TESTING FOR RACIAL PREJUDICE IN THE PAROLE BOARD RELEASE PROCESS:
THEORY AND EVIDENCE

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ABSTRACT

We develop a model of a Parole Board contemplating whether to grant parole release to a prisoner who has finished serving their minimum sentence. The model implies a simple outcome test for racial prejudice robust to the inframarginality problem. Our test involves running simple regressions of whether a prisoner recidivates on the exposure time to the risk of recidivism and its square, using only the sample of prisoners who are granted parole release strictly between their minimum and maximum sentences and separately by race. If the coefficient estimates on the exposure time term differ by race, then there is evidence of racial prejudice against the racial group with the smaller coefficient estimate. We implement our test for prejudice using data from Pennsylvania from January 1996 to December 31, 2001. Although we find racial differences in time served, we find no evidence for racial prejudice on the part of the Parole Board based on our outcome test.

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1 Introduction

It has been widely documented that blacks comprise a disproportionate share of the U.S. prison population. According to the U.S. Bureau of Justice Statistics (BJS), there were a total of 2,297,500 inmates held in custody in state or federal prisons or in local jails as of June 30, 2009. Whites account for 34% of the jail and prison population, non-Hispanic blacks account for 39%, and Hispanics (of all races) account for 20%.[1] In contrast, the fraction of non-Hispanic whites, blacks (including Hispanic blacks) and Hispanics of all races account for 69%, 14% and 16% of the US population according to the 2010 U.S. Census.[2] The BJS also found that in 2009, the incarceration rates (number per 100,000 population) among black and Hispanic males were respectively about 7 and 2.5 times higher than that among white males.[3]

It is thus an important policy question to understand the causes for the racial disparities in incarceration rates. Of course, there are many possible culprits, including racial differences in crime prevalence, unfair penal codes, and racial prejudice in the various stages of the criminal justice system. Different causes for the racial disparities in incarceration rates call for different policy responses. For example, with unfair penal codes many observers argued that the much harsher mandatory penalties for crack cocaine established by the 1986 and 1988 Anti-Drug Abuse Acts compared to that for powder cocaine contributed to the higher incarceration rates for minorities. The policy response to this was the Fair Sentencing Act, signed into law by President Barack Obama in 2010, which, among other provisions, reduced the disparity between the amount of crack cocaine and powder cocaine needed to trigger certain United States federal criminal penalties, and eliminated the five-year mandatory minimum sentence for simple possession of crack cocaine.[4] On the other hand, if racial differences in crime prevalence are the reason for the racial disparities in incarceration rates, the right response would involve a different set of policies including creating better employment opportunities for minorities.

If instead racial prejudice in the criminal justice system is to blame for the racial disparities in

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[1]See Table 16 in *Prison Inmates at Midyear 2009* (West, 2010).

[2]See U.S. Census Bureau: "*The 2010 Census Brief: Overview of Race and Hispanic Origin*" available at: http://www.census.gov/prod/cen2010/briefs/c2010br-02.pdf

[3]See Table 18 in *Prison Inmates at Midyear 2009* (West, 2010). The differences for female incarceration rates by race are are also large, though less dramatic: The rate among African- American females was more than 3.5 times the rate of white females (333 African-American v. 91 white), and the rate for Hispanic females was 1.5 times higher (142 Hispanic) than that among white females.

[4]US Public Law 111-220. See http://www.gpo.gov/fdsys/pkg/PLAW-111publ220/content-detail.html.

incarceration rates, then we should identify and replace the prejudiced police, judges and Parole Boards to reduce the disparities. Identifying racial discrimination at the various stages of the criminal justice system has indeed has been the focus of a recent but growing literature. Knowles, Persico and Todd (2001), Anwar and Fang (2006) and Antonovics and Knight (2009) study the role of prejudice in motor vehicle searches. Anwar, Bayer and Hjalmarsson (2010) examined discrimination at the conviction stage and found that the racial makeup of the jury has a large effect on the black-white conviction ratio. Other studies have looked at potential discrimination at the sentencing stage. In Pennsylvania, Steffensmeier and Demuth (2001) find that Hispanic defendants receive the harshest sentences, while Muhlhausen (2004) finds that black judges sentence black offenders to longer prison terms than white judges gave to white offenders. Ayres and Waldfogel (1994) and Bushway and Gelbach (2010) study the role of prejudice in bail setting, while Alesina and La Ferrara (2009) study the role of racial prejudice in death penalty sentences.

In this paper, we study the role of racial prejudice in the Parole Board's discretionary release decisions.[5] Parole release is an integral and important part of the U.S. criminal correction and justice system. According to the U.S. Department of Justice, there were a total of 819,308 adults under parole or other post-custody supervision at the end of 2009.[6] In fact, in most states, prisoners do not serve out the whole sentence because many are granted parole release before completing the sentence. For example, in our data set from Pennsylvania, 18% of all prisoners were parole released once they served their minimum sentences, and only 37% of the prisoners served the maximum sentence (see Table 2).[7] To the extent that the Parole Board has discretion over how much of the sentence range the prisoner will serve, they are in the position to either remedy or exacerbate the biases that may be present in earlier stages of the criminal justice system such as law enforcement, prosecution and sentencing.

Many previous studies have examined this issue using action based tests, which essentially compare whether minorities serve a greater proportion of their sentence before being paroled than their white counterparts.[8] However, it is well known that simple racial disparities in proportion served, even after controlling for observable characteristics of inmates, are not necessarily evidence that the

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[5]We discuss the connections of our paper to a closely related paper by Mechoulan and Sahuguet (2011) in Section 2.

[6]There were also 4,203,967 additional adults on probation at the year end of 2009. See Glaze (2010): "Correctional Populations in the United States, 2009."

[7]The criminal sentencing system in Pennsylvania is described in detail in Section 3.

[8]The results of these studies are discussed in Section 2.

Parole Board is racially prejudiced. These disparities may result from an omitted variables problem, which occurs when there are systematic differences across races in the inmates' characteristics that are observable to and used by the Parole Board in their release decision, but that are unobserved by researchers. These disparities can also arise from statistical discrimination, which occurs when there is crucial information that is unobservable to the Parole Board, but that is correlated with inmate race. To deal with these issues we use an outcome-based test because, if applied properly, these tests can identify racial prejudice even in the presence of omitted variables and statistical discrimination.

The specific outcome test we use is based on a simple model of the Parole Board's release decisions.[9] We consider a Parole Board who is contemplating whether to grant parole release to a prisoner who has just finished serving their minimum sentence and is thus eligible for parole. The Parole Board faces a trade-off. On one hand, releasing the prisoner on parole saves the imprisonment cost; on the other hand, it imposes a social cost if the prisoner has not been rehabilitated and commits crimes while on parole. We show the Parole Board will choose to grant the prisoner parole if and only if their perceived rate of recidivism is at or below a certain threshold, where the rate is defined as the product of the perceived probability the inmate is not rehabilitated and the rate of recidivism for non-rehabilitated inmates.[10] The Parole Board will use a lower threshold for minorities if they are prejudiced against them. If the inmate's rate of recidivism at the completion of their minimum sentence is too high, the Parole Board will keep the inmate incarcerated; each successive time period the inmate completes with good behavior increases the Parole Board's perception the inmate is rehabilitated, and thus lowers their perceived rate of recidivism. The moment the inmate's perceived recidivism rate is lowered enough to hit the Parole Board's threshold, they are released. If the inmate's perceived rate never falls enough to hit the threshold, they will be released upon the completion of their maximum sentence. Importantly, this implies that every prisoner granted parole release *between* their minimum and maximum sentences has an assessed recidivism rate *exactly* equal to the aforementioned race-specific threshold.

To implement our outcome test for racial prejudice we need to identify the release thresholds being used for each race and compare them. As is well-known, the main difficulty that arises when implementing outcome tests is the "infra-marginality problem", which refers to the difference

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[9]Our model is related to Bernhardt, Mongrain and Roberts (2010). Kuziemko (2007) also developed related ideas. The goal of both papers is to show the efficiency of the parole board release system, instead of testing for prejudice.

[10]We assume rehabilitated inmates do not recidivate.

between the comparisons of the average and marginal outcomes across racial or gender groups.[11]   In order to identify the threshold being used, we need to identify the recidivism rate for the marginal person that is released (i.e. the person released whose rate is exactly at the threshold).   However, in the data we can only identify the average recidivism rate.   We deal with the infra-marginality problem in this paper by noting that in our model, every prisoner released by the Parole Board between their minimum and maximum sentence, regardless of their characteristics, will have a recidivism rate exactly equal to the threshold set by the Parole Board.   Therefore, within this subsample, the marginal prisoner released is the same as the average prisoner released.   Thus our application of the outcome test is not subject to the infra-marginality problem critique, and is valid even though we can never hope to have as much information about a prisoner as the Parole Board does.[12]

Our test for racial prejudice is based on our model of Parole Board behavior.   As such, evidence for or against racial prejudice using our test is only as credible as our proposed model.   Fortunately, our model has several auxiliary implications that can be tested using our data set.   First, our model predicts that the probability of recidivating within a certain time frame should be in ascending order for those released immediately after serving their minimum sentences, those released in-between their minimum and maximum sentences, and those released after serving their maximum sentences. Second, our model predicts that, for those parolees released strictly in-between their minimum and maximum sentences, their probability of recidivating on parole should be independent of their time served, and positively related to their time on parole.   We find supportive evidence for both of these predictions, thus lending credence to our model and our proposed test for racial prejudice.

Using data from the Pennsylvania Department of Corrections on all individuals who were released from prison on or after January 1, 1996 and whose maximum sentence ended by December 31, 2001, we find our model is consistent with the data if and only if we define recidivism as returning to prison due to committing a violent or sex crime.   Using this definition of recidivism, we find no evidence that the Parole Board is racially prejudiced in its discretionary parole release decisions.

The remainder of the paper is structured as follows. In Section 2 we review the related literature. In Section 3 we describe the sentencing and parole system in Pennsylvania in detail.   In Section 4 we present a model of how the Parole Board makes parole release decisions and, based on the

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[11]See Knowles, Persico and Todd (2001) and Anwar and Fang (2006) for descriptions of this problem, and see Persico (2010) for a comprehensive review of the recent racial profiling literature.

