# Who is Responsible for Racial Sentencing Disparities? New Evidence From Linked Federal and State Court Sentencing Decisions

Daniel L. Chen and Brendon McConnell*

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**Abstract**

Several key actors – police, prosecutors, judges — can alter the course of individuals passing through the multi-staged criminal justice system. We use linked arrest-sentencing data for federal courts from 1994-2010 to examine the role that earlier stages play when estimating Black-white sentencing gaps. We find no evidence of sample selection at play, suggesting federal judges are largely responsible for racial sentencing disparities. In contrast, we document substantial sample selection bias in New Orleans state courts that leads to an underestimation of the true sentencing race gaps. Our findings have implications for how linked data can be used to address sentencing disparities.

**Keywords: Racial Sentencing Disparities, Ordered Sample Selection**
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*All errors are our own responsibility. Author affiliations and contacts: Chen (Toulouse, daniel.li.chen@gmail.com ); McConnell (Southampton, brendon.mcconnell@gmail.com).

# 1 Introduction

Racial disparities in sentence lengths can stem from multiple decision-makers as defendants enter the criminal justice system: police can choose to arrest, prosecutors can choose to file charges, and judges can choose the sentence length. An average of 104,000 people per year were arrested on federal charges in the decade between 1994 and 2003. Only 53,000, or 51% of the arrested, came before a federal judge for sentencing each year in this same period. For the New Orleans state criminal justice system, of the 24,000 arrested per year between 1989 and 1999, 36% came in front of a sentencing judge. Thus, with data on sentencing outcomes, researchers are typically observing at most one half of the original sample of arrestees, raising the possibility of sample selection issues plaguing sentencing regression estimates.

The disposition of the case, which determines the progression of the arrested individual from arrest to sentencing is a multi-stage process, involving several key actors including prosecutors, judges, in some cases juries, and defense counsel. Even if an actor is not directly involved in a stage, they can affect the actions of others involved, who may internalize their expected future behavior. There is scope for arrested individuals to leave the criminal justice system (hereafter CJS) at almost every stage. Arrest individuals may have cases dismissed or screened out. Charges may be filed, but then later dismissed. Those charged with an offense may be found not guilty. Those found guilty may receive a fine or probation rather than a custodial sentence. Examining racial disparities accounting for selection at previous stages is challenging due to the scarcity of data. This article constructs a data linkage from 1994-2010 for the U.S federal system and a novel data linkage from 1989-1999 for the New Orleans District Attorney's Office and uses the identity of the earlier decision-makers to assess selection at different stages.

No paper has previously formally accounted for the potential sample selection bias induced by the multi-stage journey defendants take from arrest through to sentencing when analyzing sentencing outcomes. In a prescient piece, Klepper et al. (1983) warned about the pitfalls of estimating sentencing differentials on the selected sample of those who make it before a sentencing judge, carefully spelling out the implications of ignoring sample selection bias: If both (i) there is disparate treatment of Black or other minority defendants in the stages preceding sentencing and (ii) the unobservables that drive progress through the stages also impact sentencing outcomes, then this will lead to the Black-white sentencing gap estimates to be biased.

We tackle this topic using data from both US federal courts, as well as state courts in New Orleans. In both cases we create a linked dataset, which allows us to follow individuals from arrest, through disposition, until sentencing. As noted above, a large proportion of arrestees do not make it to the sentencing stage. For the subset who do, we observe their sentences. We explicitly model progression through the various stages of the CJS using an ordered probit model. This forms the basis of an ordered sample selection model (hereafter an ordered Heckman model), which is an extension of the regular Heckman selection model (Heckman, 1979) that allows for multiple stages in the selection equation. The key question we pose, and answer, in this paper is to what extent does the Black-white sentencing gap change when one properly accounts for the potentially endogenous selection process from arrest through to sentencing?

Using the universe of U.S. federal sentencing decisions from 1994, we find that Black and white individuals have similar progression from arresting to sentencing. Put differently Black defendants are no more likely to progress through to sentencing than their white counterparts.

