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Racial stereotypes and robbery

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ABSTRACT

Robbery is a serious, widespread and sometimes violent crime resulting each year in costs to victims of several billion dollars. Data on the incidence of robbery reveals certain striking racial disparities. African-Americans are more likely to be victims, arrestees and prisoners than are members of other demographic groups, and while black-on-white robberies are very common, white-on-black robberies are extremely rare. The disparities for robbery are also much greater than those for other crimes of acquisition. We develop a model of robbery that attempts to address these and other stylized facts. Robberies are typically interactions between strangers that involve a sequence of rapid decisions with severely limited information. Potential offenders must assess the likelihood of victim resistance, and victims must assess the likelihood that resistance will be met with violence. Racial disparities in the distribution of income can cause such probability assessments to be race-contingent, affecting crime rates as well as rates of resistance and violence. We argue that this model helps account for several empirical regularities that appear puzzling from the perspective of alternative theories of crime.

1. Introduction

Robbery is a very serious crime, often involving violence, and resulting each year in aggregate costs to victims of several billion dollars (Miller et al., 1996). It is also a crime that involves significant and persistent racial disparities. African-Americans are considerably more likely to be robbery victims, arrestees, and prisoners than either whites or Hispanics. No other crimes except murder and possibly drug trafficking are nearly so concentrated among African-Americans. Robberies are about forty times as common as murders, and more state prison inmates are incarcerated for robbery than for any other index crime.[1]

Even more striking is the fact that while white-on-white, black-on-black, and black-on-white robberies are all very common, white-on-black robberies are extremely rare. Single-offender robberies with white victims and black offenders were more than 14 times as frequent as those with black victims and white offenders for the years 2000–2002. Since white criminals are plentiful, the paucity of white-on-black robberies is puzzling. This phenomenon runs counter to some common beliefs about racism: if whites dislike blacks, or if law enforcement undervalues black safety, or if courts are reluctant to accept black testimony against whites, then white criminals should eagerly rob blacks. The abundance of black-on-white robbery is also somewhat surprising. Although the overwhelming majority of black robbers' victims would be white if robbers were sorted to victims completely randomly, most other crime seems to be concentrated within groups.[2] Nor is

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[1] See Section 2 below for detailed evidence and data sources.

[2] While over half the victims of black robbers were white, only 16 percent of the victims of black murderers and 26 percent of the victims of black rapists were white (Fox and Zawitz, 2004; U.S. Bureau of Justice, 2002, Table 42). The ratio of black-on-white to white-on-black crime was 3.02 for rape and 2.51

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the relative attractiveness of white victims explained by greater amounts of money or more valuable goods that they carry. We present evidence below that the losses incurred by black victims are on average somewhat *greater* than those of white victims.

We argue that the key to understanding racial disparities in the prevalence of robberies is to recognize that they involve dynamic interactions among strangers under conditions of incomplete information.[3] Victims of attempted robberies may choose to comply or resist, and offenders may respond to resistance by fleeing or attempting to force compliance through violence. Because members of different groups are drawn from different distributions of unobserved characteristics, they will be treated differently and will therefore face different incentives.[4] Hence two individuals who share the same non-racial characteristics will exhibit systematic differences in equilibrium behavior. Specifically, the likelihood of victim resistance can depend on the perceived race of the offender and hence make robbery itself more lucrative for members of groups who face less resistance. This interdependence of victim and offender conjectures makes robbery different from other crimes of acquisition (such as burglary and theft) and explains why blacks are more disproportionately involved with robbery than with these other crimes.[5] Intimidation is no advantage for a burglar or thief, but it is for a robber. To the extent that whites find blacks intimidating, black criminals face incentives to eschew burglary and theft and concentrate on robbery.

More concretely, suppose that robbery victims believe that black offenders are more likely than white ones to use violence in the face of victim resistance. In this case, they will be less likely to resist black offenders relative to white ones. Other things equal, this results in crime being more lucrative for blacks relative to whites. Suppose further that potential offenders believe that black victims are more likely than white ones to resist an attempted robbery. Then offenders of all types will prefer white victims to black ones. In equilibrium, these beliefs must accurately reflect the objective probabilities of violence (conditional on resistance) and resistance (conditional on being confronted). How might the such beliefs arise in equilibrium *without any innate group differences in the propensity for violence*? This can happen if the probabilities of victim resistance and offender violence are correlated with such characteristics as personal income or wealth, which are imperfectly observable to the participants in a robbery, but which exhibit systematic and well-known differences across groups. For instance, if poorer offenders are more likely to use violence in an attempt to force compliance, and if poorer victims are more likely to resist robbery attempts, then racial income disparities can cause both victims and offenders to condition their actions on the perceived race of those with whom they are interacting. We show how this can account for the racial disparities in crime rates, as well as the enormous gap between black-on-white relative to white-on-black robberies.

The model also implies systematic racial differences in rates of resistance and violence. For instance, we predict that offenders of all types will be *less* likely to resort to violence when facing resistance from white (rather than black) victims. This latter prediction is surprising and follows from the fact that those potential robbers who confront only white victims are less prone to violence than those who confront victims of all types. Furthermore, the model predicts that victims of all types will offer less resistance to black (relative to white) offenders. These predictions can be tested using data from the U.S. Bureau of Justice Statistics National Crime Victimization Survey (NCVS), which allow us to estimate the likelihood of resistance and the likelihood of violence conditional on resistance for each type of interaction pair (black-on-white, black-on-black, white-on-white and white-on-black). We show below that for robberies involving black offenders over the periods 1993–2002, white victims faced a significantly lower likelihood of violence conditional on resistance relative to black victims. Furthermore, we find that white victims were significantly more likely to resist a robbery attempt when the offender was also white, relative to the case when the offender was black. These findings accord with the predictions of the model.

We begin in Section 2 with the legal definition of robbery and a further discussion of the empirical regularities that motivate this work. Section 3 contains a model of robbery that attempts to capture the essential features, sequential choice under incomplete information, described above. Section 4 contains our main results, showing how the racial disparities evident in the data can arise in equilibrium. Section 5 considers alternative hypotheses that have been advanced to account for racial disparities in the incidence of criminal behavior, and argues that they are inadequate in explaining both the extent and the nature of the disparity. Section 6 concludes.

2. Definitions and evidence

In the United States, robbery is defined as "taking, or attempting to take, anything of value from the care, custody, or control of a person or persons by force or threat of force or violence and/or by putting the victim in fear" (Sourcebook, 2002, p. 570). Examples are muggings, hold-ups, and even confrontations where one teenager scares another into giving up his coat. Unsuccessful attempts still count as robberies.

for murder, compared with 8.62 for robbery in 2002.

[3] In 2002, 72.1 percent of robberies were committed by strangers. In contrast, strangers committed only 33.4 percent of rapes and 47.2 percent of assaults (U.S. Bureau of Justice, Table 27). For 1976–2001, strangers committed only 13.9 percent of homicides although the relationship between the offender and the victim was unknown in 34.4 percent of homicides (Fox and Zawitz, 2004). Given the small number of homicides by strangers (a few thousand a year), it is likely that a significant fraction of these started as robberies.

[4] By "unobserved" we mean characteristics that other participants in a robbery do not observe, not characteristics that econometricians do not usually observe. For example, the personal income of a robbery victim is typically unobservable to a potential offender.

[5] Regarding incarceration, for instance, the disproportion for blacks relative to non-Hispanic whites was 6.6 for burglary and 8.6 for theft, as compared with 16.1 for robbery.

Table 1
Victim identification of robbers, 2002 (single-offender robberies)

Race of victim	Perceived race of robber			
	White	Black	Other	Total
White	0.399	0.231	0.104	0.734
Black	0.027	0.226	0.013	0.266
Total	0.426	0.457	0.117	1.000

Proportion of total single-offender robberies where identification was made.

