, which postulate that attractive individuals are perceived as being better and more trustworthy, even if it is not necessarily so. Because of these differential evaluation and treatment, such individuals develop different behaviors and internalize these self-views. These theories predict that very young children do not display different behavior and attitudes based on their looks, but as they grow up they will start to because of societal influences.

Finally, another leading theory is the *kernel of truth theory,* which is based on stereotyping and its reinforcements. If the majority of individuals believe that certain characteristics are associated with higher productivity, then such stereotypes, whether accurate or not, can become self-fulfilling by influencing the effort and evaluations of teachers and employers, and the level of motivation and self confidence of the individuals themselves (Cauthen *et* al., 1971).

For example, beauty is perceived to be correlated with intelligence, social skills and health. If teachers, consciously or not, expect good-looking children to do better, they will dedicate more effort and attention to them because of their greater potential and, as a result, such children will be better prepared and more confident (Langlois, 2000). Similarly, the economics literature comprises various

studies examining how workers belonging to discriminated groups might be discouraged from making the appropriate investments in human capital if they perceive that they will not be adequately rewarded by the labor market because of prejudices on the part of employers, co-workers or customers (Arrow, 1973; Coate and Laury, 1993). This behavior in turn makes the prejudices self-fulfilling.

To the extent that economic agents are actually affected by the stereotypes held about them and modify their behavior in the ways specified above, this theory would have empirical implications similar to those of the statistical discrimination theory by Arrow and Phelps described in Section 2. On the contrary, if individuals do not modify their behaviors because of the stereotypes, such prejudices will turn out to be inaccurate ex-post, very much like in the case of Becker's theory of taste-based discrimination. Nevertheless, such prejudices, even if unfunded, might persist for a long time in the economy if each economic agent has relatively few experiences through which she can update her beliefs and if there is a tendency toward giving higher weights to evidence that confirms prior beliefs. Section 3 reports evidence on this theory and its implications for the labor market, the political arena, and other aspects of life.

2.4. More Complex Theories

Before turning our attention to the empirical evidence on the theories described above, it is worth to briefly review some more complex theories based on the same intuition as taste-based or statistical discrimination theories, but containing more details on the information environment, the cost of acquiring such information and the possible comparative advantages in processing it.

One such study, by Calomiris, Kahn and Longhogfer (1994) postulates that loan officers have a comparative advantage in evaluating borrowers with whom they have a cultural affinity. This leads them to perceive the same objective information differently for minorities and other borrowers because they can interpret it more precisely for the latter. For this reason, it costs more for the bank to gather and evaluate information on the creditworthiness of minorities, and this might lead to a lower acceptance rate or to higher interest rates to compensate for the higher costs and uncertainty.

Phelps (1972); Aigner and Cain (1977); Lundberg and Startz (1983) and Cornell and Welch (1996) develop models in which the signal to noise ratio for minority applicants is lower than for whites, and, as a result, employers and lenders set a compensation/interest rate schedule which places less weight on observables in the case of minorities because they find it difficult to evaluate them. This in turn decreases the incentives of minorities to invest in human capital and generates an equilibrium in which minorities are indeed on average less productive even if they have the same innate abilities.

Lundberg and Startz (1998) present a similar set of models based on search frictions and imperfect signals of ability. They show that because of economies of scale in information acquisition and processing and of minorities' smaller group size, it might be optimal for the lenders to invest in learning more about the rest of the borrowers. As a result, such lenders will restrict lending to minorities or charge a higher price to compensate for the lack of good information.

Altonji and Black (1999) provide a summary of such models in the context of labor markets.

3. Empirical Evidence

Using traditional data to detect the presence and type of discrimination in the market is quite challenging.

Disparity in market outcomes does not prove discrimination. Differences in skills, productivity and creditworthiness that are not appropriately captured by the control variables considered in the analysis could be the cause of the observed differences in treatment. Many studies have tried to address these issues by looking for detailed field datasets, natural experiments, using audit studies, or recreating the economic exchanges in the controlled environment of a laboratory.