[12]Similar ideas to dral with the inframarginality problem in the outcome test for racial prejudice were also used by Ayres and Waldfogel (1994) and Anwar and Fang (2011).

implications of the model, derive an estimation equation that will inform us about whether racial prejudice plays a role in the Parole Board's decision making. In Section 5 we describe our data set and present the descriptive statistics. In Section 6 we present our main empirical results regarding the role of prejudice in Parole Board decisions, as well as additional evidence supportive of the auxiliary predictions of the model. In Section 7 we compare our results to the results we would have obtained if we used tests conducted in the previous literature. Finally, in Section 8 we conclude.

2   Related Literature

Research that specifically examines racial prejudice in the parole release process has been rather scarce. Previous literature falls into two main categories. The first type of study essentially examines whether minorities serve a greater proportion of their sentence before being paroled than their white counterparts (Morgan and Smith, 2008). The findings have been mixed. Petersilia (1983) found that minorities in Texas served a higher proportion of their sentences relative to whites, but the reverse was true in Michigan. More recently, Huebner and Bynum (2006) found race had no effect on sentence served among a sample of men incarcerated for sexual offenses.

The second strand of literature uses data from parole decisions and explicitly examines whether race has an effect on parole being granted. Carroll and Mondrick (1976) examined the cases of 243 prisoners who appeared before a Parole Board between 1970-1971 and find that race had no impact on the decision to grant parole. In a more recent study, Morgan and Smith (2008) again found that race had no effect on parole release decisions using a sample of 762 inmates in Alabama that were eligible for parole between 1993-1994.

All of the above literature makes varying attempts to control for potential confounding factors, although none have access to all of the information the Parole Board has at the time of release. This opens the door for any potential racial disparity found to simply be the product of an omitted variables problem. Even if there were no omitted variable problem, these studies still could not differentiate between statistical or taste discrimination (racial prejudice), because they both have the same impact on the dependent variable.

Mechoulan and Sahuguet (2011).   Our paper is most closely related to a recent paper by Mechoulan and Sahuguet (2011, henceforth MS) which also uses an outcome test to test for racial prejudice in parole release decisions. It is important to highlight that our paper differs from the MS paper in both modeling and data, which leads to us running different empirical tests and finding

different conclusions. We will detail the difference between our proposed test and that of MS and explain the differences in our conclusions in Section 7.2. Here we describe the differences in the models and the data sets.

In the MS model the Parole Board aims to *minimize* the total number of *parole violations*, subject to a constraint that at least a certain fraction of the prisoners has to be released. Their model predicts that, in the absence of prejudice, all prisoners are released such that their *probability* of recidivating while on parole is the same. The Parole Board can accomplish this because of the mechanical relationship between recidivating on parole and time on parole–the less time an individual spends on parole, the lower the probability they will recidivate on parole. In contrast, in our model the Parole Board compares the benefits and costs of keeping an inmate for the next period, which results in the Parole Board releasing all inmates with the same *rate* of recidivism in the absence of prejudice. While both models are theoretically plausible, we show in Section 7.2 that in our data set only our model is supported.

The second key difference in our papers comes from the fact that the MS paper uses data from the National Corrections Reporting Program (NCRP) parole release file. While the NCRP data has a large sample size and covers many different states, it has two important shortcomings in implementing the test for racial prejudice. The first shortcoming is that the NCRP data does not allow researchers to distinguish those who were released immediately after serving their minimum sentences from those that were released in-between their minimum and maximum sentences, and thus the MS paper is forced to use all parolees in their analysis. This is problematic because the outcome test used (in both the MS paper and ours) is only free of the infra-marginality problem when it is applied to parolees released strictly in between their minimum and maximum sentences.[13] The second shortcoming of the NCRP data is that the only measure of recidivism it records is whether or not the individual returned to prison while on parole, but does not identify whether they were sent back due to committing a technical violation or from committing a new crime. This forces them to run their outcome test by comparing the probability different races returned to prison while on parole. Not only must MS assume this is the measure of recidivism the board cares about, but using this measure can also be problematic because one of the requirements for the outcome test is that the outcome must be objectively measured. Because parole officers have some discretion in whether they want to send individuals back for technical violations,[14] the MS finding that blacks

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[13]See Figure 1 for an illustration of this point.

[14]As Steen and Opsal (2007) point out, there are at least three theoretical reasons to expect discretion at the stage of parole revocation – parolees have fewer legal rights at this decision point than they do at earlier points, parole

recidivate at a much higher probability than whites could simply reflect potential prejudice by parole officers in the outcome measured, as opposed to their conclusion that the Parole Board is prejudiced against whites.

The data we use does not suffer from the above two shortcomings. First, our data set records both the date of release and the dates the minimum and maximum sentences would be completed. This allows us to precisely identify the inmates released between their minimum and maximum sentences. Second, our data records the reason (technical violation, minor crime or violent crime) a parolee is returned to prison. This allows us to examine which recidivism outcome best satisfies our model's testable implications. Indeed we find that the testable implications of our model are satisfied only if we use returning due to committing a violent crime as the measure of the recidivating outcome. This outcome also has the advantage that it is more likely to be objectively measured, because it is automatic that any individual convicted of a violent crime will be sent back to prison.

3 Criminal Sentencing and Parole Release in Pennsylvania[15]

All individuals in Pennsylvania convicted of a crime are sentenced by a judge who determines their minimum and maximum sentence.[16] If the offender receives a maximum sentence that is two or more years, they will be sent to prison, where they must serve at least their minimum sentence.[17] Once they have completed this, Pennsylvania's Parole Board, which consists of nine members appointed by the governor, has complete discretion over when to release them, up until they reach their maximum sentence.[18]

revocations are relatively invisible and are thus not subject to public scrutiny, and finally parole officers have to make revocation decisions based largely on their subjective assessment of the risk posed to the community by a parolee.

[15]Unless noted otherwise, the information regarding the parole release process described in this section comes from the website of Pennsylvania's Board of Probation and Parole: http://www.pbpp.state.pa.us/portal/server.pt/community/reports_and_publications/5358/publications/617822

[16]The judge is aided in their decision by the sentencing guidelines, which consist of a grid containing a range of suggested minimum sentences, where the offender's offense gravity score of their current offense is on one axis, and their prior record score (measuring their prior criminal activity) is on the other axis. Judges are not required to conform to these guidelines.

[17]Offenders with a maximum sentence of less than two years are sent to jail. The sentencing judge has discretion over when they are released.

[18]Once this is reached, they "max out" and must be released.

Approximately four months before the inmate completes their minimum sentence, board members and hearing examiners will review the inmate's file. The board uses this information to fill out the Parole Decisional Instrument form, which serves as a guideline for release. The instrument takes into account the type of conviction offense (non-violent or violent), the level of risk (low, medium, or high) of returning to prison for a new offense or violation according to the Level of Service Inventory-Revised (LSI-R),[19] institutional programming completion, and institutional behavior. The inmate receives scores for each of these four critical dimensions, which are summed up to calculate an overall score.[20] Scores from 2 to 6 "suggest parole", while scores of 7 or greater "suggest parole refusal".

The board is not bound by these guidelines when casting their vote, however, and can take into account other factors such as the recommendation of the sentencing judge, prosecuting attorney, and warden, as well as their general impression of the inmate during the parole interview. The decision makers for each case depend on the type of offense committed. For non-violent offenses, a hearing examiner and one board member will vote on the case. For violent offenses (except sex crimes and murder), two board members will vote on the case. The inmate must receive two affirmative votes to be granted parole. For murder and sex offenses, the full board reviews the case, and the majority of the board must approve the inmate's release. Approximately 70% of the final case decisions follow what the Parole Decisional Instrument recommends.

Individuals that are not granted parole are given a list of specific requirements to be fulfilled by the time of the next parole review, which is usually within six months to a year. Individuals that are granted parole are released and monitored by parole officers. They can be returned to prison if they have a technical violation of their parole requirements, or if they commit a new crime.[21]

The different reasons for a parolee being returned to prison likely have different consequences for the Parole Board. It is expected that a reasonable fraction of parolees will return due to technical violations or for committing minor crimes, and thus these returns are not likely to have any real consequences for the board's general review process. In contrast, parolees that return to prison

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[19]The LSI-R is a quantitative survey of offender attributes and their situation, and is designed to help predict recidivism.

[20]For example, an offender receives three points for serving a sentence for a violent offense, receives three points if they have an unacceptable program compliance, receives three points if the LSI-R considers them high risk, and receives five points if they have a record of serious misconduct in prison (Goldkamp, 2010).

[21]Common reason for technical parole violations include failure to report to a parole officer, carrying weapons, travelling too far from home, not maintaining employment, and failing drug and alcohol tests (Petersilia, 2003). Parolees receive an average of five violations before being returned to prison.

after committing a violent crime can have direct consequences for the Parole Board. For example, in 1995 an inmate on parole in Pennsylvania killed a police officer. In response to this, the governor demanded that the Parole Board tighten parole granting procedures, leading to a sharp decline in the number of individuals paroled.[22] A similar situation happened again in 2008, which led to the governor of Pennsylvania placing a temporary moratorium on all parole releases and launching a review into the parole release process. These anecdotes indicate that if the Parole Board were to release an offender that committed an excessively violent crime while on parole, it could lead to a critical review of their procedures. It is thus likely that the main cost factor the Parole Board is likely to consider when releasing an inmate is whether the inmate will commit a violent crime while on parole.[23] However, because the objective of the Parole Board is central to our test of racial prejudice, we will explicitly show evidence that this is their objective in Section 6.1.

4 A Model of the Parole Board's Behavior

In this section we propose a simple continuous-time learning model of the Parole Board which is adapted from the model developed in Bernhardt, Mongrain and Roberts (2010). We derive several implications and use these to test whether the Parole Board exhibits racial prejudice in their release decisions.