Table 2
Median monetary values of robbery victim losses, 1993–2002

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
White	$124	$99	$106	$90	$126	$92	$199	$213	$142	$153
Black	$181	$109	$165	$209	$112	$144	$224	$136	$163	$258

Robbery is distinguished from other crimes of property acquisition by the use or threat of force. Burglary, for instance, involves entering a structure to take something without confronting a person, and theft involves activities such as shoplifting where no personal confrontation occurs. Personal confrontation is a necessary element of robbery. Stealing a car with nobody in it is motor vehicle theft; stealing a car with someone in it (a carjacking) is robbery. Robbery differs from assault, another crime of personal confrontation, because its purpose is acquisition. Barroom brawls and domestic violence are assaults because offenders are not trying to acquire money or property from their victims.[6]

African-Americans are considerably more likely to be arrested and imprisoned for robbery relative to other groups. Relative to whites in 2002, African-Americans were 8.55 times as likely to be arrested for robbery, and relative to non-Hispanic whites, they were 16.1 times as likely to be incarcerated in a state prison for robbery. Relative to Hispanics, African-Americans are 3.51 times as likely to be prisoners. In New York State in 1999, African-Americans were 2.85 times as likely to be arrested for robbery as Hispanics.[7] This does not necessarily imply that African-Americans *commit* robberies at a higher rate than members of other racial or ethnic groups since it cannot be reasonably assumed that the criminal justice system is free of bias. The consensus among criminologists who have studied the question for many years, however, is that African-Americans do commit robberies at considerably higher rates than whites or Hispanics. The relative disparities in offending probably approach the relative disparities in arrests or incarceration (see Sampson and Lauritsen, 1997 for a review article that summarizes the consensus).

Some of the most useful data on this question come from the NCVS, a household survey that asks about crime experiences. Part of the survey asks crime victims about the people who committed crimes against them. Of victims of single-offender robberies in 2002 who could identify the robber's race, 46 percent said that the robber was black (NCVS, 2002, Table 40). In robberies with multiple offenders, 45 percent of victims who could identify the race of their robbers said they were all black; another 16 percent said the group robbing them were of mixed race (NCVS, 2002, Table 46). These proportions are almost as high as the proportions of African-Americans among robbery arrestees and prisoners. Table 1 provides more detail on victim identifications for single-offender robberies (NCVS, 2002, Table 42).

The most striking feature of this table is the large difference between the number of black-on-white robberies and the number of white-on-black robberies.[8] The latter are virtually non-existent. 2002 is not an anomaly in this regard; in 2001 the survey did not find any black victim of a white single-offender robbery. Similar patterns arise in the case of multiple offender robberies: in the 2002 survey over 30 percent of all such robberies involved a white victim and an all-black group of offenders, while none involved a black victim and an all-white group of offenders. Our model addresses and accounts for this finding, as well as the disproportionate prevalence of blacks among the population of offenders.

Although whites are in general wealthier than blacks as a group, this does not imply that they carry more transferable wealth on their person. The data suggest that, if anything, black victims carry more loot than white victims. The NCVS provides a distribution of the monetary value of victims' losses; it does not estimate averages. Generally, stochastic dominance does not hold between the distribution of black victims' losses and the distribution of white victims' losses. However, as may be seen in Table 2, for 8 of 10 years the median monetary loss was greater for black than for white victims.[9]

There are several possible explanations for the fact that white robbery victims do not lose more than black victims despite the fact that whites in the general population are more affluent on average than blacks. To begin with, wealthier individuals

[6] A few robberies turn into murders when victims die. The classification of "murder" trumps the classification of "robbery." For our purposes, these crimes should be considered robberies, but government agencies do not keep data in this fashion. The number of felony-murders, however, is small (less than half a percent of the number of robberies).

[7] Sources: U.S. Bureau of Justice (2002, Table 4.10), Harrison and Beck (2004, Table 15), New York State (2004), the Statistical Abstract (2000, Table 13). The population base for arrests and prisoners is population over 18 (U.S. Census); for victimization, population over 12 (NCVS).

[8] Standard errors are 0.054 (white-on-white), 0.052 (black-on-white), 0.017 (white-on-black) and 0.045 (black-on-black).

[9] Similarly, the proportion of black victims with losses below $250 was smaller than the corresponding proportion of white victims in 8 of the 10 years (NCVS, Table 82). No individual year differences were significant, but the weighted average proportion of white losses under $250 was 67.8 percent, significantly greater than proportion of black losses under $250, which was 62.0 percent (with standard errors 1.3 and 2.0 percent, respectively).

have better access to financial intermediaries and use much of their wealth to purchase immovable goods such as housing or services such as travel or education. Second, rates of robbery victimization decline with income since wealthier individuals are better able to avoid situations in which they may be at risk. For instance, commuters from suburban locations face fewer risks than those who live in high crime central city neighborhoods. Third, the manner in which crime victimization declines with income is itself race contingent, with blacks facing greater risk at any given income level. This is in part due to the kinds of mechanisms identified in this paper: robbers expect less resistance from whites and target them with greater frequency, and this induces whites to withdraw to safer locations at higher rates relative to blacks of comparable income. As a result, the average black robbery victim is higher in the black income distribution than the average white robbery victim is in the white income distribution.[10]

Wright and Decker's (1997) ethnographic study of (largely black) active armed robbers provides support for the view that many offenders are aware of such empirical regularities. The study is based on detailed interviews with 86 routine offenders, and an entire chapter is devoted to the choice of target. Robbers identify two broad classes of target: those who are engaged in illegal activity (such as soliciting prostitutes or purchasing drugs), and those who are not. With respect to the former group, several robbers are quoted as preferring white drug users (p. 64) or white johns (p. 70). For instance, Wright and Decker say of the robbers who victimized johns, "All three of these offenders had robbed both black and white men but preferred whites because they usually offered no resistance" (p. 70). They report no robbers preferring blacks.

With noncriminal victims, race figures in two discussions: who carries more money, and who resists more. The discussion about who carries more money is not conclusive, with robbers being quoted on both sides.[11] The discussion about resistance, however, is unanimous. Four robbers are directly quoted on the desirability of white victims, and the authors summarize the views of others as follows: "Many of the offenders reported that, other things being equal, they preferred to rob whites because, compared to their black counterparts, such victims were more likely to be cooperative" (p. 84). Wright and Decker report no dissents from this view, although they note that robbers in a black neighborhood who are in a hurry to get money will often settle for a black victim. These beliefs and behavior are fully consistent with the model developed here.

3. A model of attempted robbery

3.1. Preliminaries

The key elements of a robbery are personal confrontation (typically between strangers), the threat or use of force, and the attempt to obtain property. Such interactions involve a sequence of rapid decisions made by victims and offenders, and these decisions must be made under severe informational constraints. Under such conditions racial markers can influence the actions of both parties. Our model is an attempt to capture these effects.

When a potential robber is faced with an opportunity, he must decide whether or not to make the robbery attempt. If an attempt is made, the victim can either comply with the robber's demand or resist it. If faced with resistance, the robber can abandon the attempt and flee or try to force compliance through violence. When contemplating a robbery, the perpetrator typically cannot know whether the victim will resist. Similarly, when contemplating resistance, the victim cannot know whether the robber will flee or attempt to force compliance. Resistance by the victim followed by an attempt at forced compliance is potentially very costly to both parties; both face the risk of serious injury, and the robber faces both an increased likelihood of arrest as well as more severe punishment conditional on arrest. The most desirable outcome from the robber's perspective is compliance by the victim. The most desirable outcome from the perspective of the potential victim is a decision by the potential robber not to make the attempt in the first place. Conditional on a robbery attempt the victim's best response is to resist if she believes that the robber will flee and to comply if she believes that the robber will use force. Conditional on victim resistance, the robber's best response may be to flee, or it may be to use violence in order to force compliance. The payoffs to both robber and victim are somewhat lower in the case of a failed robbery attempt (when resistance is met with flight) than if no attempt had been made in the first place.[12]

A key aspect of robbery that we wish to capture is robber uncertainty about the victim's likelihood of resistance, as well as victim uncertainty about the robber's propensity to respond violently to resistance. We allow for heterogeneity in preferences and incomplete information as follows. Suppose that each of the two players (robber and victim) is drawn from a set of types $\Theta = [\theta_{\min}, \theta_{\max}]$, such that a player's type $\theta \in \Theta$ completely defines her preferences over all outcomes in the attempted robbery. One interpretation of a player's type is her outside option or initial wealth level, although other interpretations are possible. We intend θ to describe the characteristics of the robber and the victim that are *unobservable* during the attempted robbery. The payoff considerations discussed above can then be expressed in the form of a three-

[10] For evidence on the manner in which victimization rates vary by income and race and a model of robbery with endogenous location choices, see O'Flaherty and Sethi (2007).