In this section, I review the empirical literature on the effects of personal characteristics on economic outcomes. I separately cover the studies that focus on beauty and facial features, and those that focus on race and gender differences.

The first set of studies spans across the fields of psychology, sociology, and economics, measures the effect of attractiveness in various life settings, and aims at uncovering the mechanism through which beauty matters. The second set of studies aims at understanding the sources of wage gaps in the labor markets and of differential treatments in the mortgage, commercial and personal loan markets.

In both cases, to distinguish between statistical and taste-based discrimination in the field, information on ex-post performance, in addition to the one on the application/evaluation stage, is necessary. Few market settings allow researchers to collect both, and online lending markets are one of the few which do. Such markets are described in more detailed later in this section and are the settings of one my studies on the effects of personal characteristics, such as beauty, race and gender, in credit markets.

3.1. Evidence on Facial Features and Beauty from Economics, Psychology and Biology

A burgeoning literature in economics, psychology and sociology estimates the effect of first impressions on success in many settings such as politics (Todorov *et* al., 2005; Olivola *et* al., 2010), the job market (Hammermesh *et* al., 1994 and 1998), credit markets (Ravina, 2008), and even the economics profession (Hamermesh, 2006).

These studies find that attractive people are perceived as more successful, more cooperative and as better leaders. They also enjoy better jobs and higher pay, borrow at lower rates, and have a higher likelihood of winning competitions and political elections.

Todorov *et* al. (2005) find a robust relationship between competence inferred from 1-second exposure to the face of the candidates in U.S. congressional elections and their success and margin of success. They interpret their findings as evidence that "rapid, unreflective trait inferences can contribute to voting choices, which are widely assumed to be based primarily on rational and deliberative considerations". Rule and Ambady (2008) show that CEO appearance is related to their firm's profitability, although they cannot distinguish whether the result is due to profitable firms hiring CEOs with certain features, or whether executives who have certain characteristics will be more successful as CEO and will generate higher profits for their firms. On the contrary, Graham *et* al. (2010) find that CEOs' competence ratings extracted from facial features are unrelated to firm's performance.

Hamermesh and Biddle (1994) examine the role of beauty in the labor market both theoretically and empirically. They find a beauty premium and an even larger discount for below-average looks. The beauty premium is equivalent to the effect on earnings of 1.5 years of schooling. Moreover, looks matter for earnings in a similar way for both men and women. The authors also find that better-looking people tend to sort themselves into occupations where beauty may be more productive, but the effect of appearance is found in most occupations irrespective of the importance of looks for productivity. In another paper, Biddle and Hamermesh (1998), they examine the career path of law school graduates and its relation to their looks and find that those who were better looking at the time they were in law school have higher earnings, bill more hours at higher rates, and are more likely to work in the private sector vs. the less lucrative public sector. The beauty effect persists, and is in fact amplified, for the self-employed attorneys indicating that employer's discrimination is not the only source of the earnings differential.

These findings beg the question of whether the effect is due to higher productivity or to the preferences of employers, customers and coworkers.

The results described above are interpreted as evidence that beauty reflects competence, likeability, and leadership. Why is it the case? Many biology experiments confirm this conjecture using computer generated faces and find that traits associated with higher reproductive ability, such as large eyes, high cheekbones and smaller jaws are also strongly associated with perceived beauty. Moreover, such studies indicate that beauty is not in the eye of the beholder, but

rather that facial features associated with youth and good health are rewarded with higher attractiveness ratings across times, ages and cultures. Although some qualities of beauty like bodyweight are culturally and time dependent, others like facial features and body proportions are not. Experiments conducted in Britain show that when Caucasian men and women were asked to select the most attractive faces among images of Japanese women they chose the same face that was ranked first by Japanese men and women (Perrett *et* al., 1994 and 2006). Other studies show that young children consider attractive the same faces that adults rate as good looking, and even two-month old babies have been shown to prefer attractive faces (see Langlois *et* al., 2000 for a survey of these studies). This evidence suggests that our brains are wired from millennia on earth to associate positive feelings with people exhibiting certain features and a particular facial geometry. But are these innate and perhaps subconscious associations hurting us in our economic decisions?