We model the Parole Board's behavior from the first moment inmate i becomes eligible for parole release, which occurs after they have served their minimum sentence $\underline{T}^i$. At that time the Parole Board observes a set of information which it uses in its parole release decision. Some of the information is also available to researchers, while some of it will not be. For example, information regarding the inmate's conviction (type of crime committed and the sentencing terms), and their basic demographics (gender, race and age) are observed in our data set; however, we do not observe any information that is likely contained in an inmate's prison dossier, including the behavior and incidents of the inmate while in prison and their general demeanor. We denote the information available to the Parole Board about inmate i at time $\underline{T}^i$ by $\left(r, c_{\underline{T}^i}\right)$ where r stands for the race of the inmate and $c_{\underline{T}^i}$ for all other information. For simplicity, we assume that the race of a prisoner is either white, denoted by W, or minority, denoted by M; i.e., $r \in \{W, M\}$.

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[22]See http://articles.philly.com/1995-08-24/news/25707662_1_grant-parole-parole-process-darlene-zelazny for more information.

[23]As further evidence of this, one of the stated missions of the Parole Board is public safety, which is mainly threatened when parolees commit violent crimes that involve victims.

Rehabilitated or Non-rehabilitated. We assume that once the inmate completes their minimum sentence they are either "rehabilitated" or "non-rehabilitated", and that their type does not change from that point on. In our model, there are two major differences between a rehabilitated and a non-rehabilitated inmate. First, a rehabilitated inmate will not recidivate during parole, while a race-r non-rehabilitated inmate will recidivate at Poisson arrival rate $g_r > 0$ if parole released. Second, when imprisoned, a race-r non-rehabilitated inmate will be involved in prison incidents at a Poisson arrival rate $\lambda_r > 0$; however, rehabilitated inmates will not be involved in prison incidents. Note that we allow the incident arrival rate for non-rehabilitated inmates to depend on their races.[24]

Parole Board's Payoffs, Belief Evolutions, and Release Decisions. At any time after inmate i has served their minimum sentence $\underline{T}^i$ and before their maximum sentence $\bar{T}^i$, the Parole Board needs to decide whether to keep the inmate imprisoned or grant parole release. Suppose that the cost of holding a prisoner for a particular time period is B, regardless of the race of the prisoner and whether they are rehabilitated.[25] The cost of releasing a non-rehabilitated inmate of race-r for a particular time period is $g_r C$, where g_r is the rate at which a non-rehabilitated race-r inmate will recidivate during that time period, and C is the cost to the Parole Board that results from the inmate recidivating. At this point, "recidivate" can mean either returning to prison for any reason (including technical violations), returning to prison for committing any new crime, or returning to prison for committing a violent/sex crime only. We will empirically determine which measure corresponds to the Parole Board's objective function in Section 6.1.

The Parole Board can also incur a *psychological cost* $D_r \geq 0$ of releasing a race-r prisoner before their maximum sentence is up, regardless of whether or not they are rehabilitated. If the Parole Board is prejudiced against a particular race of inmates they are likely to feel a higher psychological cost from releasing them early. This idea is summarized in the following definition:

Definition 1. *We say that the Parole Board is* prejudiced *against race-r inmates if* $D_r > D_{r'}$ *for* $r \neq r'$.

The costs associated with releasing a race-r prisoner for a particular time period is summarized in Table 1. We assume that $C > B > 0$ and $0 < B - D_r < g_r C$. These parameter restrictions

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[24]We can allow for the possibility that rehabilitated inmates can also be involved in prison incidents, but at rates lower than their non-rehabilitated counterparts. We discuss this case in Section 4.4. Our qualitative results are not affected by such generalizations.

[25]In the empirical section this time period corresponds to one month.

	Nonrehabilitated	Rehabilitated
In	B	B
Out	$g_r C + D_r$	D_r

Table 1: The Parole Board's Flow Costs from Race-r Inmates

imply that, if the Parole Board knows for certain that a prisoner is rehabilitated, it prefers that the inmate be released; on the other hand, if the Parole Board knows for certain that an inmate is non-rehabilitated, it prefers that the inmate be imprisoned.

Because a parolee will return to prison if they recidivate during parole, the Parole Board's decision of whether to release a prisoner on parole is simply to compare the cost of keeping them incarcerated for the next period with the cost of releasing them for the next period.[26] For the purpose of this comparison, let us denote by π_t^i the Parole Board's belief at time t that inmate i is of a rehabilitated type for some $t \geq \underline{T}^i$. (We will describe the evolution of the Parole Board's beliefs next.) The Board will release the prisoner on parole if and only if the cost of releasing them is lower than the cost of keeping them incarcerated for the next period:

$$\left(1 - \pi_t^i\right)\left(g_r C + D_r\right) + \pi_t^i D_r \leq B,$$
$$\Leftrightarrow \quad \pi_t^i \geq 1 - \frac{B - D_r}{g_r C} \equiv \pi_r^*. \tag{1}$$

Thus, the Parole Board will grant parole release to inmate i only if it is sufficiently confident that i has been rehabilitated. Importantly, the threshold π_r^* defined in (1) is increasing in D_r. This means that if the Parole Board is prejudiced against race-r inmates, they need to be more certain (probabilisticly) that race-r inmates are rehabilitated before granting parole release. We summarize the above discussion by the following proposition:

Proposition 1. *The Parole Board will grant parole release to a race-r inmate at the first point in time when its belief about the inmate being rehabilitated exceeds π_r^*.*

The Parole Board cannot perfectly know whether the prisoner is rehabilitated or not at the time of the parole decision. Instead it forms beliefs based on available information, beginning at the time

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[26]If the parolee does not recidivate during time period t, they will remain on parole for the next time period $t + 1$. When we discuss the evolution of the Parole Board's beliefs in the next section it will be evident that if it is profitable for the board to release the inmate for time period t and the inmate does not recidivate during t, it will be even more profitable for the board to release the inmate in period $t + 1$. Thus when deciding to release an inmate, comparing the costs and benefits for one time period t is all that matters.
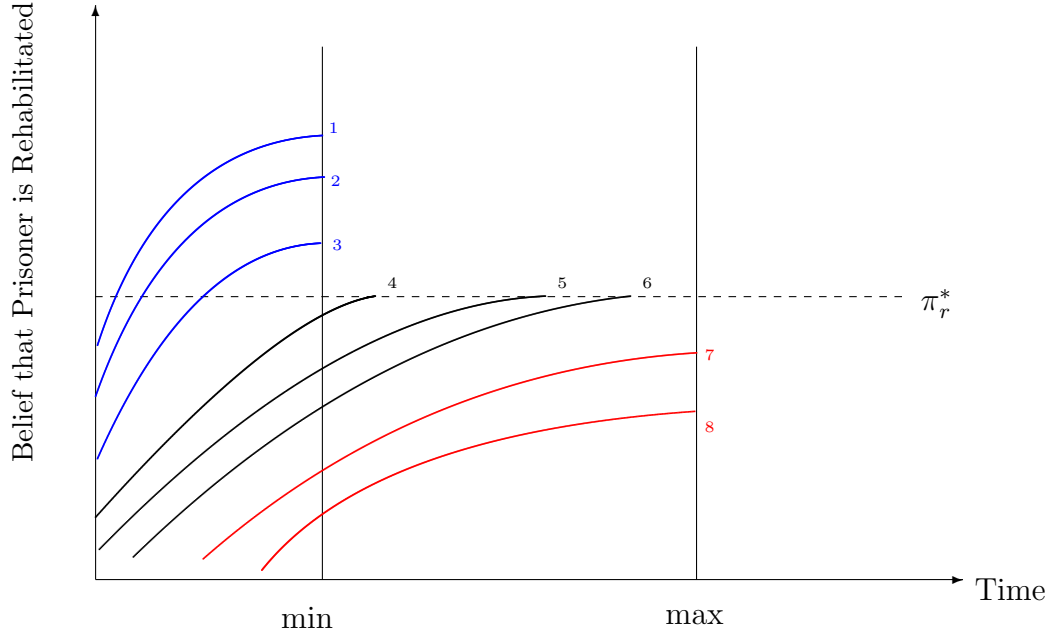
Figure 1: A Graphical Illustration of the Parole Board's Release Decisions.

period when prisoner i has just completed their minimum sentence $\underline{T}^i$. We denote $\pi^i_{\underline{T}} \equiv \pi\left(r^i, c^i_{\underline{T}}\right)$ as the Parole Board's belief given information $\left(r^i, c^i_{\underline{T}}\right)$ that the prisoner has been rehabilitated at time $\underline{T}^i$. Figure 1 shows the relationship between the evolution of the Parole Board's beliefs and their release decisions for eight race-r inmates who enter the prison with different characteristics.[27] The vertical axis measures the evolution over time of the Parole Board's beliefs that these prisoners are rehabilitated. In particular, for prisoners 1-3, upon completion of their minimum sentence $\underline{T}$, the Parole Board's belief that they are rehabilitated, $\pi^i_{\underline{T}}$, already exceeds the threshold π^*_r, and thus the Parole Board will release them immediately.

For prisoners 4-8, however, $\pi^i_{\underline{T}} < \pi^*_r$, and thus these inmates will not be released immediately at $\underline{T}^i$. Their specific time of release will then depend on the evolution of the Parole Board's belief of π^i. Recall that the Parole Board will use all available information about prisoner i at time t to form their belief π^i_t. Although most of this information is static (such as prisoners' demographics and crime committed), the one component that will change over time is whether or not they are involved in prison incidents. We now derive the differential equation that governs how π^i_t changes over time.