[11] Some robbers express considerable frustration with the propensity of white victims to carry small amounts of cash. As one offender puts it, "most white people have about two dollars on them, and credit cards, something like that". This view is ecohoed by others: "whites, they have credit cards and checkbooks on them... they get robbed, they cancel it" (p. 82) and "all they got is plastic and checks" (p. 77).

[12] The payoff structure assumed here is based on a view of robbery as an act motivated by pecuniary gain. See Silverman (2004) for a model of street crime in which the desire to build a reputation for violence plays a central role.

stage game of incomplete information as follows. At the first stage, the potential robber (player 1) decides whether or not to attempt to rob the potential victim (player 2). If there is no confrontation, payoffs of both players are normalized to equal zero. In this case each player retains her initial level of wealth. If the robber confronts the victim, the latter can either resist or comply with the robber's demand. If the victim complies, the payoffs are $x_1(\theta_1)$ to the robber and $-x_2(\theta_2)$ to the victim, where θ_1 and θ_2 are the robber and victim types, respectively. If the victim resists the robber can then either flee or attempt to force compliance. If the robber flees, the payoffs are $-y_1(\theta_1)$ to the robber and $-y_2(\theta_2)$ to the victim. If the robber attempts to force compliance through violence, the payoffs are $-z_1(\theta_1)$ to the robber and $-z_2(\theta_2)$ to the victim.

The payoffs $x_k(\theta)$, $y_k(\theta)$ and $z_k(\theta)$, $k \in \{1, 2\}$, are all fully determined by the player's type and are assumed to be differentiable functions of θ. We assume that robbers of all types gain from a robbery attempt that is successful without violence, but lose from an unsuccessful attempt. This is relative to the zero-payoff baseline in which no robbery attempt is made. Furthermore, we assume that victims of all types rank the four possible outcomes in the same order: from the victim's point of view, violent robberies are worse than successful non-violent ones, which in turn are worse than unsuccessful robbery attempts. Hence a victim who is certain that resistance will be met with flight will resist, and one who is certain that resistance will be met with violence will comply. Best of all is the outcome in which no attempt at robbery is made in the first place. These considerations imply the following.

Assumption 1. For all $\theta \in \Theta$, $x_1(\theta) > 0$, $y_1(\theta) > 0$, and $z_2(\theta) > x_2(\theta) > y_2(\theta) > 0$.

Next consider the manner in which payoffs vary with type. We assume that robbers with higher θ incur higher costs from a violent outcome as well as from an unsuccessful robbery attempt, and the former costs rise faster than the latter. Wealthier robbers have more to lose from the harsher penalties or injuries that can result from a violent outcome, and these costs rise with wealth faster than the relatively minor costs associated with an unsuccessful robbery attempt. The payoffs of victims vary with type in exactly the same way: wealthier victims incur greater costs from violent outcomes as well as from failed robbery attempts, and the former costs rise with wealth more rapidly than the latter costs. In addition, we assume that victims of higher type lose less, and robbers of higher type gain less, upon completion of a successful robbery. The rationale is that the wealth transfer that takes place during a successful robbery is a smaller share of initial wealth for higher types. Taken together, these consideration imply

Assumption 2. For all $\theta \in \Theta$, and for $k = 1, 2$, $z_k'(\theta) > y_k'(\theta) > 0 > x_k'(\theta)$.

Finally, we assume that robbers with very low wealth levels prefer to respond violently when faced with resistance, while those with higher wealth levels prefer to flee. Furthermore, individuals with sufficiently low wealth prefer to attempt robbery even if they are certain of resistance. The rationale is that poorer robbers have more to gain from the completion of the robbery, and hence the higher probability of capture (and the more severe penalties conditional on capture) that violence entails are less of a disincentive. Hence we have

Assumption 3. $z_1(\theta_{\min}) < 0$ and $z_1(\theta_{\max}) > y_1(\theta_{\max})$.

Assumptions 1–3 together imply that for any given beliefs of the victim regarding the probability with which resistance will be met with violence, lower wealth victims will be more likely to resist relative to higher wealth victims. They also imply that for any given robber's beliefs about the probability of victim resistance, lower wealth individuals will be more likely to attempt robbery.

We have motivated our discussion of types by interpreting θ as wealth or income, an unobservable variable that reduces a robber's willingness to use violence and increases a victim's expected losses from a violent encounter. Wealth, of course, is not the only variable that has this property. For instance, unobserved psychological and moral propensities, real or imagined, clearly play a role in how people react in stressful situations. It is probably most appropriate to think of θ as a latent variable that is a function both of wealth and a set of psychological variables.

Empirical considerations also require this richer interpretation of θ. Hispanics have about the same distribution of income and wealth as blacks, but are arrested for far fewer robberies. One important difference between black and Hispanic offenders relates to the certainty and ease with which they can be identified as such by victims. Victims might consider many Hispanics to be white and react to them as if they were white. Hispanics who believed that they would be perceived as white could expect to face greater resistance and might therefore be less willing to engage in robbery. Census data indicate that a large fraction of Hispanics self-report as white; many of these may be light-skinned enough to believe that others would also think of them as such. In the 2000 census, 48 percent of Hispanics self-reported as white only (Grieco and Cassidy, 2001, Table 10), and another 4 percent self-reported as white and 'some other race' (Jones, 2005). In essence, then, our model is not about a self-identified population such as Hispanics in the United States, but about populations as they are identified by others in fleeting encounters. Your appearance matters more in such situations than your identity.

3.2. Equilibrium

While θ represents their unobservable characteristics, robbers and victims also have observable characteristics of which sex, age and race are perhaps the most salient.[13] We focus here on race as the single observable attribute, although a similar analysis could be conducted for other characteristics. Suppose that each individual belongs to one of two identifiable groups, black and white, and that the groups differ with respect to their type distributions. Let $F_b(\theta)$ and $F_w(\theta)$ denote the distribution functions for robbers, and $G_b(\theta)$ and $G_w(\theta)$ the distribution functions for victims in the two groups respectively. The corresponding density functions are represented using lower-case letters. We assume that the functions x_i,y_i and z_i are identical across groups. Once the race of victim and offender have been observed the type distributions $F_i(\theta)$ and $G_j(\theta)$ for the two players are commonly known. These distributions, together with the functions $x_k(\theta)$,$y_k(\theta)$ and $z_k(\theta)$, define an extensive-form Bayesian game Γ_{ij} where $i, j \in \{b, w\}$ and $k \in \{1, 2\}$. We next characterize the Perfect Bayesian Equilibria of Γ_{ij} for each interaction pair ij. Of particular concern is the manner in which rates of violence, resistance and crime vary across equilibria of the four games $\{\Gamma_{bb}, \Gamma_{bw}, \Gamma_{wb}, \Gamma_{ww}\}$.