In addition, we find that there is no significant relationship between the unobservables that drive progression across the stages, and those that determine sentencing. This suggests that federal judges play the predominant role in driving racial disparities in the federal justice system. In an extension to our baseline approach, we show that the primary role of judges remains even when we account for mandatory minimum sentence charging – a key prosecutorial margin highlighted by the work of Rehavi and Starr (2014). Importantly, this means that in the federal system during the time of study, there is no gain to an econometric approach that jointly accounts for selection into sentencing, and the determination of sentence length. For instance, this means that if unobservables, like neighborhood or individual-level covariates, are correlated with differential selection into sentencing, these unobservables are not correlated with sentence length. The Black-white gap remains large in the ordered Heckman specification, yet identical to the gap estimated by OLS.

In contrast to the federal case, our approach establishes differential progression of Black and white individuals in the 1990s New Orleans court system, a period and locale well-known for discriminatory practices that received attention by the U.S. Supreme Court for its level of "deliberate indifference"[1]. Even in a smaller dataset, here, we observe that Black arrestees are more likely to progress to sentencing than their white counterparts. There is also evidence of sample selection bias – the unobservables that impact progression through the New Orleans court system are positively and significantly correlated with the unobservables that affect sentence length. The consequence of this is that the OLS-based Black-white sentencing gap underestimates the true, selection-corrected Black-white sentencing gap – in this case a 13% underestimate.

The data linkages we present offer a way to potentially identify and address sources of racial disparities. Where one has access to linked arrest-sentencing data, we advise the researcher to implement the procedure we illustrate here as part of an initial set of specification checks. If one finds that race (or any other characteristic of interest) is significant in the selection equation, and that the selection parameter ($\rho$ below) is statistically significantly different from zero, then arguably an approach such as the one we outline in this article should be used to estimate the (correctly adjusted) sentencing differential of interest. To not do so will lead to biased estimates of the sentencing differential of interest.

Racial disparities in criminal justice has been studied in many fields including economics, law, criminology and sociology. Prior research has considered the role of decisions-makers or selection at different stages in isolation. One can find several papers that implement a Heckman selection model when considering custodial (court-imposed) vs. non-custodial sentences at the sentencing stage (Steffensmeier and Demuth, 2001; Ulmer and Johnson, 2004). Other methods include modeling selection with a hazard rate term when analyzing outcomes in stage $K$ to account for selection from the previous stage $K-1$ alone (Leiber and Mack (2003) and Wooldredge and Thistlewaite (2004)). Rehavi and Starr (2014) show that severity of the prosecutor charge largely renders statistically insignificant racial disparities at the judicial sentencing stage. Policy-makers have thus focused heightened scrutiny to the role that prosecutors can play in exacerbating racial disparities. None of the papers consider the global progression from arrest to sentence, nor sought to understand the role of sample selection bias.

[1] Indeed, Justice Ginsburg identified the New Orleans District Attorney's office "deliberately indifferent" to the rights of defendants in *Connick v. Thompson*, 563 U.S. 51 (2011).

The rest of the paper is organized as follows. In Section 2, we describe the data we use and provide an overview of the setting of the two court systems we study here. In Section 3, we describe our empirical approach, and detail the ordered sample selection method we use to implement this approach In Section 4, we estimate Black-white sentencing differentials using specifications that do not account for differential progression through the stages (which we refer to as stadial progression) and sample selection, and for those that do, contrasting the resulting estimates. Finally, Section 5 concludes.

## 2 Data and Setting

In this section, we outline the data we use from both federal and state courts. We also provide summary statistics on the key outcomes of study – progression through the CJS and sentence length outcomes conditional on coming before a sentencing judge – that are the focus of this paper.