Consider a small interval of time Δ between t and $t+\Delta$. Because we assume that prison incidents

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[27]To keep the figure simple all eight prisoners have the exact same sentence, but this assumption has no impact on the results presented in this section.

arrive according to a Poisson process, we know that when Δ is small, there are two possible outcomes between t and $t+\Delta$: the first outcome is that an incident occurs in this time interval and the second outcome is that no incident occurs. If an incident occurs, then the belief of the Parole Board will immediately decrease to 0 and remain there up through $\overline{T}$, because only non-rehabilitated inmates will be involved in an incident. If no incident occurs, then the Parole Board will update its beliefs using Bayes' rule. Noting that a race-r nonrehabilitated inmate will have no incidents during time interval Δ with probability $e^{-\lambda_{r_i}\Delta}$, we have:

$$\pi^i_{t+\Delta} = \frac{\pi^i_t}{\pi^i_t + (1 - \pi^i_t)\, e^{-\lambda_{r_i}\Delta}}.$$

Thus, the evolution of the Parole Board's posterior belief if no incidents have occurred through $t + \Delta$ is governed by the following differential equation:

$$
\begin{aligned}
\dot{\pi}^i_t &= \lim_{\Delta \to 0} \frac{\pi^i_{t+\Delta} - \pi^i_t}{\Delta} \\
&= \lim_{\Delta \to 0} \frac{\pi^i_t\left(1 - \pi^i_t\right)}{\pi^i_t + (1 - \pi^i_t)\, e^{-\lambda_{r_i}\Delta}} \frac{\left(1 - e^{-\lambda_{r_i}\Delta}\right)}{\Delta} \\
&= \lambda_{r_i} \pi^i_t \left(1 - \pi^i_t\right).
\end{aligned}
\tag{2}
$$

Note that $\dot{\pi}^i_t > 0$, which means each time period in which prisoner i doesn't have an incident the Parole Board will increase its probability assessment that prisoner i is rehabilitated. This corresponds to the evolution of beliefs for prisoners 4-8 being drawn as upward sloping.

If inmate i has not been involved in any incident from $\underline{T}$ up through time t, then we solve the differential equation (2) to find an expression for π^i_t:

$$\pi^i_t = \frac{1}{1 + \frac{1 - \pi^i_{\underline{T}}}{\pi^i_{\underline{T}}} e^{-\lambda_{r_i} t}} \tag{3}$$

Proposition 2. (Parole Board's Belief Evolution) *If the Parole Board's initial belief that inmate i is of rehabilitated type is $\pi^i_{\underline{T}}$, and the inmate is not involved in any incident from time $\underline{T}$ to time t, then the Parole Board's posterior belief at t is given by (3).*

As stated in Proposition 1, the Parole Board will want to release prisoner i the moment π^i_t hits π^*_r. We can find this optimal release time, denoted t^*_i, by equating π^i_t with π^*_r and solving out for t:

$$t^*_i\left(\pi^i_{\underline{T}}\right) = \frac{\ln\left(\frac{1 - \pi^i_{\underline{T}}}{\pi^i_{\underline{T}}}\right) - \ln\left(\frac{1 - \pi^*_{r_i}}{\pi^*_{r_i}}\right)}{\lambda_{r_i}}. \tag{4}$$

If this point in time occurs after the prisoner's maximum sentence $\overline{T}$, the Parole Board will be constrained to release them upon completion of $\overline{T}$. This is the case for prisoners 7 and 8 in Figure

14

1. If this point in time occurs between the prisoner's minimum and maximum sentences, as is the case for prisoners 4-6, the Parole Board will release them exactly at $t_i^*\left(\pi_{\underline{T}}^i\right)$. The following proposition summarizes the Parole Board's release decisions:

Proposition 3. *(Characterization of the Release Time) Let the Parole Board's initial belief about race-r inmate i being of rehabilitated type be $\pi_{\underline{T}}^i$. Assuming inmate i has no incidents in prison after $\underline{T}$, the Parole Board's release schedule is as follows:*

- *If $\pi_{\underline{T}}^i \geq \pi_r^*$, inmate i is released at $\underline{T}$.*

- *If $\pi_{\underline{T}}^i < \pi_r^*$ and $\underline{T} < t_i^*\left(\pi_{\underline{T}}^i\right) < \overline{T}$, inmate i is released at $t_i^*\left(\pi_{\underline{T}}^i\right)$.*

- *If $\pi_{\underline{T}}^i < \pi_r^*$ and $t_i^*\left(\pi_{\underline{T}}^i\right) \geq \overline{T}$, inmate i is released at $\overline{T}$.*

An important implication of the model is that all race-r prisoners released *between* $\underline{T}$ and $\overline{T}$ will have a probability of being rehabilitated that is exactly π_r^*. As is evident from Figure 1 this is not the case for those released at either $\underline{T}$ and $\overline{T}$. Among race-r prisoners released at the completion of their minimum sentence, there is a substantial amount of heterogeneity in their probability of being rehabilitated at the time of their release. The same is true among race-r prisoners released at their maximum sentence.

Reasons for Racial Differences in Sentence Served   The framework of the model also allows us to see the various reasons inmates of different races serve different proportions of their sentences. The first case we consider is a racially prejudiced Parole Board. For ease of exposition, assume for now that λ and g are the same across races. As discussed in Section 4, if the Parole Board is racially prejudiced against minority inmates they will require them to have a higher probability of being rehabilitated than white inmates (i.e. $\pi_M^* > \pi_W^*$). Figure 2(a) shows the effects of this on two inmates, one white and one minority, who have exactly the same characteristics (and are thus represented by the same π_t^i curve). As is evident from the figure, $t_W^* < t_M^*$, and thus the minority inmate will be forced to serve more of their sentence than the identical white inmate.

Disparities in time served can also arise from statistical discrimination, which occurs when there is crucial information that is unobservable to the Parole Board, and is correlated with inmate race. It will be efficient for the Parole Board to proxy for this unobservable information by taking an inmate's race into account. If, on average, minorities are known to rate worse with respect to this unobservable information, statistical discrimination will result in the Parole Board having a lower initial probability of a minority inmate being rehabilitated than they will have of an observationally

(a) When $\pi_t^W = \pi_t^M$, but $\pi_W^* \neq \pi_M^*$ (b) When $\pi_W^* = \pi_M^*$, but $\pi_t^W \neq \pi_t^M$
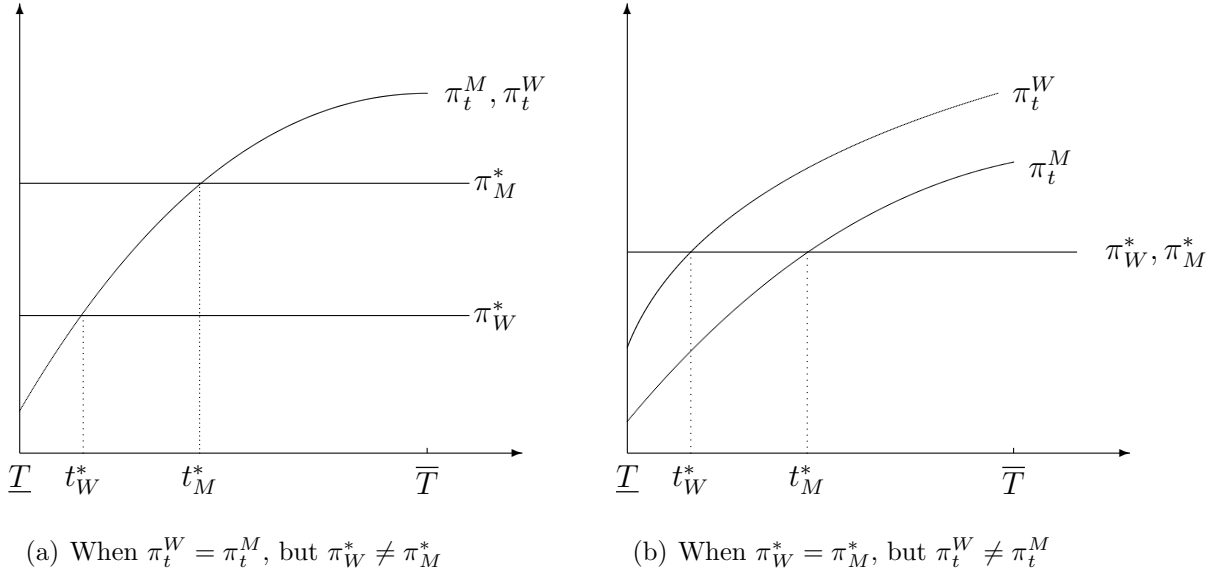
Figure 2: Reasons for Racial Differences in Sentence Served.

equivalent white inmate. As shown in Figure 2(b), the Parole Board will then require more incident-free time of minorities before they hit the release threshold.

If the parameters λ and g are differ across races, it will be efficient for the Parole Board to take these differences into account, which will again lead to observationally equivalent individuals serving different amounts of their sentences. Because the Parole Board uses this information out of efficiency purposes (and not racial prejudice), this is another manifestation of statistical discrimination.

Finally, an omitted variables problem will also result in us observing racial differences in time served. This is different than both racial prejudice and statistical discrimination, because in both of the above cases, researchers have access to the same information the Parole Board does, but will still find racial differences in time served using a regression framework. With an omitted variables problem, we can find racial differences in time served simply because we cannot control for all of the factors the Parole Board takes into account in making release decisions.

The above analysis makes clear that a valid test for racial prejudice cannot rely on time served, because racial prejudice, statistical discrimination, and an omitted variables problem all have the same implications on time served. In the next section we will develop a test that does not have this problem.

4.1 Test for Racial Prejudice

Given the difficulty mentioned above in using the racial disparities of the parole release time as indications of racial prejudice, we instead use an outcome test. This test requires an outcome that can be identified with available data, and where taste and statistical discrimination have different impacts. If we restrict ourselves to looking at inmates that are released between their minimum and maximum sentences, the outcome that satisfies both of these requirements is the inmate's expected rate of recidivism on parole, defined as $(1 - \pi_r^*)\, g_r$. Recall that this rate is the same for everyone within a race because the Parole Board strategically releases every race-r inmate at the time their probability of being rehabilitated is exactly π_r^*.