Consider a victim drawn from group i who has been confronted by a robber drawn from group j and who believes that resistance will be met with violence with probability λ_{ij}. In this case the victim will comply if her type θ is such that

$$x_2(\theta) < \lambda_{ij} z_2(\theta) + (1 - \lambda_{ij}) y_2(\theta) \tag{1}$$

and resist if the inequality is reversed. Since x_2 is decreasing and y_2 and z_2 are both increasing, there will exist some threshold type $\tilde{\theta}(\lambda_{ij})$ such that victims will comply if their wealth exceeds $\tilde{\theta}(\lambda_{ij})$ and resist if it lies below it. The probability that a robber will meet resistance is then simply $G_j(\tilde{\theta})$. The threshold $\tilde{\theta}$ is itself strictly decreasing in λ; the greater the expectation of violence, the smaller the set of victims who resist.

Now suppose that potential robbers believe that a proportion μ_{ij} of victims will resist if confronted. In this case an individual of type θ will attempt robbery if

$$(1 - \mu_{ij}) x_1(\theta) > \mu_{ij} \min\{y_1(\theta), z_1(\theta)\}, \tag{2}$$

and refrain from doing so if the inequality is reversed. Since $z_1(\theta_{\min}) < 0$ and $x_1 > 0$ for all θ, individuals who are of sufficiently low type will attempt robbery. Furthermore, since $\min\{y_1(\theta), z_1(\theta)\}$ is increasing and $x_1(\theta)$ is decreasing, there exists some type $\hat{\theta} > \theta_{\min}$ such that all types below $\hat{\theta}$ attempt robbery and all types above $\hat{\theta}$ do not. The threshold $\hat{\theta}$ is strictly decreasing in μ. Of the types who attempt robbery, a subset will use violence if they meet with resistance. Let $\bar{\theta} \in (\theta_{\min}, \theta_{\max})$ denote the unique solution to the equation $y_1(\theta) = z_1(\theta)$. (Uniqueness and interiority of $\bar{\theta}$ follow from Assumptions 2 and 3 above.) Then the proportion of robbers who are prepared to use violence is given by $F_i(\bar{\theta})/F_i(\hat{\theta})$ if $\hat{\theta} \geq \bar{\theta}$ and 1 otherwise.

In equilibrium, the beliefs of both robbers and victims must be consistent with the strategies adopted by the players, namely the mappings from types to actions. Hence equilibrium beliefs $(\lambda_{ij}^*, \mu_{ij}^*)$ must satisfy

$$\lambda_{ij}^* = \min\left\{\frac{F_i(\bar{\theta})}{F_i(\hat{\theta}(\mu_{ij}^*))}, 1\right\} \tag{3}$$

and

$$\mu_{ij}^* = G_j(\tilde{\theta}(\lambda^*)). \tag{4}$$

Given our assumptions, the following holds.

Proposition 1. *For each pair ij, Γ_{ij} has a unique equilibrium $(\lambda_{ij}^*, \mu_{ij}^*)$. Furthermore, $\lambda_{ij}^* \in (0, 1)$.*

Proof. First we show that $\lambda_{ij}^* < 1$ in any equilibrium of Γ_{ij}. Suppose, instead, that $\lambda_{ij}^* = 1$. Then $\mu_{ij}^* = G_j(\tilde{\theta}(1)) = 0$ from (4) and hence, using (3) and $F_i(\hat{\theta}(0)) = 1$, we have

$$\lambda_{ij}^* = \min\left\{\frac{F_i(\bar{\theta})}{F_i(\hat{\theta}(0))}, 1\right\} = F_i(\bar{\theta}) < 1,$$

contradicting the supposition that $\lambda_{ij}^* = 1$. Hence $\lambda_{ij}^* < 1$, and we can rewrite (3) as simply

$$\lambda_{ij}^* = \frac{F_i(\bar{\theta})}{F_i(\hat{\theta}(\mu_{ij}^*))}.$$

Combining this with (4) we get the following single condition for equilibrium:

$$\varphi_{ij}(\lambda_{ij}^*) = F_i(\bar{\theta}), \tag{5}$$

[13] More generally, such attributes as weight, manner of dress and speaking, presence of eyeglasses or facial scars, or visible possession of a weapon are all observable attributes that are likely to affect beliefs and behavior.

where $\varphi_{ij}(\lambda^*_{ij}) = \lambda^*_{ij} F_i(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{ij}))))$. Note that φ_{ij} is increasing in λ^*_{ij}, since $\tilde{\theta}(\cdot)$ and $\hat{\theta}(\cdot)$ are both decreasing and $F_i(\cdot)$ and $G_j(\cdot)$ are both increasing. Furthermore, $\varphi_{ij}(0) = 0$ and $\varphi_{ij}(1) = 1$. The latter follows from the fact that $G_j(\tilde{\theta}(1)) = 0$ (facing certain violence, all victims comply) and $F_i(\hat{\theta}(0)) = 1$ (facing certain compliance, all robbers confront). Hence there is a unique $\lambda^*_{ij} \in (0, 1)$ that satisfies the equilibrium condition (5), implying a unique μ^*_{ij} from (4). □

Since $\lambda^*_{ij} \in (0, 1)$ in equilibrium, we can rewrite (3) as simply

$$\lambda^*_{ij} = \frac{F_i(\tilde{\theta})}{F_i(\hat{\theta}(\mu^*_{ij}))}, \tag{6}$$

and combine this with (4) to get the following equilibrium condition:

$$\lambda^*_{ij} F_i(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{ij})))) = F_i(\tilde{\theta}). \tag{7}$$

Let $\gamma^*_{ij} \equiv F_i(\hat{\theta}(\mu^*_{ij}))$ denote the crime rate when the perpetrator belongs to group i and the victim to group j.

In equilibrium, some types attempt robbery while others do not. The set of types who attempt robbery include some who flee when met with resistance and some who resort to violence. Hence there are three types of crime that can arise with positive probability: (i) nonviolent robberies, (ii) violent robberies, and (iii) failed robbery attempts. The rates at which these occur depend on the type distribution in the population and the manner in which types are related to payoffs through the functions x_k, y_k, and z_k. Given the payoff and distribution functions, rates of crime, violence and resistance are *uniquely* determined for each of the four interaction pairs.

4. Explaining racial disparities

We know from Proposition 1 that for any given interaction (once the race of both victim and offender have been observed), equilibrium behavior is uniquely determined. Behavior in equilibrium will generally be *race-contingent*. For instance, a victim's decision to resist may depend on the race of the perpetrator since this may provide information about the probability with which resistance is met with violence. This latter probability may itself depend on the race of the victim, if a robber's decision to confront a victim is sensitive to the victim's race.

Our formulation here assumes that all robbers draw on the same pool of potential victims. For instance, a black robber confronting a white victim faces the same distribution of victim types as a white robber confronting a white victim. We call this the racial homogeneity assumption. Note that since black and white income distributions differ, the racial homogeneity assumption is entirely consistent with racial heterogeneity in equilibrium rates of resistance, violence and crime. In fact, racial heterogeneity arises even conditional on income: blacks and whites with the same value of θ have the same payoff functions, but will act differently and be treated differently in equilibrium. We make the following assumptions regarding racial disparities in income distributions.

Assumption 4 *(Stochastic dominance).* For all $\theta \in \Theta$, $F_b > F_w$ and $G_b > G_w$.

Assumption 5 *(Monotone likelihood ratio property).* f_w/f_b is increasing in θ.

It is easy to verify that these conditions hold for the published income distributions of black and white non-Hispanic households. The monotone likelihood ratio property is a somewhat stronger assumption than we need; we use it because its implications have been extensively studied in economics since Milgrom (1981).

The following result establishes that if the white income distribution stochastically dominates the black income distribution among the population of potential robbers, then blacks will have higher crime rates than whites against each victim group. Furthermore, if the black and white robber distributions satisfy the monotone likelihood ratio property (Assumption 5), then white offenders will be resisted more frequently in equilibrium and are less likely to resort to violence conditional on resistance, regardless of whether the victim is black or white.