Feingold (1992) conducts a meta-analysis of the relationship between individuals' attractiveness and their perceived and actual qualities and finds a very weak correlation between beauty and measures of personality and mental ability, but a much stronger correlation between self-ratings of attractiveness and such measures. Olivola *et* al. (2010) examine the accuracy of appearance-based inferences in the context of an online website and a large experiment. In both settings, they find that appearance is overweighed and accuracy would have been higher if the judges had based their ratings on characteristics' base-rate frequencies only.

In the realm of economics the question is why beautiful people have higher wages and are perceived to be more competent and able. Are they really more productive or are they only perceived to be so? And if it is the latter, what is the mechanism?

One channel could be self-confidence. Many studies in psychology describe the effects of beauty on others' perceptions and attitudes and on the confidence levels of beautiful individuals. Attractive children and adults are perceived as better and treated better both by those who don't know them and those who do, and exhibit more positive behavior (Langlois *et* al., 2000). Langlois *et* al. (1995) show that beautiful children are treated better by parents and teachers, develop more confidence and end up performing better. The debate is still open on whether the better performance of attractive people is due to the better treatment they receive and the better self-image and confidence they gain as a result, or whether attractiveness is just the exterior manifestation of health and good genes and for this reason it appears to be correlated with better performance.

Mobius and Rosenblat (2006) address this question in an experimental labor market in which they can separately measure skills and productivity from "em-

ployers" and "customers" perceptions. In their lab setting, they ask the "workers" to perform a maze in which skill is uncorrelated with beauty. Then they observe the wage negotiation between workers and employers and the interaction between workers and customers. They find that more attractive workers are more confident in their negotiations and have better social skills in their interaction with customers and employers, and, as a result, they are perceived to be more skilled even if it is not the case.

Andreoni and Petrie (2008) conduct a study on beauty, cooperation and stereotyping in a public good experiment. Players in this game have to repeatedly make investments in a private and a public good. The private good returns to the players twice as much as the public good, but players also get rewarded for the group's investment in the public good. In some of the sessions, the experimenters show a digital *picture* of the group members and in a subset of such sessions they also reveal each player's previous history of contributions to the public good. They find that beautiful people are perceived as more cooperative, while, in reality, they are not more or less so. This stereotype is stronger for women. In those cases where performance cannot be evaluated, beautiful people are given the benefit of the doubt. On the contrary, when past contributions were disclosed, beauty decreased cooperation, as the subjects expected beautiful people to contribute more, and were disappointed when they found out they didn't.

The evidence from the lab is very valuable because it allows us to open the black box of the economic interactions and analyze with precision different aspects of them. However, the behavior in the artificial setting of the lab doesn't always carry over to real markets. Levitt and List (2007) illustrate how individuals might behave differently when they are scrutinized, the context of the lab might not accurately reflect the economic phenomena naturally occurring in the markets, and the subjects might not be representative of the economic agents entering the real life transactions being studied.

Outside of laboratory experiments, it is very difficult to measure both perceptions and their consequences, and performance, a necessary requirement to attempt to distinguish the theories on statistical discrimination from those on taste-based discrimination and stereotypes.

One of the few settings in which this is possible is online lending markets. These markets have been recently developed in the United States and other countries and allow individuals to post requests for small unsecured loans, ranging from $1,000 to $25,000, to consolidate credit card debt, finance small businesses and fund educational and medical expenses. They provide lenders with credit bureau information and other borrower's characteristics, a picture and a brief description of their circumstances, and allow them to diversify across loans. In this

setting, the econometrician can observe the same information as the lenders, who bid on fractions of each loan in a second price auction. Ex-post performance for each loan is also clearly measurable and observable.