Plugging in the expression of π_r^* from (1), we have

$$(1 - \pi_r^*)\, g_r = \frac{B - D_r}{C}. \tag{5}$$

Thus, the only reason the expected rate of recidivism will differ across races occurs if D differs across races, which happens if racial prejudice is present. Intuitively, with statistical discrimination, the Parole Board will take race into account when making release decisions, but they do so in such a way that the expected rate of recidivism across all races is the same. When the Parole Board is racially prejudiced against race-r inmates, they will require them to serve longer than is optimal and they will thus recidivate at a lower expected rate.[28]

Although we can't identify the expected rate of recidivism directly, we can indirectly estimate this by exploiting the fact that this rate affects the probability an individual will recidivate while on parole. Specifically, because only non-rehabilitated types will recidivate, and they will do so at Poisson arrival rate $g_{r_i} > 0$, the probability that inmate i will recidivate *at least once* during parole is:

$$\left(1 - \pi_{r_i}^*\right) \left[1 - e^{-g_{r_i}\left(\bar{T}_i - t_i\right)} \right]. \tag{6}$$

---

[28]Note that the probability that parolees are rehabilitated, π_r^*, would not satisfy the outcome test requirement because both racial prejudice and statistical discrimination can lead to π_r^* differing by race. In our model, different race parolees can have different rehabilitation thresholds set due to racial prejudice. However, they can also have different thresholds set due to differences in g_r, the rate at which non-rehabilitated race-r inmates recidivate. For example, if non-rehabilitated minority inmates are known to recidivate at a higher rate than non-rehabilitated white inmates, the Parole Board will rationally respond by making minorities reach a higher probability of being rehabilated before they can be released. This statistical discrimination will result in both racial groups having the same recidivism rate, although minorities will have a higher probability of being rehabilitated upon release.

where $\bar{T}_i - t_i$ is inmate i's time on parole. (Note that recidivating at least once on parole is synonymous with recidivating on parole.) If we approximate the expression in (6) using a second Taylor expansion of $e^{-g_{r_i}(\bar{T}-t)}$, we can explicitly see how the probability of recidivism depends on the rate of recidivism:

$$
\begin{aligned}
\left(1 - \pi^*_{r_i}\right)\left[1 - e^{-g_{r_i}\left(\bar{T}_i - t_i\right)}\right] &\approx \left(1 - \pi^*_r\right)\left\{1 - \left[1 - g_{r_i}\left(\bar{T}_i - t_i\right) + g^2_{r_i}\left(\bar{T}_i - t_i\right)^2\right]\right\} \\
&= \left(1 - \pi^*_r\right)g_{r_i}\left(\bar{T}_i - t_i\right) - \left(1 - \pi^*_r\right)g^2_{r_i}\left(\bar{T}_i - t_i\right)^2 \quad (7) \\
&= \frac{B - D_r}{C}\left(\bar{T}_i - t_i\right) - \frac{B - D_r}{C}g_{r_i}\left(\bar{T}_i - t_i\right)^2. \quad (8)
\end{aligned}
$$

where the last equality follows from plugging in the expression of π^*_r from (1). We can estimate (8) using a standard regression framework. Note that the estimated coefficient on the time on parole will identify $\frac{B-D_r}{C}$, which is the expected rate at which race-r recidivates. To estimate the rate for each race separately, we run the following regression:

$$
\begin{aligned}
\text{RECIDIVATE}_i &= \alpha_1 * \left(\bar{T}_i - t_i\right) + \beta_1 * \text{MINORITY}_i * \left(\bar{T}_i - t_i\right) \\
&\quad + \alpha_2 * \left(\bar{T}_i - t_i\right)^2 + \beta_2 * \text{MINORITY}_i * \left(\bar{T}_i - t_i\right)^2 + \varepsilon_i, \quad (9)
\end{aligned}
$$

where RECIDIVATE_i is an indicator for whether the parolee recidivates during their parole, and MINORITY_i is an indicator for whether inmate i is a minority.[29] The coefficient α_1 is our estimate of the expected recidivism rate for whites, while $(\alpha_1 + \beta_1)$ is the expected recidivism rate for minorities. Recall that if the Parole Board is racially prejudiced against minorities it will result in minority inmates having a lower expected recidivism rate. Thus, our test for racial prejudice will be whether $\beta_1 < 0$.

It is important to note that the only reason we can use (9) to estimate the recidivism rate for race-r inmates is because all inmates of race r are released with the same π_r. This ensures that the coefficient on $\left(\bar{T}_i - t_i\right)$ is race-specific, and thus can be estimated. If instead individuals within a race were released at different π's the coefficient would be individual-specific and could not be estimated. This issue is more generally known as the infra-marginality problem and is a common problem for outcome tests. We avoid this problem because in our context the Parole Board can perfectly adjust the treatment variable (time served) to ensure that everyone has the same rate. This point also highlights why our test is not valid for those who are released at their minimum or maximum sentence, since those inmates are released with various rates of rehabilitation.

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[29]In the estimation section we will estimate this for separately for blacks and Hispanics.

4.2 Identifying Other Parameters of the Model

While the main interest of our empirical investigation is to test for racial prejudice, it is also interesting to note that the coefficient estimates from regression (9) also allow us to identify other key parameters of the model, such as g_r and π_r^* as follows:

- We can estimate g_W and g_M by

$$\widehat{g_W} = -\frac{\widehat{\alpha_2}}{\widehat{\alpha_1}}; \quad \widehat{g_M} = -\frac{\widehat{\alpha_2} + \widehat{\beta_2}}{\widehat{\alpha_1} + \widehat{\beta_1}}. \tag{10}$$

- With g_W and g_M estimated as above, we can recover π_W^* and π_M^* using (5) as:

$$\widehat{\pi_W^*} = 1 - \frac{\widehat{\alpha_1}}{\widehat{g_W}}; \quad \widehat{\pi_M^*} = 1 - \frac{\widehat{\alpha_1} + \widehat{\beta_1}}{\widehat{g_M}}. \tag{11}$$

In Section 6.3 we will present our estimates of g_r and π_r^* based on our regression.[30]

4.3 Testable Implications of the Model

Because our test for prejudice comes directly from our model, it is important to run some validity checks. In this section, we delineate several implications of the model that can be directly tested. These checks will also help determine the correct measure of recidivism to use, as we will only use the measure that simultaneously satisfies all of the proposed tests.

The first testable implication is based off the probability a race-r inmate released between $\underline{T}$ and $\overline{T}$ recidivates within a certain time period T:

$$(1 - \pi_r^*) \left[1 - e^{-g_r(T)} \right] \tag{12}$$

This expression is similar to (6), except now the time window over which we examine the recidivism probability is the same for everyone and is not inmate specific. Recall that any race-r inmate released exactly at $\underline{T}$ should have a rehabilitation probability π_i that is at or above π_r^*. This means the average probability of recidivating within T among all race-r inmates released at $\underline{T}$ should be lower than the average among race-r inmates released between $\underline{T}$ and $\overline{T}$ (which is given by (12)). Likewise, among race-r inmates released at $\overline{T}$, $\pi_i \leq \pi_r^*$, implying their average probability of

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[30]The standard errors for $\widehat{g_r}$ and $\widehat{\pi_r^*}$ are obtained using the delta method.

recidivating within T should be greater than for the group released between $\underline{T}$ and $\overline{T}$. To test this claim, we pool this result across races for simplicity and run the following regression:

$$\text{RECIDIVATE-T}_i = \delta_0 + \delta_1 * \text{MIN-SENTENCE}_i + \delta_2 * \text{MAX-SENTENCE}_i + \varepsilon_i, \qquad (13)$$

where RECIDIVATE-T_i is an indicator for whether inmate i recidivates within T, and MIN-SENTENCE_i and MAX-SENTENCE_i are indicators for whether inmate i is released upon completion of their minimum sentence or maximum sentence, respectively. The omitted group are inmates released between $\underline{T}$ and $\overline{T}$. Our model predicts $\delta_1 < 0$ and $\delta_2 > 0$.

The second testable implication is based off (8), and only applies to the individuals released between $\underline{T}$ and $\overline{T}$. This equation implies that the probability a race-r inmate recidivates on parole is positively related to their time on parole, and is negatively related to the square of time on parole. The positive relationship between time on parole and the probability of recidivism on parole is quite intuitive: since all race-r inmates are released with the same rate of recidivism, we would expect that the longer they are on parole, the more likely they will be to recidivate on parole.

Equation (8) also implies that the only way race should be related to the probability of recidivism on parole comes through its interaction with time on parole. Thus, any race indicator variable that is included should have a coefficient of 0. Likewise, the total time inmates spend in prison is also not included in (8), implying this variable should have no effect on the probability of recidivism on parole.

To test all of these implications we run the following regression:

$$\text{RECIDIVATE}_i = \theta_0 + \theta_1 * \text{MINORITY}_i + \theta_2 * \text{TIME-SERVED}_i + \theta_3 * \left(\bar{T}_i - t_i\right) + \theta_4 * \left(\bar{T}_i - t_i\right)^2 + \varepsilon_i, \quad (14)$$

where, as before, RECIDIVATE_i is an indicator for whether the parolee recidivates during their parole, and TIME-SERVED_i is the amount of prison time inmate i serves . Note that for simplicity we have pooled the coefficients on parole time across all races. Our model predicts $\theta_0 = \theta_1 = \theta_2 = 0, \theta_3 > 0$, and $\theta_4 < 0$.

A final check of our model occurs when we use our estimates from (9) to calculate $\widehat{\pi_r^*}$ (as shown by equation (11)). Since we do not restrict $\widehat{\pi_r^*}$ to be strictly between 0 and 1 in our regression, reasonable estimates for $\widehat{\pi_r^*}$ as implied by our regression coefficients should also be considered as supportive evidence for our model.

4.4 Discussion

The basic model above is rather general in several aspects. For example, our test allows the probability of non-rehabilitated inmates being involved in prison incidents, λ_r, to differ by race; it also allows the probability that non-rehabilitated types commit crime when released, g_r, to differ by race. Here we explain that the key idea of our test still works in even more general environments.

Possible Prison Incidents for Rehabilitated Prisoners. In the basic model we assumed that only nonrehabilitated inmates would be involved in prison incidents. Now suppose that rehabilitated prisoners can also be involved in such incidents, but at a lower rate than non-rehabilitated types. Specifically, suppose that race-r inmates are involved in prison incidents with Poisson arrival rate λ_{1r} if they are non-rehabilitated, and λ_{0r} they are rehabilitated with $\lambda_{1r} > \lambda_{0r} \geq 0$.

Similarly to the derivation of the belief evolution equation (2), we can show that, if there is no occurrence of incident at time t, then the Parole Board's belief that i is rehabilitated evolves according to:

$$\dot{\pi}_t^i = (\lambda_{1r_i} - \lambda_{0r_i}) \pi_t^i \left(1 - \pi_t^i\right). \tag{15}$$

Note that (15) coincides with (2) when $\lambda_{0r_i} = 0$.