Proposition 2. *Suppose F_w stochastically dominates F_b. Then for each $j \in \{b, w\}$, $\gamma^*_{bj} > \gamma^*_{wj}$. If, in addition, the monotone likelihood ratio property holds, then $\lambda^*_{bj} > \lambda^*_{wj}$ and $\mu^*_{bj} < \mu^*_{wj}$ for each $j \in \{b, w\}$.*

Proof. Suppose $F_b(\theta) > F_w(\theta)$ for all $\theta \in \Theta$. Then, in particular, $F_b(\tilde{\theta}) > F_w(\tilde{\theta})$. Now suppose (by way of contradiction) that $\gamma^*_{bj} \leq \gamma^*_{wj}$ for some $j \in \{b, w\}$. Recall that $\gamma^*_{ij} = F_i(\hat{\theta}(\mu^*_{ij}))$ by definition, so from (6), we obtain $\lambda_{bj} > \lambda_{wj}$. Since $\tilde{\theta}(\cdot)$ is decreasing and $G_j(\cdot)$ is increasing, this implies $\mu_{bj} < \mu_{wj}$ from (4). But since $\hat{\theta}(\cdot)$ is decreasing, F_w is increasing, and $F_b(\theta) > F_w(\theta)$ for all $\theta \in \Theta$, we obtain

$$\gamma^*_{wj} \equiv F_w(\hat{\theta}(\mu^*_{wj})) < F_w(\hat{\theta}(\mu^*_{bj})) < F_b(\hat{\theta}(\mu^*_{bj})) \equiv \gamma^*_{bj},$$

which contradicts the hypothesis that $\gamma^*_{bj} \leq \gamma^*_{wj}$. Hence $\gamma^*_{bj} > \gamma^*_{wj}$ for all $j \in \{b, w\}$.

Now suppose that MLRP holds. It is easy to show that MLRP implies that $F_w(\theta)/F_b(\theta)$ is nondecreasing. Consider any $j \in \{b, w\}$. We claim that

$$\lambda^*_{bj} F_w(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{bj})))) > F_w(\bar{\theta}). \tag{8}$$

To see why, note that

$$\lambda^*_{bj} F_w(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{bj})))) = \lambda^*_{bj} F_b(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{bj})))) \left(\frac{F_w(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{bj}))))}{F_b(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{bj}))))} \right) > \lambda^*_{bj} F_b(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{bj})))) \left(\frac{F_w(\bar{\theta})}{F_b(\bar{\theta})} \right)$$

since $\hat{\theta} > \bar{\theta}$ from Proposition 1, and F_w/F_b is increasing in θ. But from (4)–(6),

$$\lambda^*_{bj} F_b(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{bj})))) \left(\frac{F_w(\bar{\theta})}{F_b(\bar{\theta})} \right) = F_b(\bar{\theta}) \left(\frac{F_w(\bar{\theta})}{F_b(\bar{\theta})} \right) = F_w(\bar{\theta}),$$

which proves that (8) holds. Note that from (4)–(6), we have

$$\lambda^*_{wj} F_w(\hat{\theta}(G_j(\tilde{\theta}(\lambda^*_{wj})))) = F_w(\bar{\theta})$$

Since $\lambda F_w(\hat{\theta}(G_j(\tilde{\theta}(\lambda))))$ is an increasing function of λ, (8) implies that $\lambda^*_{wj} < \lambda^*_{bj}$. Since the function $\tilde{\theta}(\lambda)$ is unchanged and decreasing, and G_j is increasing, (4) then implies that $\mu^*_{wj} > \mu^*_{bj}$. □

Hence black crime rates will be uniformly higher than white crime rates against both black and white victims if whites are more affluent than blacks as a group. Note that this effect occurs despite the fact that (by assumption) the payoff to an offender from the successful completion of a robbery without victim resistance does not depend on whether the victim is black or white. The reason for the higher crime rates is more subtle and can be understood intuitively as follows. Suppose crime rates were uniform across race. Then blacks would face lower resistance from victims of all groups since, relative to whites, a greater proportion of those attempting robbery would be willing to use violence. This follows directly from the hypothesis that the white income distribution stochastically dominates the black income distribution. Lower resistance makes crime more lucrative, resulting in higher black crime rates. Note that in equilibrium, it need not be the case that blacks in fact face lower resistance or that a greater proportion of black offenders are prepared to use violence. Since the set of types who choose robbery in the black population is larger than the set of types who choose robbery in the white population, it is entirely possible that a greater proportion of black robbers are in fact non-violent in equilibrium.

Next consider how rates of crime, resistance and violence vary with the race of the victim, holding fixed that of the robber.

Proposition 3. *Suppose G_w stochastically dominates G_b. Then for each $i \in \{b, w\}$, $\gamma^*_{ib} < \gamma^*_{iw}$, $\lambda^*_{ib} > \lambda^*_{iw}$ and $\mu^*_{ib} > \mu^*_{iw}$.*

Proof. Suppose $G_b(\theta) > G_w(\theta)$ for all $\theta \in \Theta$ and suppose (by way of contradiction) that $\gamma^*_{iw} \leq \gamma^*_{ib}$ for some $i \in \{b, w\}$. Then, by definition of γ_{ij}, we have $F_i(\hat{\theta}(\mu^*_{iw})) \leq F_i(\hat{\theta}(\mu^*_{ib}))$. From (6), therefore, $\lambda_{ib} \leq \lambda_{iw}$. Using this, together with (4) and the facts that $\tilde{\theta}(\cdot)$ is decreasing, $G_w(\cdot)$ is increasing, and $G_b(\theta) > G_w(\theta)$ for all $\theta \in \Theta$, we get

$$\mu^*_{iw} = G_w(\tilde{\theta}(\lambda^*_{iw})) \leq G_w(\tilde{\theta}(\lambda^*_{ib})) < G_b(\tilde{\theta}(\lambda^*_{ib})) = \mu^*_{ib}$$

and hence $\mu^*_{iw} < \mu^*_{ib}$. Using this, the fact that $\hat{\theta}(\cdot)$ is decreasing and F_i is increasing for each $i \in \{b, w\}$, we get

$$\gamma^*_{ib} \equiv F_i(\hat{\theta}(\mu^*_{ib})) < F_i(\hat{\theta}(\mu^*_{iw})) \equiv \gamma^*_{iw},$$

contradicting the hypothesis that $\gamma^*_{iw} \leq \gamma^*_{ib}$. Hence $\gamma^*_{ib} < \gamma^*_{iw}$ for all $i \in \{b.w\}$.

To obtain the results for λ and μ, recall that for any $i, j \in \{b, w\}$, $\lambda F_i(\hat{\theta}(G_j(\tilde{\theta}(\lambda))))$ is increasing in λ. Since $\hat{\theta}(\cdot)$ is decreasing, and $G_b(\theta) > G_w(\theta)$ for all θ, we therefore have

$$\lambda^*_{ib} F_i(\hat{\theta}(G_w(\tilde{\theta}(\lambda^*_{ib})))) > \lambda^*_{ib} F_i(\hat{\theta}(G_b(\tilde{\theta}(\lambda^*_{ib})))) = F_i(\bar{\theta}),$$

where the last equality follows from the equilibrium conditions (4)–(6). The same conditions imply

$$\lambda^*_{iw} F_i(\hat{\theta}(G_w(\tilde{\theta}(\lambda^*_{iw})))) = F_i(\bar{\theta}),$$

and so we have

$$\lambda^*_{ib} F_i(\hat{\theta}(G_w(\tilde{\theta}(\lambda^*_{ib})))) > \lambda^*_{iw} F_i(\hat{\theta}(G_w(\tilde{\theta}(\lambda^*_{iw}))))$$

Since $\lambda F_i(\hat{\theta}(G_w(\tilde{\theta}(\lambda))))$ is increasing in λ, we have $\lambda^*_{ib} > \lambda^*_{iw}$. From (6), this implies $F_i(\hat{\theta}(\mu^*_{ib})) < F_i(\hat{\theta}(\mu^*_{iw}))$ and hence, since $\hat{\theta}(\cdot)$ is decreasing and $F_i(\cdot)$ increasing, we have $\mu^*_{iw} < \mu^*_{ib}$. □

Hence all robbers in both groups exhibit a preference for white over black victims. The probability of violence conditional on resistance is greater for black victims relative to white. This is because the pool of offenders willing to confront white

victims is larger and hence contains a greater share of non-violent types. Despite the fact that white victims are less likely to face violence conditional on resistance, the model predicts that they resist at lower rates than black victims. Hence the effect on resistance rates of the fact that whites are richer as a group outweighs the effect of the fact that they face a less violent population of robbers in equilibrium.