In a recent paper, Ravina (2008), I investigate the effect of personal characteristics on the terms of transactions borrowers obtain in these online credit markets. I find that after accounting for credit and employment history, homeownership, income and other hard financial information correlated with repayment ability, attractiveness and other personal characteristics affect the likelihood of getting a loan and the interest rate the borrower pays. Beautiful borrowers increase their likelihood of getting a loan by the same amount an average-looking borrower would if he or she increased the interest rate she is willing to pay by 1.46 percentage points. More attractive borrowers, all else equal, also pay lower interest rates, on average 81bps less. However, after accounting for the fact that attractive borrowers tend to have higher income and better credit history, I find that they are three times more likely to default than an average looking borrower with the same characteristics (the delinquency probability jumps from to 1.15% to 4.99%).

These results confirm the finding from the psychology literature that individuals tend to overestimate the abilities and the qualities of beautiful people. They are also in line with the predictions of taste-based discrimination against unattractive individuals. In order to determine the exact mechanism behind this phenomenon, a long time series of lenders' choices is necessary, as we need to check whether the lenders update their beliefs and realize that beautiful people are not as good borrowers as they believed. Theories funded on stereotypes would predict that lenders slowly update their assessments and the bias decreases, while taste-based discrimination theories postulate that the lenders are aware of their biases, they act this way because of their preferences, and are ready to leave money on the table and get worse returns in order to avoid lending money to unattractive counterparties. Section 4 examines these issues more closely and provides some empirical evidence in favor of the first interpretation.

3.2. Evidence on Discrimination in the Labor and Mortgage Markets

Two settings where the effects of personal characteristics have been extensively studied are the labor and the mortgage markets. Most studies focus on the effect of race or gender. A variety of empirical designs have been employed to try to distinguish between instances in which these are easily observable proxies for productivity and creditworthiness from those in which they matter per se because of animus.

The original studies are mainly based on surveys about lending practices from financial institutions, or employment and wage datasets collected by government organizations. The typical analysis is based on regressions that aim at explaining

the rejection rate in loans and job applications as a function of a battery of applicant and job/loan characteristics. Most studies that took this route find evidence of discrimination against women and minorities. An alternative specification consists in interacting the applicant's race with the variables measuring credentials, such as credit or employment history, to examine whether lenders and employers evaluate this information differently when facing applicants of different races. These studies do not generally find that it is the case, while they detect evidence of discrimination in the terms offered to minorities and in their likelihood of getting funds or getting hired (see, for example, Stengel and Glennon, 1995).

Many of these early analyses focus on the mortgage market because of its economic importance and the large amount of high quality available information. Since the passage of the Equal Credit Opportunity Act in 1974, which made it illegal to use the racial composition of the neighborhood as a determinant of lending decisions, and the Home Mortgage Disclosure Act (HMDA) in 1975, which requires lenders to report information about their mortgage lending activities by Census Tract, the detailed information available in this area has spurred many studies. Ladd (1998) provides a detailed overview of this literature.

A landmark study based on the 1990 HMDA data was published in 1992 by economists at the Federal Reserve Bank of Boston and provided evidence of discrimination against minorities (Munnell *et* al., 1996). The study stirred a lot of debate because the information initially available comprised race, age, gender and income and whether the application was rejected or accepted, but it did not include credit histories, debt burden, loan-to-value ratios for the mortgage, and other factors that lenders consider in making their decisions. A follow up study that collected such information confirmed the findings, although with a smaller magnitude. It revealed that, after accounting for the lower wealth, weaker credit history and higher loan-to-value ratios of minority applicants, their probability of being denied the mortgage was still 8 percentage points higher than a white applicant with the same characteristics.

This study confirmed the findings of several other studies that had been conducted in the past on smaller samples of a few institutions voluntarily participating, and with less detailed data on applicants' creditworthiness (Black *et* al., 1978; Schafer and Ladd, 1981).