On the other hand, if an incident occurs at time t, the Parole Board's revision of its belief about the inmate will not jump down to zero as in the basic case where $\lambda_{0r} = 0$. However, the posterior will still exhibit a discrete downward jump whose magnitude is derived as follows. Consider a short time interval between t and $t + \Delta$. If an incident occurs in the interval, then $\pi_{t+\Delta}^i$ can be obtained using Bayes' rule as:

$$\pi_{t+\Delta}^i = \frac{\pi_t^i \left[1 - e^{-\lambda_{0r_i}\Delta}\right]}{\pi_t^i \left[1 - e^{-\lambda_{0r_i}\Delta}\right] + (1 - \pi_t^i) \left[1 - e^{-\lambda_{1r_i}\Delta}\right]}.$$

Thus,

$$
\begin{aligned}
\lim_{\Delta \to 0} \left(\pi_{t+\Delta}^i - \pi_t^i\right) &= \lim_{\Delta \to 0} \frac{\pi_t^i (1 - \pi_t^i) \left(e^{-\lambda_{1r_i}\Delta} - e^{-\lambda_{0r_i}\Delta}\right)}{\pi_t^i \left[1 - e^{-\lambda_{0r_i}\Delta}\right] + (1 - \pi_t^i) \left[1 - e^{-\lambda_{1r_i}\Delta}\right]} \\
&= \frac{(\lambda_{0r_i} - \lambda_{1r_i}) \pi_t^i (1 - \pi_t^i)}{\pi_t^i \lambda_{0r_i} + (1 - \pi_t^i) \lambda_{1r_i}}.
\end{aligned} \tag{16}
$$

Note that the expression (16) implies that $\lim_{\Delta \to 0} \left(\pi_{t+\Delta}^i - \pi_t^i\right) = -\pi_t^i$ when $\lambda_{0r_i} = 0$, which coincides with our basic case where following an incident the Parole Board's posterior belief jumps down to zero.

Therefore, in this extended environment where rehabilitated inmates may also be involved in prison incidents, the Parole Board's evolution of beliefs becomes more complicated as it goes up

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continuously with episodes of no incidents, but exhibits a discrete downward jump following any incident. The more complicated belief evolution makes it impossible to provide an analytical expression of the release time $t_i^* \left(\pi_{\underline{T}}^i \right)$ as we provided in (4); in the extended model, the release time t_i^* will not only depend on the Parole Board's initial belief $\pi_{\underline{T}}^i$ about inmate i, but also depend on the complete incident/no incident history of inmate i. Nonetheless, at whatever time t_i^* inmate i is released (if they are released at all between $\underline{T}_i$ and $\bar{T}_i$), it must satisfy:

$$\pi_{t_i^*}^i = \pi_{r_i}^*$$

where $\pi_{r_i}^*$ is characterized in (1). The effect of this generalization on Figure 1 is that the time paths for the belief evolutions will stochastically exhibit discrete downward jumps. However, the key feature for our test – that prisoners who are released in between their minimum and maximum sentences are all released at the rehabilitation belief threshold π_r^* – remains valid.

5 Data

We use data from the Pennsylvania Department of Corrections on all individuals who were released from prison on or after January 1, 1996, and whose maximum sentence ended by December 31, 2001. The data includes individuals who were released before the completion of their maximum sentence and were thus on parole from their release date until their maximum sentence expired; it also includes individuals who were released at the completion of their maximum sentence and thus spent no time on parole. We restrict the data set to individuals who were new court admissions when they first entered our data set and who were either white, black, or Hispanic males. We are left with a total of 14,309 individuals.

For each of the above individuals we observe their sentence lengths (minimum and maximum) prescribed by the judge, admission date, release date, the dates their minimum and maximum sentences are completed, name, state identification number, date of birth, and main offense committed.[31]

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[31]The date the minimum sentence is completed is often different than just the sum of the prison admission date and the minimum assigned sentence. Many individuals that cannot afford bail (or are deemed too risky) spend time in jail while they are awaiting formal sentencing, and get credit for this time served once the formal sentence is handed down. Having the date the minimum sentence is completed allows us to accurately identify individuals that are released right after serving their minimum sentence (by comparing the prison release date with the minimum sentence completion date). It also allows us to accurately calculate time served as the minimum assigned sentence plus the difference between the prison release date and the minimum sentence completion date.

We also observe whether, upon release, they returned to prison by March 31, 2009. We have information on the date of this return, as well as the reason for the return: whether it was for a new crime committed or a technical parole violation. This information allows us to determine if an individual committed a new crime on parole, but does not tell us whether this new crime committed is a violent/sex crime.

To determine the nature of the new crime committed while on parole we matched the individuals in our data set who returned to prison due to committing new crimes to data from the Pennsylvania Sentencing Commission, which is a data set produced annually and includes information on all individuals sentenced in that year.[32] We were able to match about half of the relevant individuals in this manner.[33] We attempted to match the remaining individuals by manually looking up their criminal records online on a website managed by Pennsylvania's Unified Judicial System.[34, 35]

[Table 2 About Here]

Table 2 provides some descriptive statistics of our sample both overall and stratified by race. 37% of our sample is white, 51% is black, and 13% is Hispanic. The majority of individuals released are age 45 or under. While we have information on the exact crime the individual committed to get into prison, the Parole Board's decision process seems to primarily consider whether this crime was either a violent or sexual offense, and thus this is the measure of crime type we use.[36] The percentage of individuals who committed a violent or sex crime varies significantly by race: 43% of whites commit a violent or sex crime, while this proportion is 37% for blacks and only 20% for Hispanics. The sentence length variable shows the minimum and maximum sentences handed down

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[32]Note that we only need to match up individuals that have committed a new crime while on parole.

[33]Individuals were matched to the year of the sentencing data that corresponded to the year in which they returned to prison. Individuals were matched based on either their State Identification Number or a combination of their name and date of birth if the State Identification Number was missing. The main reason we could not match so many individuals is that their year of return to prison is often different than the year in which they were sentenced. This can happen if they are immediately returned to prison upon arrest, but are convicted and sentenced at a later time.

[34]See http://ujsportal.pacourts.us/DocketSheets/CP.aspx

[35]There were still a small fraction of individuals that could not be matched in this way, which amounted to 2.2% of the total observations, and they were dropped from the data set. The majority of these individuals could not be matched because while they were charged with a crime, the charges were ultimately dropped. These individuals were likely returned to prison the moment they were charged with a crime, but released when the charges were dropped. For the rest of the individuals, there was either no record of the individual online, or no record of conviction that coincided with the return date to prison.

[36]We obtained a list of crimes from the Parole Board that they consider to be violent or sexual.

by the sentencing judge. On average, individuals are given a sentence with a minimum of 24 months and a maximum of 55 months. There is not too much racial variation in these initial sentences, although both blacks and Hispanics are assigned slightly shorter sentences than whites.

The release group and sentence served variables reflect how much of the assigned sentence individuals were required to serve. 18% of the sample were released upon completion of their minimum sentence, 45% were released at some point between their minimum and maximum sentence, and 37% were not released until the completion of their maximum sentence. On average, individuals served 75% of their maximum sentence. Note that the standard deviation of the proportion served is .251, which implies there is a decent amount of variation among sentence served. Both whites and blacks served about five percentage points more of their maximum sentence than Hispanics did, although, as discussed earlier, racial comparisons of these variables do not make a good test of Parole Board prejudice.

The parole violation variable shows the proportion of people that violated parole. Because individuals that were released at their maximum sentence spent no time on parole (and thus mechanically could not violate their parole) they were excluded from this part of the analysis. 60% of individuals that were released at some time before the completion of their maximum sentence did not violate parole, 31% violated parole by committing a technical violation, 7% violated parole by committing a new crime that was neither a violent nor a sexual crime, and 1% violated parole by committing a new crime that was either violent or sexual.[37] Interestingly, while there is a decent amount of racial variation among the first three categories (with blacks being more likely to violate parole due to a technical violation than either whites or Hispanics), there is almost no racial difference in the percent of individuals that violate parole by committing a violent or sexual crime. These results imply that the measure of recidivism used in the objective function of the Parole Board can have a large effect on the findings.

6 Empirical Analysis

6.1 Testing Model Implications

Before implementing our test for prejudice, we first test the predictions of our model that were outlined in Section 4.3. The purpose of this is two-fold. First, it is important to present empirical

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[37]Note that by "committed" a crime, we mean the individual was convicted of said crime, as opposed to just being charged with it.

support for our model, because the validity of the test for prejudice is based on the validity of the model. Second, running these model checks also helps determine which measure of recidivism enters the Parole Board's objective function. We consider three different definitions of a recidivating event: "*Any Violent Crime*" denotes returning to prison due to committing a violent or sex crime, "*Any New Crime*" denotes returning to prison due to committing any new crime, and "*Any Return*" denotes a return to prison for any reason (i.e., either committing any new crime or a technical parole violation). The recidivism measure that satisfies all model checks is the measure we will use in our test for prejudice.

We first run the test specified in (13). This determines whether individuals released between their minimum and maximum sentences have a higher probability of recidivating within a certain time period than individuals released at their minimum sentence and a lower probability than those released at their maximum sentence. We set the time period over which we measure recidivism as 18 months.[38] Table 3 presents the results from estimating (13) using OLS. The three columns correspond to the three potential definitions of recidivism and are indicator variables for whether the inmate committed the relevant offense within 18 months of release. Specification (3) uses the full sample of individuals described in Table 1. However, due to how recidivism is defined in Columns (2) and (3) we lose individuals in those specifications. For example, Column (2) defines recidivism as returning to prison due to committing any crime within 18 months of release. However, there are some individuals that are returned to prison within that time frame for committing a technical parole violation. We drop these individuals from the sample, as we have no way of knowing if they would have committed a new crime if we had been able to observe them for the full 18 months. Likewise, in Column (1) we drop all individuals that returned to prison within 18 months for committing either a non-violent crime or a technical parole violation.