These theoretical results have certain clear empirical implications for rates of crime, resistance and violence. While a systematic empirical analysis is well beyond the scope of this paper, we can provide a tentative assessment of some of these implications using NCVS data.

4.1. Disparities in crime rates

Taken together, Propositions 2 and 3 imply that if the white income distribution stochastically dominates the black income distribution in both robber and victim populations, then $\gamma^*_{wb} < \gamma^*_{ww} < \gamma^*_{bw}$ and $\gamma^*_{wb} < \gamma^*_{bb} < \gamma^*_{bw}$. These conditions can be combined as follows:

$$\gamma^*_{wb} < \min\{\gamma^*_{ww}, \gamma^*_{bb}\} \leq \max\{\gamma^*_{ww}, \gamma^*_{bb}\} < \gamma^*_{bw}. \tag{9}$$

Does the empirical evidence support the ordering of crime rates implied by (9)? Addressing this question requires us to take into account the fact that black–white residential segregation remains extreme in metropolitan areas of the United States.[14] Hence encounters between individuals belonging to different groups are less frequent than they would be under purely random matching. Ordinarily, this would cause crime to be highly concentrated within groups, which is indeed the case for murder, rape and assault. What makes robbery unusual is the extremely high rate of black-on-white incidence, despite the continuing prevalence of residential segregation and the negligible incidence of white-on-black robbery. This disparity is predicted by (9), which implies $\gamma^*_{wb} < \gamma^*_{bw}$. Since every time a black person encounters a white person, a white person encounters a black person, so we do not have to account for segregation in making this comparison. Since the number of black-on-white robberies is roughly 8 times as great as the number of white-on-black robberies in Table 1, this part of (9) receives strong support.

The next part of (9) asserts that $\gamma^*_{bb} < \gamma^*_{bw}$. Here the question of encounters becomes more difficult. In terms of total numbers, the number of black-on-white robberies is somewhat greater than the number of black-on-black robberies, but not by much. The inequality from (9) would be contradicted if blacks encountered whites considerably more often than they encountered blacks. Segregation is great enough that such a proposition is dubious. In 2000, the average white resident of a metropolitan area in the U.S. lived in a neighborhood that was 80 percent white and just 7 percent black, while the average black resident lived in a neighborhood that was 51 percent black (Lewis Mumford Center, 2001). While other venues such as jobs and sidewalks may be less segregated than neighborhoods, the weight of evidence seems to support this part of (9).

The next part of (9) asserts $\gamma^*_{ww} < \gamma^*_{bw}$. This seems more certain. In Table 1, white-on-white robberies are about 1.77 times as numerous as black-on-white robberies. This inequality holds, then, if a white person is more than 1.77 times as likely to encounter another white person as she is to encounter a black person. Even if encounters were purely random and there were no segregation, this condition would hold since whites are a significant majority in the population at large. As it happens, the average white resident of a U.S. metropolitan area is 12 times as likely to encounter a white neighbor as a black neighbor (Lewis Mumford Center).

The final part of (9) asserts that $\gamma^*_{wb} < \gamma^*_{ww}$. White-on-white robberies are about 14.8 times as numerous as white-on-black robberies. Since the housing evidence cited in the previous paragraph does not seem to support such a wide disparity, even in aspects of life that are comparatively segregated, this inequality seems to have some support.

4.2. Disparities in resistance and violence

Propositions 2 and 3 also make sharp predictions about rates of violence and resistance. Holding constant the race of the offender, a white victim faces a *lower* probability that resistance will be met with violence. Despite this, white victims resist with lower frequency. Also, holding constant the race of the victim, black offenders are more likely to resort to violence conditional on resistance and are less likely to face resistance in the first place. We have no predictions about how intraracial robberies differ in resistance rates, or how interracial robberies differ in violence rates, but we expect

$$\lambda^*_{bb} > \max(\lambda^*_{wb}, \lambda^*_{bw}) \geq \min(\lambda^*_{wb}, \lambda^*_{bb}) > \lambda^*_{ww}$$

and

$$\mu^*_{wb} > \max(\mu^*_{ww}, \mu^*_{bb}) \geq \min(\mu^*_{ww}, \mu^*_{bb}) > \mu^*_{bw}.$$

Since white-on-black robberies are so infrequent in the data, the testable implications of the model are

$$\lambda^*_{bb} > \lambda^*_{bw} > \lambda^*_{ww}$$

[14] For a thorough analysis of segregation levels and trends see Massey and Denton (1993) and Farley and Frey (1994); more recent evidence is discussed in Glaeser and Vigdor (2001) and Lewis Mumford Center (2001).

Table 3
Rates of violence by race of victim, 1993–2002

	1993	1994*	1995*	1996	1997	1998	1999*	2000	2001	2002
λ_{bw}	0.322	0.373	0.242	0.296	0.563	0.480	0.324	0.694	0.754	0.776
λ_{bb}	0.461	0.646	0.652	0.535	0.727	0.518	0.659	0.698	0.522	0.699

and

$$\max(\mu^*_{ww}, \mu^*_{bb}) \geq \min(\mu^*_{ww}, \mu^*_{bb}) > \mu^*_{bw}.$$

How well do these predictions accord with the evidence? NCVS data for single-offender robberies can be used to address this question. One of the less intuitive predictions of the model is that relative to black victims, white victims face a smaller likelihood of violence conditional on resistance: $\lambda^*_{bw} < \lambda^*_{bb}$. Aggregating data for the periods 1993–2002, we obtain the estimates $\lambda_{bw} = 0.448$ (standard error 0.029) and $\lambda_{bb} = 0.614$ (standard error 0.037), confirming that black victims do, in fact, face a considerably higher likelihood of violence when they choose to resist black offenders. This difference is statistically significant. Table 3 contains the disaggregated data, which shows that despite considerable variation over time in rates of violence, the predicted inequality is satisfied for 8 of the 10 years in the sample. For three of these years (denoted by an asterisk) the difference is statistically significant at the 5 percent level. Moreover, for the 2 years in which the inequality is not satisfied, the difference is insignificant.

Turning to the likelihood of resistance, the model implies that white victims will resist with greater likelihood when faced with a white (rather than black) offender: $\mu^*_{ww} > \mu^*_{bw}$. Aggregate estimates of rates of resistance for the periods 1993–2002 are $\mu_{ww} = 0.618$ (standard error 0.019) and $\mu_{bw} = 0.553$ (standard error 0.023), which is consistent with this prediction. This difference is statistically significant. The disaggregated data is shown in Table 4: the inequality holds in 7 of the 10 years in the sample, although none of the individual year differences is significant.

Some predictions of the model, however, accord less well with the data. The model predicts (under the somewhat stronger assumptions of Proposition 2) that white victims will face a higher likelihood of violence from black (relative to white) offenders: $\lambda^*_{bw} > \lambda^*_{ww}$. This appears not to be the case when we look at the periods 1993–2002, for which we find $\lambda_{ww} = 0.464 > 0.448 = \lambda_{bw}$ in the aggregate. In other words, white victims appear to face a smaller likelihood of violence from black (relative to white) offenders than our model predicts. However, this difference is not statistically significant (standard errors are 0.024 and 0.029 for estimates of λ_{ww} and λ_{bw}, respectively).