The crucial requirement for these studies to be able to identify the effect of race and gender on firm's behavior is very stringent. All the relevant variables entering the firm's evaluation of the applicant's quality must have been included in the analysis. Another drawback of this and other studies using similar data is that they only have information on the application stage, but are unable to tell whether the groups that received worse terms were also more likely to default later on, as

predicted by statistical discrimination theories, or not, as predicted by taste-based discrimination ones. In other words, if loans to minorities are riskier and this is not adequately captured by the observable characteristics available to the econometrician, while it is taken into account by the lenders, these studies would find evidence of bigotry when none was there.

To try to partially address this issue some studies have analyzed lenders' subjective measures of borrowers' creditworthiness and they have found it to be correlated with the race of the applicants, even after controlling for objective measures of creditworthiness (Carr and Megbolughe, 1993). Other studies analyze default behavior by race and other characteristics, but do not have information on the pool of applicants and the likelihood of being accepted, and they therefore face a selected sample. Evans *et* al. (1985) and Berkovec *et* al. (1996) are examples of such studies. They find that, controlling for observable characteristics, minority borrowers are more likely to default on their mortgages than whites. Even after accounting for the fact that losses on minority loans tend to be lower, the difference in expected returns is still above 2%. This evidence seems to support statistical discrimination on the lenders' part, as minorities turn out to have higher default rates ex-post. However, the selection issues make it difficult to draw a firm conclusion on whether minorities are riskier than their observable characteristics would suggest and lenders take this into account and set worse terms, or rather they appear to default more often because their creditworthiness is mismeasured and the selection at the time of application makes the minorities and white borrowers not comparable (Brueckner, 1996).

Similarly to the mortgage markets, a wide range of studies have addressed the question of whether there is discrimination in labor markets. Some focus on the wage gap between genders or across ethnicities and regress wages on a battery of job and applicant characteristics (Blau and Kahn, 1992; Macpherson and Hirsch, 1995; Juhn, Murphy and Pierce, 1991; Card and Lemieux, 1994).

Other studies attempt to compare the workers' marginal product to their wages. For example, Hellerstein *et* al. (2002) regress wage cost on the demographic composition of the firm, using Becker's insight that discriminatory firms are willing to leave money on the table and earn lower profit in order to avoid hiring minority workers. They indeed find that, within a plant, women are 15% less productive than men, but earn 32% less. A caveat is that the study doesn't explain why different firms choose a different mix of workers. One possibility is different degrees of discrimination across firms, but a competing possibility is that there are differences in production technology. If it is the latter, the findings are biased.

A different approach is pursued in Altonji and Pierret (2001), who estimate a model of statistical discrimination where firms learn over time about workers'

productivity. They show that learning makes the coefficients on easily observable characteristics in the wage equation fall over time, and the coefficients on harder to observe characteristics rise. When they estimate this model on the 1979 National Longitudinal Survey of Youth data, they find little support for statistical discrimination as an explanation for the wage gap.

Despite their sophistication these studies are based on surveys and share with the analyses described at the beginning of the paragraph, the drawback that employers observe much more information than the econometricians and it becomes difficult to assess whether the differential treatment is the result of discrimination or rather of differences in productivity-relevant characteristics unobservable to the researcher.

One setting in which it is possible to observe both the application stage and future performance, and where the information observed by the econometrician is the same as the one viewed by the lenders is online credit markets, described earlier in this Section. In Ravina (2008), I conduct a study of the effect of personal characteristics on the likelihood of getting loans and the terms of such loans using these markets as the setting of my study. I find that black applicants have the same likelihood of getting loans as whites, but that after controlling for all observable characteristics pay significantly higher interest rates (between 139 and 146 basis points more), although they are equally likely to default. I also find once we control for the race of the lenders it emerges that the higher rates are charged by white lenders. On the contrary, black lenders charge similar rates to blacks and whites, although they are more likely to lend money to borrowers of their own race. Although white lenders suffer more defaults on black borrowers than black lenders do, in line with theories based on differential screening abilities and costs, even adjusting for defaults, the returns that they earn on black borrowers are higher than the returns they earn on white borrowers.[2] These findings are in line with taste based discrimination a la' Becker (1957).