[Table 3 About Here]

Column (1) shows that if recidivism is defined as "*New Violent Crime*", the model's predicted order of recidivating rates is affirmed: inmates released at the completion of their minimum sentence

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[38]While this time frame is arbitrary, there are two factors which affected our decision. The first is that since one measure of recidivism, returning to prison due to committing a violent or sex crime, is such a rare event it is difficult to estimate this probability accurately if we use too short of a time period. However, the longer time frame we use the more individuals that will have recidivated. Recall that we have to manually match up these individuals using the process described in Section 5 to determine their new crime. In order to prevent having to look up too many individuals, we avoid using too long of a time period.

are .8 percentage points less likely to return for a new violent crime than individuals released between their minimum and maximum sentences (who had a .014 probability of doing this). Inmates released at the completion of their maximum sentence are 1.2 percentage points more likely to return for a new violent crime than the reference group. Columns (2) and (3), however, show that the predicted order of recidivism rates is not affirmed by the data if we were to use either "*Any New Crime*" or "*Any Return*" as the defining recidivating event. For both of these definitions we find that inmates released after completing their maximum sentence recidivate at a lower rate than inmates released between their minimum and maximum sentences.[39]

We next run the test specified in (14). Recall that this equation regresses whether or not an inmate recidivates *on parole* on their race, time served and time on parole to determine if the signs of the estimated coefficients match the predictions from the model. One issue that appears when running this regression is that a parolee is returned to prison whenever the first trigger event occurs (which can be either a technical violation, committing a new non-violent crime, or committing a new violent crime). Thus, if a parolee returns to prison because of a technical violation, they are no longer able to commit non-violent and violent crimes, but this does not mean that the parolee would not have committed either crime type if they were still on parole. To deal with this issue, we define, for a given definition of recidivating event, the corresponding *exposure time* as the relevant time a parolee is exposed to the risk of committing the particular recidivating event. Specifically,

- If the recidivating event is defined to be "*New Violent Crime*," then the exposure time will be the parole time (maximum sentence date minus parole release date) if the parolee does not return to prison for technical violations or new non-violent crimes; however, if the parolee returns to prison before parole time ends due to either technical violations or new non-violent crimes, then the exposure time for this parolee to the risk of committing a new violent crime is defined to be the difference between their readmission date and the parole release date.

- Similarly, if the recidivating event is defined to be "*Any New Crime*", then the exposure time is defined to be the parole time if the parolee does not return to prison for a technical violation; however if they are returned for a technical violation, the exposure time is defined

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[39]This result is not surprising for the "*Any Return*" recidivism definition because inmates released at the completion of their maximum sentence cannot commit a technical parole violation (since they never go on parole). This means there are less ways for them to recidivate than inmates released before their maximum sentence. Because of this issue, we can't use the negative coefficient as evidence against using "*Any Return*" as our definition of recidivism. However, the next model check will definitively show that "*Any Return*" is not a viable measure.

to be the difference between their readmission date and the parole release date.

- Finally, if the recidivating event is defined to be "*Any Return*", then the exposure time is simply the parole time.

Table 4 presents the results from the test specified in (14), where "*Exposure Time*", has now replaced parole time. Both "Exposure_Time" and "Time_Served" are measured in months. Recall that (14) is only a valid test of the model if we use prisoners released in between their minimum and maximum sentences, and thus the sample used in Table 4 is substantially smaller than that for Table 3. For each definition of recidivism we report results from three specifications. Specifications 1, 4 and 7 only include race dummies and Time_Served; and specifications 2, 5 and 8 also include Exposure_Time linearly; finally specifications 3, 6 and 9 also includes Exposure_Time^2. Recall that the key implications of our model are that the constant and the coefficients on the race indicators and Time_Served should be zero, while the coefficient for Exposure_Time should be positive and the coefficient for Exposure_Time^2 should be negative. Although these are very strong predictions, it can be seen that the data is consistent with all of them if we define the recidivating event as "*New Violent Crime*". In contrast, if we use other definitions of recidivism, our model's predictions are not affirmed in the data. Specifically, if we use either the "*Any New Crime*" or "*Any Return*" definition of recidivism, we find the coefficients on the black indicator variables to be positive and the coefficient on Time_Served to be negative; all are statistically significant. We consider this as the additional evidence suggesting that our model is plausible only if we use "New Violent Crime" as the recidivating event that enters the Parole Board's objective function.

[Table 4 About Here]

6.2 Main Result: Test for Racial Prejudice

We have shown all of our model's rather strong testable implications are supported if we define recidivism as "*New Violent Crime.*" We now implement the test implied by the model to determine whether there is evidence that racial prejudice plays any role in the Parole Board's discretionary parole release decisions.

[Table 5 About Here]

The regressions reported in Table 5 correspond to the test outlined in (9), with the exception that we again substitute exposure time for parole time. Specifically, we regress whether an inmate recidivates during parole on "Exposure_Time" and "Exposure_Time^2", where both variables

Parameter	Estimate	Std. Err.	Parameter	Estimate	Std. Err.
g_W	0.00243	0.0121658	π_W^*	0.6023058	1.84667
g_B	0.008122***	0.0020492	π_B^*	0.823095***	0.0435659
g_H	0.0133142***	0.0024218	π_H^*	0.9279218***	0.0262447

Table 6: Auxiliary Estimates of g_r and π_r^* Based on Coefficient Estimates from Table 5.

are fully interacted with race. Column (1) uses "*New Violent Crime*" as the recidivism measure and, as such, presents our main results. Recall that the coefficient on exposure time for each race will define their respective recidivism rates. Because both Exposure_Time*Black and Exposure_Time*Hispanic have statistically insignificant coefficients, this implies all races recidivate at statistically the same rate. Thus, our test implies no evidence of racial prejudice.

Columns (2) and (3) report analogous regression results using "*Any New Crime*" and "*Any Return*", respectively, as the measure of recidivism. As the results from Section 6.1 showed, our model is not consistent with either of these definitions of recidivism. However, we present the results to show what the conclusion would have been if these recidivism measure had been used instead. In both of these specifications, blacks are recidivating at a higher rate than whites, which would have led us to conclude that the Parole Board discriminates against whites in favor of blacks.

6.3 Auxiliary Estimates

In Table 6, we report the auxiliary estimates of g_r and π_r^* using the expressions (10) and (11) based on the coefficient estimates for "Exposure Time" and "Exposure Time^2" for each race from Column (1) of Table 5. We calculate the standard errors of these auxiliary estimates using the delta method.

Table 6 shows that the implied π_W^* is about 0.60 (though it is not precisely estimated), meaning that the Parole Board is willing to release a white prisoner on parole if the assessed probability that the prisoner is rehabilitated is at least 0.6. In contrast, the threshold for releasing blacks, π_B^*, is precisely estimated to be about 0.82 and the threshold for releasing Hispanics is also precisely estimated to be 0.93. However, due to the large standard error for π_W^*, the hypothesis that $\pi_W^* = \pi_B^* = \pi_H^*$ can not be statistically rejected (the p-value is 0.1181).

On first glance, one may interpret the rather different release thresholds π_r^* used by the Parole Board as evidence for prejudice. However, note that in our model the release threshold π_r^* is set not so that all races are rehabilitated at the same rate, but rather so that all races *recidivate at*

the same rate. The latter is a function of both π_r^* and g_r, where g_r is interpreted as the rate of committing violent crimes in a month for a non-rehabilitated parolee of a given race. Note that g_r can vary by race due to the impact of the neighborhoods that parolees are released into and the innate tendency to commit violent crime, among other reasons. The results in Table 6 show that, in fact, the implied estimates for g_r do vary by race. The estimate for g_W is only 0.2%, smaller than the estimate for g_B at 0.8% and g_H at 1.3%. However, again due to the relatively large standard error for the estimate of g_W, the hypothesis that $g_W = g_B = g_H$ can not be statistically rejected (the p-value is 0.2135). Together, these results imply that minorities are required to have a higher probability of being rehabilitated, because given that they are not rehabilitated, they will commit crimes at a higher rate.

We consider the auxiliary estimates reported in Table 6, though very crude, nonetheless interesting in their own right, as we are not aware of any previous attempt in the literature to obtain an estimate of the probability of being rehabilitated among parolees of a given race. It is also worth emphasizing that nowhere in our regressions did we impose any restrictions to ensure that the implied estimates for π_r^* be between 0 and 1. We consider the fact that they did, as reported in Table 6, as further evidence in support of the model.

7 Comparison with Other Tests

7.1 Comparison with the Action-Based Test for Prejudice

As discussed in Section 2, previous studies have tested for discrimination in the parole release process by examining whether minorities serve a greater proportion of their sentence, after controlling for various observable differences. Although we show in Section 4 that this action-based test both suffers from an omitted variable problem and cannot distinguish between types of discrimination, it is still instructive to compare the results with our outcome based test results.

[Table 7 About Here]

In Column (1) of Table 7, we report the results from regressing an inmate's time served (measured in months) on their prescribed minimum and maximum sentences, race, age, and an indicator for whether their initial conviction is for a violent crime using the full sample of inmates. The results imply that both blacks and Hispanics serve less of a given sentence. Users of this test would conclude the Parole Board discriminates against whites in favor of minorities. This is in stark contrast to the results of our outcome based test which found no evidence of racial prejudice.

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Comparing the results from both tests also allows us to say something about the fairness of the original sentence. The fact that the Parole Board requires minorities to serve less of their sentences, but that these differences do not reflect racial prejudice, implies that the Board perceives the sentences prescribed to minorities as being too high. Columns (3) and (4) specifically examine whether the judges prescribed minimum and maximum sentence (measured in months) depend on race. The results imply that judges are handing down longer sentences to minorities, but that the Parole Board is counteracting this by making minorities serve less of it. This implication is further supported by the results in Column (2) which repeats the specification in Column (1), but does not control for the judges prescribed sentence. Here we see that there is no difference overall between the sentences served by minorities and whites. While these results imply that the Parole Board views the initial sentence handed down to minorities as too long, it does not necessarily mean judges are discriminating. It could easily be the case that judges simply have a different objective function than the Parole Board (such as caring about general deterrence), or that their decisions are simply reflecting the sentencing guidelines which might be inefficient.