In addition, the model predicts that black offenders will face greater resistance from black victims than they face from white victims: $\mu^*_{bw} < \mu^*_{bb}$. This too appears not to hold in the aggregate for the period in question, where we find $\mu_{bb} = 0.479 < 0.550 = \mu_{bw}$. This difference is statistically significant (standard errors are 0.027 and 0.023 for estimates of μ_{bb} and μ_{bw}, respectively). In other words, black offenders face somewhat more resistance from white victims than one would predict on the basis of the model. Since these predictions rely on the racial homogeneity assumption, we feel that a relaxation of this is a promising direction for future research.

To summarize, the model accounts for the racial disparity in robberies, and in particular the enormous gap between black-on-white and white-on-black robbery rates. It also makes a number of predictions about racial differences in rates of resistance and violence that can be tested against the empirical record. A preliminary look at the data suggests that some (but not all) of the predicted patterns appear to arise. Until a systematic investigation is undertaken, however, these empirical claims must be considered highly tentative.

5. Alternative explanations

Quite a few theories have been advanced to explain the racial disparity in robbery rates. There are also "common-sense" folk explanations. In this section we will review some of the more popular of these theories and show why they are inadequate. Sampson and Lauritsen provide a more detailed critique of many of these theories. While the various arguments presented here can account to some degree for the racial disparities in overall crime perpetration, none are able to address the striking fact that black-on-white robbery rates are vastly greater than white-on-black robbery rates. Furthermore, these are theories of crime in general rather than robbery in particular. Hence they cannot address racial disparities in the likelihood of resistance and violence.

Table 4
Rates of resistance by race of offender, 1993–2002

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
μ_{bw}	0.561	0.621	0.570	0.523	0.592	0.512	0.625	0.442	0.549	0.411
μ_{ww}	0.724	0.699	0.491	0.666	0.703	0.466	0.499	0.563	0.674	0.673

5.1. Characteristics

The most popular way to explain racial disparities in crime is to point to some particular characteristic, assert that this characteristic causes a disproportionate propensity to engage in crime, and show that African-Americans are more likely than whites to have this characteristic. Examples of characteristics that might be used in this way are having grown up without a father present, being poor, being poorly educated, having lower scores on standardized tests, and owning a gun. In this view, characteristics are the link between race and crime: conditional on having one or more of them, blacks should be no more or less likely to commit crime than whites or Hispanics.[15]

These explanations fail because it is impossible to explain the racial disparity in robbery unless the explanation includes why blacks are more likely to commit robbery *conditional on these characteristics*. Robbery arrests are far more concentrated on African-Americans than are any of these characteristics. As noted in the introduction, blacks are over *eight* times more likely as whites to be arrested for robbery, yet black children are only 2.56 times as likely as white to live with a single parent (Statistical Abstract, 2000), blacks between 18 and 35 are only 1.90 times as likely to be poor as whites of similar age, and blacks are *less* likely to own guns than whites, both unconditionally and conditional on a long list of standard variables, including urban or rural residence (Glaeser and Glendon, 1998).

Notice that equal concentration is not a sufficient condition for characteristic stories such as these to work. Even if blacks were eight times as likely as whites to be poor, for instance, poverty differentials would explain the robbery arrest disparity only if the non-poor were never arrested for robbery. Thus, Lochner and Moretti (2004) find that equalizing black and white educational attainment would eliminate only 23 percent of the racial incarceration gap (which is smaller than the racial robbery arrest gap).[16]

Considering the interaction among several characteristics moves us no closer to an explanation. In general, a story about interaction between two characteristics can explain more than the stronger of two simple characteristics stories only in two special circumstances: either crime depends on the intersection and the characteristics are much more strongly correlated among blacks than among whites; or crime depends on the union and the characteristics are much more strongly correlated among whites than among blacks. Analogous conditions hold for 3-way and n-way interaction. We have found no evidence that either of these special circumstances holds for any set of characteristics.

5.2. Under-deterrence and social osmosis

Economic theories of crime emphasize how the probability and severity of punishment deter potential wrong-doers. Under-deterrence, therefore, is a potential explanation for black crime; perhaps African-Americans commit more crimes because they are less afraid of the consequences. This is the operative mechanism in Sah's (1991)"social osmosis" theory of crime; for instance, neighborhoods with many criminals in them overwhelm the police, lowering the probability of apprehension, thus perpetuating and exacerbating disparities. This hypothesis also appears in Anderson (1999). His argument is that lawlessness prevails in black neighborhoods because the police have abandoned them and do not treat black-on-black crime sufficiently seriously.

The greatest problem that an under-deterrence theory of racial disparities encounters is that there is no evidence that African-American criminals face lower probabilities of apprehension or less severe punishments. If such were the case, they would be more heavily represented among offenders identified by victims than among arrestees or prisoners. That is not the pattern we see.

Racial disparities in judicial processing have been studied extensively, and the consensus is that blacks are *not* treated more leniently than whites. Ayres and Waldfogel (1994) find that African-Americans are forced to pay discriminatorily high bail. The U.S. Office of Juvenile Justice and Delinquency Prevention (1999, p. 3) concluded from a review of many studies that "there is substantial evidence that minority youth are treated differently from majority youth within the juvenile justice system", being more likely to be placed in public secure facilities, for instance, rather than private facilities or diversion, even considering the severity of the crime and other factors. Sampson and Lauritsen (1997, p. 355) review the literature on adult case disposition and sentencing, and find no major disparities.

The severity with which defendants are treated by the criminal justice system depends not only on their race but also that of their alleged victims. For instance, Eberhardt et al. (2006) examine black defendants in capital cases involving white victims, and find that those with more stereotypically black features have a significantly higher likelihood of receiving the death penalty. No such effect is found when the victim is black. To the extent that the justice system does not treat black victimization as seriously as white, we would expect to see more white-on-black robbery than black-on-white, when in fact the opposite is the case.

The second problem with an under-deterrence theory of racial disparities is that elasticities of crime with respect to deterrence measures are so small that disparities in apprehension and punishment would have to be very great to explain

[15] Note that in our model, blacks and whites with *identical* non-racial characteristics (as represented by θ) will behave differently in equilibrium since their racial characteristics alone are sufficient to influence beliefs and hence the actions of those with whom they interact.

[16] This is their OLS result. They do not report similar calculations for the more sophisticated regressions that they run, but those regressions lead them to conclude that OLS produces a reasonably accurate measurement of the impact of education on crime.

any substantial portion of the disparity. Most econometric estimates (for instance, Witte, 1980) put the elasticity of offenses with respect to the probability of arrest or imprisonment in the range of 0.3–0.5. Almost certainly it is less than unity. But only if the elasticity of offenses is greater than unity can weaker deterrence explain more per capita arrests. With this elasticity less than unity, a group with a lower threat of arrests would have fewer arrests, not more.

Econometric estimates of the elasticity of offenses with respect to length of sentences generally find that it is lower than the elasticity with respect to arrest probability ("certainty matters more than severity") and often find that it is very small. Suppose that this elasticity is 0.3—a very high estimate. Then African-Americans would commit twice as many offenses as whites only if their punishment was roughly a tenth of white expected punishment. And African-Americans would commit eight times as many robberies only if whites were punished a thousand times more severely. Considering the volume of research on racial sentence disparities, it is inconceivable that a discrepancy of this magnitude could have been overlooked.

Thus traditional deterrence theory is of little use in explaining racial disparities, and any more imaginative reconstruction (defining the severity of punishment differently, for instance) has very large obstacles to overcome.