In general, it is difficult to find settings like online lending platforms where such detailed information is available and where the lenders/employers have the same information as the researcher. An alternative approach to address this lack of information on the application stage and the future performance of minorities is provided by natural experiments and audit studies.

A famous example of the first type of studies has used the introduction of blind auditions in orchestras, with a screen to disguise the identity of the candidate from the jury, to study the effects of conscious or unconscious discrimination

2. The lending platform is set up in a way that the borrowers cannot selectively choose to repay some lenders and not others. Thus, the differences in repayment rates across borrowers are due to lenders' screening abilities and lending preferences.

on women's likelihood of being hired (Goldin and Rouse, 2000). The authors only have information on gender and no other characteristics such as race and age. Their empirical strategy exploits the fact that blind auditions were introduced at different times in different orchestras. They find that after these procedures were introduced, the fraction of women who got hired increased significantly. While the screen gets rid of all the information on the candidate's personal characteristics and cleanly measures the effect of gender biases, it is difficult to recreate such a situation in most real markets and therefore, despite its effectiveness, unfortunately it has limited applicability.

Some researchers have tried to come close to this ideal in real market settings by carefully designing audit studies. Such studies consist in performing a *ceteris paribus* experiment where two otherwise observably identical candidates of different race/gender/… approach a firm to apply for a job or a loan. The extent to which they receive a different treatment is the measure of discrimination produced by these studies. Auditors are chosen and trained to be similar in as many characteristics as possible, except for race or gender, and are sent to interviews at a sample of firms. The advantage of this approach is that it measures behavior in the market, and at the same time it keeps many variables constant, or at least measures them more accurately.

Audit studies have a long tradition in labor economics, dating back to Newton (1978); McIntyre (1980); till Turner *et* al. (1991); Ayres and Siegelman (1995) and Bertrand and Mullainathan (2004) to cite a few. Despite variation in methodologies and findings, the evidence seems to tilt toward finding that there is discrimination in US labor markets. A well-known example of audit study is Ayers and Seligman (1995) analysis of car dealerships. The authors sent 300 audit pairs to a randomly selected group of Chicago car dealerships to buy a new car. They found that white males got quoted significantly lower prices than blacks and women, although all auditors were using the same bargaining script provided by the authors. They interpret their findings as partially supportive of statistical discrimination, where car dealers use race and gender to make inferences on the profitability and reservation price of the customer they face.

The fact that the experimenter can keep many characteristics constant across the pair of auditors visiting a firm constitutes both the strength and the weakness of this method. Specifically, to the extent that there are characteristics that are unobservable to the designer of the study, but at least partially observable to the hiring firms, then fixing certain attributes across pairs of auditors might actually induce a bias and detect discrimination when it is not there, while miss it when it is indeed pervasive. These issues are highlighted in Heckman (1998) which shows that the implicit assumption for audit studies to measure the degree of dis-

crimination correctly is that the effect of these unobserved characteristics averages out across firms for a given pair of auditors. This is a strong and untested assumption and might not be satisfied in many settings. The simplest example is the case in which productivity is determined by two characteristics in an additive way and such characteristics are independent from each other. Only one of these characteristics, say v_1, is visible to the designer of the study, while both are visible to the firm and used in making the hiring decision. Suppose group A and B have identical total productivities, but that group A has on average higher productivity on the observable component (v_1) and group B on the unobservable one.

If the audit study takes two individuals with the same v_1 and sends them to a given firm, the auditor belonging to group B is more likely to have a high value of the unobserved characteristic and will therefore be hired even if the firm sets the same threshold for both applicants. In this case, the audit study detects discrimination when none is present. Moreover, were the results of the study such that the two groups have the same likelihood of being chosen, there would indeed be discrimination against group B, but it would go undetected by the study.

Similar examples can be built for the cases of dependent characteristics to show that the bias is amplified, and for the case in which the firm observes these characteristics with an error, as long as it does so more accurately than the researcher, a condition that is most likely met in the majority of audit studies.