7.2 Comparison with the MS Test

In Section 2 we discussed the model and data used by the MS paper, which is the only other study to use an outcome test to study prejudice in the Parole Board release process. Recall that the MS model says the Parole Board wants to minimize the probability a parolee returns to prison, and thus their test compares the probabilities different racial groups return to prison while on parole. Column (7) of Table 4 presents the test MS run, applied to our data. The results imply that blacks recidivate on parole at a higher rate than whites, which MS would interpret as the Parole Board having racial prejudice against whites. This is the same conclusion they reach in their paper.

Because our test finds no evidence of racial prejudice, it is useful to contrast our empirical test with the MS test. They differ in two key ways. First, because we use different models, our empirical test compares the recidivism rates of different racial groups, while the MS test compares the probability different racial groups recidivate while on parole. Although both models are theoretically plausible, we find the data is only consistent with our model's testable implications. Specifically, one key testable implication where our models differ is the effect of parole time on the probability of recidivism on parole. We detail in Section 4.3 that our model predicts that the longer an individual is on parole, the more likely they are to recidivate while on parole. The MS model however says that all individuals should have the same probability of recidivating on

parole, and thus time on parole should have a zero effect on recidivism probability. In fact, in the MS model this is the strategic variable the Parole Board uses to ensure recidivism probabilities are equal–inmates that have a higher recidivism rate will be released with less time on parole so that they will (mechanically) have a lower chance of recidivating while on parole. Columns (8) and (9) of Table 4 show that Exposure_Time (which is exactly the same as Parole Time in these specifications) has a positive and significant effect, which supports our model. Note that no matter what measure of recidivism is used, Exposure_Time always has a significantly positive relationship with the probability of recidivism on parole.

Another key difference between the test MS run and ours is the measure of recidivism used. The results from Table 4 and 5 imply that this is the key reason we come to different conclusions. Specifically, comparing the results in Column (1) of Table 4 with Column (1) of Table 5 shows that when "New Violent Crime" is used as the measure of recidivism both the MS test and ours conclude there is no racial prejudice. In contrast, comparing the results in Column (7) of Table 4 with Column (3) of Table 5 shows that when "Any Return" is used as the measure of recidivism both tests conclude there is racial prejudice against whites in favor of blacks. In Section 6.1 we showed evidence that "New Violent Crime" is the proper measure of recidivism to use. Thus it is possible that MS come to the conclusion that there is prejudice against whites because they are using the wrong definition of recidivism, one that can itself reflect discrimination (see Section 2 for a discussion).

8 Conclusion

In this paper we develop a model of a Parole Board who is contemplating whether to grant parole to a prisoner who has finished serving their minimum sentence. In our model the Parole Board will choose to grant the prisoner parole if and only if the assessed recidivism rate is below a threshold, with the threshold being lower for minority prisoners if the Parole Board is prejudiced against minorities. In our model, for any prisoner who is granted parole release strictly between the minimum and maximum sentences, their exact release time is chosen to ensure that the Parole Board's assessed recidivism rate at the release time exactly equals the aforementioned threshold specific to the race of the prisoner.

We derive a very simple outcome test for racial prejudice based on our model that is immune to the infra-marginality problem. Our test simply involves running regressions of whether a prisoner recidivates on the exposure time to risk of recidivism and its square, using only the sample of

prisoners who are granted parole release strictly between their minimum and maximum sentences and separately by race. If the coefficient estimates on the exposure time term differ by race, then there is evidence of racial prejudice against the racial group with the smaller coefficient estimate.

We implement our test for prejudice using data on all prisoners released in Pennsylvania from January 1996 to December 31, 2001. We first document strong evidence for our model when we define the recidivating event as "new violent crimes." Using this definition of the recidivating event, we find no evidence for racial prejudice on the part of the Parole Board based on our outcome-based test.

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Table 2: Descriptive Statistics

Variable		All	Whites	Blacks	Hispanics
Race	White	0.365	1	0	0
	Black	0.508	0	1	0
	Hispanic	0.127	0	0	1
Age at Release	18-25	0.249	0.187	0.291	0.261
	26-35	0.393	0.369	0.400	0.431
	36-45	0.247	0.283	0.227	0.220
	46-55	0.083	0.111	0.065	0.071
	56+	0.029	0.049	0.017	0.018
crime type	violent/sex crime	0.369	0.432	0.366	0.199
sentence length	min sentence (months)	24.0	24.2	24.1	23.4
	max sentence (months)	55.2	56.0	54.9	53.5
released:	at minimum sentence	0.182	0.174	0.172	0.242
	between min and max sentence	0.452	0.426	0.461	0.489
	at maximum sentence	0.366	0.399	0.367	0.269
sentence served	length (months)	41.5	43.4	41.4	36.5
	proportion of max sent	0.746	0.758	0.750	0.692
	standard deviation of proportion	0.251	0.26	0.247	0.235
parole violation	none	0.607	0.654	0.568	0.630
	technical	0.311	0.271	0.343	0.297
	new crime--non-sex and non-violent	0.068	0.062	0.074	0.064
	new crime--sex or violent	0.013	0.013	0.014	0.009
Sample Size		14,309	5,225	7,271	1,813

Table 3: Comparisons of Recidivism Rates for Prisoners Released at Different Time, for Different Recidivating Events

	New Violent Crime (1)	Any New Crime (2)	Any Return (3)
Max_Sentence	0.0122***	-0.0234***	-0.254***
	(0.00286)	(0.00538)	(0.00678)
Min_Sentence	-0.00761***	-0.0153**	-0.0420***
	(0.00254)	(0.00715)	(0.0105)
Constant	0.0140***	0.0902***	0.322***
	(0.00176)	(0.00413)	(0.00581)
N	11346	12083	14309
R Squared	0.003	0.002	0.080

Notes: Standard errors are in parentheses. ***, **, and * represents statistical significance at 99%, 95% and 90% respectively.

Table 4: Tests of the Model Predictions Under Alternative Definitions of Recidivating Event in Parole Board's Objective Function

	New Violent Crime			Any New Crime			Any Return		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Black	-0.0000492	0.000566	0.000800	0.0169**	0.0201**	0.0224***	0.0743***	0.0751***	0.0764***
	(0.00351)	(0.00351)	(0.00353)	(0.00837)	(0.00815)	(0.00812)	(0.0135)	(0.0132)	(0.0131)
Hispanic	-0.00558	-0.00641	-0.00627	0.00615	0.00143	0.00252	0.0343*	0.0274	0.0272
	(0.00449)	(0.00451)	(0.00452)	(0.0121)	(0.0120)	(0.0119)	(0.0195)	(0.0194)	(0.0191)
Time_Served	0.00000585	-0.0000759	-0.0000782	-0.000261*	-0.000886***	-0.000897***	-0.000540**	-0.00177***	-0.00158***
	(0.0000650)	(0.0000661)	(0.0000661)	(0.000142)	(0.000141)	(0.000140)	(0.000269)	(0.000271)	(0.000269)
Exposure_Time		0.000737***	0.00122***		0.00527***	0.0113***		0.00828***	0.0271***
		(0.000157)	(0.000269)		(0.000348)	(0.000638)		(0.000474)	(0.00147)
Exposure_Time^2			-0.00000926**			-0.000113***			-0.000370***
			(0.00000439)			(0.0000110)			(0.0000291)
Constant	0.0161***	0.00732*	0.00345	0.106***	0.0410***	-0.00785	0.395***	0.274***	0.0997***
	(0.00389)	(0.00404)	(0.00430)	(0.00839)	(0.00870)	(0.00880)	(0.0144)	(0.0157)	(0.0193)
N	6198	6198	6198	6396	6396	6396	6387	6387	6387
R Squared	0.000	0.006	0.007	0.001	0.052	0.066	0.005	0.049	0.074

Notes: Standard errors are in parentheses. ***, **, and * represents statistical significance at 99%, 95% and 90% respectively.

Table 5: Test for Racial Prejudice Under Alternative Definitions of Recidivating Event in Parole Board's Objective Function

	New Violent Crime	Any New Crime	Any Return
	(1)	(2)	(3)
Exposure_Time	0.000966**	0.00743***	0.0300***
	(0.000395)	(0.000748)	(0.00131)
Exposure_Time * Black	0.000470	0.00284***	0.00679***
	(0.000453)	(0.000930)	(0.00166)
Exposure_Time * Hispanic	-0.00000672	0.00149	0.00668***
	(0.000527)	(0.00152)	(0.00251)
Exposure_Time^2	-0.00000235	-0.0000562***	-0.000428***
	(0.0000126)	(0.0000200)	(0.0000365)
Exposure_Time^2 * Black	-0.00000932	-0.0000422*	-0.0000925**
	(0.0000132)	(0.0000228)	(0.0000457)
Exposure_Time^2 * Hispanic	-0.0000104	-0.0000567	-0.000175**
	(0.0000138)	(0.0000380)	(0.0000704)
N	6198	6396	6387
R Squared	0.023	0.163	0.458

Notes: Standard errors are in parentheses. ***, **, and * represents statistical significance at 99%, 95% and 90% respectively.

Table 7: Results from Action-Based Tests

	Time Served (1)	Time Served (2)	Min Sentence (3)	Max Sentence (4)
Min Sentence	0.300***			
	(0.0418)			
Max Sentence	0.678***			
	(0.0225)			
Black	-0.595**	0.211	0.846***	0.815
	(0.268)	(0.540)	(0.272)	(0.557)
Hispanic	-2.972***	-0.138	1.998***	3.297***
	(0.377)	(0.647)	(0.378)	(0.737)
Age_at_Admission	-0.160**	-0.127	0.0600	0.0211
	(0.0714)	(0.137)	(0.0706)	(0.142)
Age_at_Admission^2	0.00265***	0.00354*	0.000127	0.00124
	(0.00102)	(0.00193)	(0.000996)	(0.00199)
Violent	7.970***	27.58***	11.11***	24.01***
	(0.266)	(0.578)	(0.286)	(0.587)
Constant	-3.163**	31.54***	17.28***	43.55***
	(1.275)	(2.364)	(1.207)	(2.443)
N	14309	14309	14309	14309
R Squared	0.790	0.187	0.119	0.132

Notes: Standard errors are in parentheses. ***, **, and * represents statistical significance at 99%, 95% and 90% respectively.