5.3. Culture of violence

Another explanation is that African-American sub-culture is to blame. According to this view, African-Americans live in a sub-culture distinct from the rest of American society, one in which crime, aggressive behaviors, and illegitimate activities are not strongly condemned. Even if this argument is not taken as a tautology, there are a number of empirical difficulties. Social surveys do not reveal major differences between blacks and whites on attitudes toward crime (Sampson and Lauritsen, 1997, p. 332). Blacks are decidedly more pious and religiously observant than whites, even holding income and education constant (Iannaccone, 1998). Freeman (1996) shows that religious youth are less likely to engage in crime. Blacks are less likely to drink, and considerably less likely to abuse alcohol (SAMHSA, 2002). Alcohol is closely linked to violence (Fagan, 1993; Markowitz, 2000a, b; Grossman and Markowitz, 1999). The only hard evidence for a sub-culture of violence, it seems, is violent crime—the phenomenon the sub-culture story is supposed to be explaining.

A culture of violence should mean a culture in which families fight. Yet in 2002, blacks were slightly *less* likely than whites to be victims of violent crimes committed by family members (1.9 per 1000 population 12 or over for blacks, versus 2.0 for whites). Since family violence is decreasing in income, a regression would probably show that "African-American sub-culture" decreases family violence (NCVS, 2004, Table 35).

The sub-culture explanation also fails to explain why African-Americans are more heavily over-represented in certain crimes than in others. Drug trafficking, gambling, prostitution, receiving stolen property, and motor vehicle theft are all less violent (and more profitable financially) than rape and assault, but African-Americans are more heavily over-represented in the former crimes than in the latter.

5.4. Physical size

Group differences in physical size cannot account for differences in robbery rates, for the simple reason that African-American men are no larger than white men of comparable age. On average, black men between 20 and 39 are slightly lighter than non-Hispanic white men (189.1 pounds for African-Americans vs. 189.7 for non-Hispanic whites), and slightly shorter (70.1 in. vs. 70.2 in.). Both differences are statistically insignificant. The mean body mass index is virtually identical across groups (Ogden et al., 2004, Tables 11, 13 and 15). Since body mass index is a nonlinear function of height and weight, it is unlikely that higher moments of the black and white bivariate distributions of height and weight differ greatly.

5.5. Adverse selection

Loury (2002) develops a model of adverse selection to explain why cab drivers fear black men. Out of fear, cab drivers make black men wait longer, and so robbers end up disproportionately represented among the black men who endure and get a cab. This is because robbers gain more from a cab ride than regular passengers do, and so are willing to wait longer. This is an equilibrium in which cab drivers' stereotype of black men as robbers is confirmed.

While this model accounts for discriminatory treatment, it predicts that within the population of passengers white men rob cabs more often than black men do. Robbing cabs is easier for white men than for black, because they do not have to wait as long, and proportionately more of them do it (although robbers are a smaller fraction of riders). Thus a generalization of Loury's model does not predict that blacks will be disproportionately involved in robbery.

5.6. Social interaction

Glaeser et al. (1996) observe that the spatial variation in crime is greater than traditional economic and demographic variables can explain, and develop a theory of social interaction. No matter what your background, if your neighborhood is full of criminals, you're much more likely to become a criminal, too. Since many African-Americans live in segregated neighborhoods with much crime, a theoretical model where social interaction among criminals led to disproportionate African-American criminality probably could be developed.

Such a model, however, would not be able to explain Glaeser et al.'s empirical results on particular index crimes. If social interaction explained African-American involvement in crime, then social interaction should be most powerful for the index crimes African-Americans commit relatively most—murder and robbery—and least powerful for those they commit relatively least—burglary and assault. Instead, Glaeser et al. conclude that social interaction is of almost negligible power for murder, and has only modest power for robbery. Social interaction is of greatest importance for motor vehicle theft, a crime of moderate African-American disproportion, and theft, a crime of little disproportion.

6. Conclusions

The idea that stereotypes can have incentive effects that result in systematic differences across groups in behavior dates back to the seminal work of Arrow (1973) and Phelps (1972), and has generated a large literature that continues to grow (Coate and Loury, 1993; Fryer, 2004; Moro and Norman, 2004; Chaudhuri and Sethi, 2008). Most applications of this idea have focused on labor markets, and addressed disparities in wages, job assignment, and human capital acquisition. In order for the theory of statistical discrimination to be operative, however, it is necessary that the characteristics in question be both unobservable and responsive to economic incentives. As noted by Akerlof (1976, p. 608), there are "difficulties in applying this model to real-world racial discrimination" in labor markets since characteristics such as education and experience are generally observable at little cost, while traits such as punctuality and initiative, being acquired in early childhood, are relatively unresponsive to wage differentials. This suggests that the theory of statistical discrimination may be most relevant to sporadic, anonymous interactions in which payoff-relevant characteristics are necessarily unobservable, and where potential gains and losses can be significant. The crime of robbery satisfies all of these criteria.

Our theory of racial disparities in the incidence of robbery, resistance, and violence is based on the idea that group inequality can affect incentives in ways that induce otherwise identical individuals to behave differently in equilibrium. Victims entertain the belief that black offenders, being drawn from a population with lower levels of income, are more likely than whites to respond violently to resistance. This lowers their incentives to resist and makes crime more lucrative for non-violent black offenders who benefit from (but do not fit) the stereotype. The result is disproportionate involvement of blacks in robbery. For similar reasons, potential robbers believe that black victims are more likely than whites to resist attempts at robbery. This makes them less attractive targets, and explains the huge gap between black-on-white relative to white-on-black crime. An implication of the disparity in crime rates is that black victims face a group of offenders that is on the whole more violent—this prediction of the model is roughly consistent with the empirical record.

One limitation of our work is that potential victims make only one decision—whether or not to resist a robbery attempt. In practice, potential victims can employ a variety of strategies (Erlich, 1981; Cook, 1986). In particular, they can employ costly precautions to avoid being victims of crime at all. Such avoidance behavior explains in part why the old, the rich, and women are less likely to be robbery victims. Allowing victims to take costly precautions is an obvious extension to our model. If moving to areas with few robbers is cheaper for whites than for blacks, then *ceteris paribus* the resistance rates for whites who do not move should be higher. This could explain one of our empirical anomalies. Furthermore, racial asymmetry in robbery rates can lead to residential segregation even when individuals are indifferent to the racial composition of their neighborhoods, and there is no overt discrimination in housing or lending markets. Our analysis here implies that blacks and whites of comparable economic characteristics face very different crime victimization rates, and hence that whites would be willing to pay more than otherwise identical blacks to migrate to safer suburban locations. In O'Flaherty and Sethi (2007) we provide a formal analysis of this effect together with supporting empirical evidence.

The methods used here could also be applied to the analysis of other criminal interactions. Like robbery, rape and assault are violent crimes which involve the possibility of victim resistance. Hence stereotypes could affect the behavior of victims and offenders, and game-theoretic models of incomplete information could shed new light on such crimes. However, such models would have to confront an entirely different set of stylized facts: for instance rape and assault are far more concentrated within groups than is the case with robbery, and are much less likely to involve interactions between strangers.

Finally, we have assumed throughout that beliefs held by both victims and perpetrators are self-fulfilling in equilibrium. This is the hallmark of the economic approach: behavior is optimal given the beliefs that individuals hold, and beliefs are accurate, given the behavior that they induce. Psychologists have long recognized, however, that "stereotypes based on relatively enduring characteristics of the person (such as race, religion and gender) have enormous potential for error" (Hilton and von Hippel, 1996, p. 241). There are a number of channels through which inaccurate stereotypes can arise and persist. Once activated, stereotypes can influence attentiveness to new information, the interpretation of ambiguous information, the behavior of the holder towards the target of the stereotype, and the standards against which the behavior of the target is judged (Hamilton et al., 1994). To the extent that the holder is more receptive to stereotype-confirming information, and tends to interpret ambiguous information in a manner that is stereotype-consistent, beliefs about group characteristics can persist even if they are inaccurate. Such considerations strengthen rather than undermine the conclusions drawn in this paper. The existence of an inaccurate but persistent stereotype of black male violence, for instance, would result in qualitatively similar but quantitatively greater racial disparities in crime rates relative to the predictions of our analysis. We consider the explicit introduction of such psychological perspectives into models of economic behavior to be a promising direction for future research.

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