Another drawback of the audit studies is that they are not double-blind, and the auditors know that the intent of the study is to determine the degree of discrimination. This might create an incentive for the auditors to generate data in line with their views on racial relations in the US, in a way that cannot be detected and controlled by the researcher.

Another weakness of audit studies, stemming directly from the intent of making certain characteristics homogeneous across the pair of auditors, or from providing the same script to them, is that they might generate a worker/applicant profile that doesn't exist in the market being studied. This might create an unobserved bias between these unusual profiles and the most common ones, which might be interpreted as differential treatment and discrimination. For example, Golberg (1996) revisits the issue of race and gender discrimination in the car dealership business by looking at transaction prices from the Consumer Expenditure Survey. She finds that after accounting for model, market-specific and purchase-specific features, consumer characteristics such as race and gender do not affect the average and median price paid, contrary to the audit study findings of Ayres and Siegelman (1995). The reason for the difference is that car dealers perceive the demand behavior of different groups of buyers to be different and they set their bargaining strategy accordingly. If black men (who in Ayres *et* al. get on

average a $1,100 higher initial offer than white males buying the same car) have more dispersion in the distribution of their reservation price, it is optimal for the car dealer to start with a higher offer when facing a Black male. If it turns out that the buyer does not fall in the extremes of the distribution, the dealer will adjust the price down during the bargaining process. Once we adjust for the fact that different races tend to buy different cars and that the bargaining process is different, on average there does not seem to be discrimination in this market. This study illustrates the perils of audit studies, and the fact that their results are not always representative of the average or the marginal outcome in the actual markets. At the same time, Goldberg's study has the drawback of not having a completely controlled environment and having to rely on some identifying assumptions regarding unobserved buyers' characteristics.

Finally, audit studies generally involve small samples because of cost issues. To the extent that one or more pairs of auditors are not well matched, or one of them engages in behaviors that bias the results toward a particular view of racial discrimination, the results of the study are likely to be hugely affected by it due to the small number of observations.

Bertrand and Mullainathan (2004) tried to address some of these drawbacks with a modified version of the audit study. They sent out fictitious resumes to help-wanted ads in the Boston and Chicago areas. They randomly assigned a black- or a white-sounding name to the resumes and found that, keeping the resume constant, white names received on average 50% more callbacks for interviews. They also found that calls were more responsive to resume-quality in the case of white names, and there were no discernible differences across occupation, industry and firm size. The advantage of this empirical strategy is that the econometricians observe the same information, the resume, as the potential employers and since no in-person meeting occurs there is no issue that the applicants look similar to the researchers, but different to the employers.

Despite these advantages, this approach has other drawbacks the authors themselves acknowledge and try in some cases to address. For example, it could be that a distinctively black-sounding name is associated with a poorer socioeconomic background and this is the reason behind the differential treatment. The authors collect information on the background of the mothers of all babies born in Massachusetts between 1970 and 1986 with the same names they use in the study and do not find a clear bias in all the tests. Another weakness is that the study analyzes only one job search channel, newspaper ads, and this restriction makes it difficult to map the findings to the degree of discrimination faced by the marginal minority worker in the U.S. labor market. The reason is that minority workers will tend to first use job search channels were discrimination is absent or

smaller. If enough jobs are available through those channels, then the fact that there is discrimination in the newspaper ads channel might be irrelevant, or provide an inflated measure of the degree of discrimination. If, on the contrary, this is a channel with relatively low discrimination compared to others, but it cannot absorb all the demand from minority workers, then the measure provided by the study is a lower bound. In Becker's (1957) words, one thing is "market discrimination, perpetrated by the marginal firm on the marginal worker", another is "discrimination encountered by a randomly selected person at a randomly selected firm" (what the audit studies uncover). In other words, some firms might be discriminating, but if they are a small enough group in relative terms, the marginal worker belonging to a group that would be discriminated will not interact with them, because there are enough non-discriminating firms he or she can work for or borrow from. If this is the case, the market clears at the same price and quantities it would if there were no discriminatory firms, and discrimination is not an issue for the policy maker.

Even putting aside these concerns, if we go back and take a global look at the results from audit studies on discrimination, we find evidence that is in partly mixed (Heckman, 1998).

To conclude, determining whether personal characteristics matter in economic exchanges and the mechanism why this happens has fascinated economists and scientists for a long time, but at the same time has proven quite challenging.

Whether there is a discriminatory intent, or the observed disparity in outcomes is the result of differential skills, education and upbringing is still an open question.

Measuring the degree of statistical vs. taste based discrimination is very important to provide policy makers with guidance on whether to concentrate their efforts in reducing the gap through education and training for minorities, to improve their human capital, or in fighting discriminatory intent.

4. Do Economic Agents Learn about the Accuracy of their Choices?

In this section I examine the degree to which employers and lenders update their assessments of the relation between certain easily observable personal characteristics and the quality of the counterparty.

Few studies follow lenders and employers over time and estimate their degree of learning. One of them is Altonji and Pierret (2001), who estimate a learning model based on statistical discrimination. The intuition is that firms should rely more on easily observable characteristics that they might deem related to unobserved productivity in the hiring decisions and early in the employment contracts. As time passes and they observe noisy measures of the worker's productivity, they should rely less and less on these variables. The authors find that the firms in

their sample seem to learn about the value and quality of workers' education, but that their learning about race is very limited. They conclude that most of the race gap in wages is not explained by statistical discrimination, providing indirect evidence consistent with taste-based discrimination.

Another setting where it is possible to measure the effect of experience on choices and to follow lenders over time to estimate whether they update their views is online lending. In a recent paper, based on Prosper.com, a U.S. online lending platform, I investigate the effect of lenders' experience on the likelihood of lending to attractive borrowers who turn out to be more likely to default (Ravina, 2008). I find that in the case of beauty the bias diminishes with experience and sophistication, measured by time since the lender joined the platform and by amount invested, respectively. These results are consistent with stereotyping.

In the case of race, the bias doesn't seem to disappear, suggesting that the findings of higher interest rates charged to Blacks without subsequent higher default rates are consistent with taste-based discrimination. The ancillary finding that the higher rates are due to white lenders is consistent with this interpretation. A caveat is the short horizon analyzed.

Open questions for future research are how long it takes for lenders to (at least partially) correct their mistakes, whether the speed of learning depends on lenders' characteristics and their experiences in the market.

5. Conclusions

In this paper I have summarized the literature in economics, social psychology and biology that investigate the reasons why personal characteristics matter in economic exchanges, even after controlling for all the observable characteristics of the counterparty. The focus of the paper is mostly on economics and, admittedly, leaves out many important papers in economics as well.

The paper shows how the debate on the sources of differential treatment based on race, gender and attractiveness in the labor and the credit markets is still open. On one side, taste-based discrimination theories a la' Becker (1957) provide an explanation based on animus, where the decision maker is fully aware that, conditional on observable characteristics, the applicants have the same quality, but he or she would rather avoid interacting with certain groups and is willing to leave money on the table in order to achieve this goal. On the other side, statistical discrimination theories pioneered by Arrow (1973) and Phelps (1972) stress how personal characteristics could matter because they are easily observable proxies for other variables that are correlated with the quality of the counterparty.

This is a very important question for policy because depending on the nature of discrimination education and training policies might be more effective in filling

the gap faced by minorities in the labor and credit markets, than direct policies against discrimination.

The empirical evidence on the issue provides supports for both theories, depending on the market and the specific personal characteristics analyzed. The inference problem is severely complicated by the difficulties in observing all the variables that enter firms and lenders' decision making process and by being able to examine both the application stage and ex-post performance. New market settings, such as online lending platforms, as well as carefully designed audit studies, help address part of these issues and seem to tilt the evidence in favor of taste-based discrimination.

On the side of the employers, lenders, and more generally the economic agents that make the choices, open questions remain on whether these biases, irrespective of their source, lead us to make suboptimal economic decisions. Who falls victim of these biases? What can we do in terms of policies and education to ameliorate this situation?

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