### 2.1 Federal CJS

We use a over a decades worth of linked arrest-sentencing data from US Federal courts spanning the fiscal years 1994-2010, with the primary focus on the 1994-2003 period. The starting point is determined by data availability. The end point of 2003 was chosen to avoid mixing sentencing outcomes from before and after the *Booker* reforms – a change in how sentencing guidelines were imposed in the federal system[2]. If we find significant racial disparities in decision-making by federal judges, even during an era with limited judicial discretion prior to the 2005 *Booker* Supreme Court ruling, it would further reinforce any potential findings of an out-sized role of judges in racial disparities.

The data appendix in Appendix B details how we link data across the various stages. In selecting our sample, we consider only adult males who are either Black or white[3]. Due to differential treatment under federal law, we remove all non-citizens. Following Rehavi and Starr (2014), who outline several reasons to do so, we omit all immigration arrests. We also follow the authors in removing arrest cases for reasons other than a criminal offense (material witness warrants, parole or probation violation). We focus on the 50 US States and the District of Columbia.

Summary statistics are presented in Table 1 for our sample of interest. We start by noting that Black individuals are over-represented by a factor of 4.27 at arrest, relative to what one would expect from a random sample of the population[4]. Just under half of Black and white

[2]The reason we truncate the data at the end of the 2003 fiscal year is that during the 2004 fiscal year, the Washington state supreme court decided on *Blakely v. Washington*, an antecedent to *U.S. v. Booker and Fanfan*, which led to certain judges deciding they could not apply the sentencing guidelines, either fully or partially, on constitutional grounds. Some did so on a case-by-case basis, whilst others followed the local norm established with their district. This was the case even though these were federal judges hearing federal cases, and *Blakely* was a state case. For this reason, we omit the fiscal years of 2004 and 2005 from analysis, and instead focus on the two homogeneous periods of i.) Pre-*Blakely* – 1994-2003 and ii.) Post-*Booker* – 2006 onward.

[3]Unlike the USSC sentencing data, the USMS arrest data that we use for our sample selection decisions does not contain information on ethnicity (i.e. no Hispanic indicator) but rather just race.

[4]The data shows a ratio of Black to white arrestees of 1:1.7, and the equivalent ratio for the population of adult males as measured in the 2000 Census is 1:7.1 – see Table 5 here https://www.census.gov/data/tables/2000/dec/phc-t-09.html.

arrestees end up facing a sentencing judge in our data. The $p$-values in column 4 show that there are no significant racial differences at either the start- or the end-point of the federal system. There are, however, large and statistically significant differences once one considers sentencing outcomes for the subset who make it to this stage. Black defendants are 8.9 percentage points more likely to get a custodial sentence, and the average custodial sentence for Black defendants is almost double that of white defendants.

Table 1: Summary Statistics – Federal CJS

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Whites | Blacks | B-W Difference | p-Value of Difference |
| Observations | 241,932 | 146,191 | | |
| **Stage of Sentencing Last Seen** | | | | |
| 0 – Arrest | 0.346 | 0.342 | –0.004 | [0.874] |
| 1 – Filing | 0.114 | 0.120 | 0.006 | [0.082] |
| 2 – Charging | 0.062 | 0.053 | –0.009 | [0.000] |
| 3 – Sentencing | 0.478 | 0.484 | 0.007 | [0.783] |
| **Sentencing Outcomes if Found Guilty** | | | | |
| Any Custodial Sentence | 0.827 | 0.916 | 0.089 | [0.000] |
| | (0.379) | (0.277) | (0.009) | |
| Custodial Sentence Length (Months) | 46.377 | 87.148 | 40.772 | [0.000] |
| | (65.388) | (96.434) | (2.598) | |

**Notes**: Means, standard deviations for continuous variables in parentheses, p-values in square brackets. When testing differences in means, standard errors are clustered at district level.

## 2.2 New Orleans State CJS

For New Orleans courts data, our reference period is 1989-1999. We make comparable, though not identical, sample selection decisions when working with this data, again making these decisions based on arrestee characteristics. Our sub-group of focus is Black and white adult male arrestees. Given that we use information on the screening prosecutor to whom arrestees are assigned, we also require arrestees to face a prosecutor for whom we see at least ten times.

Table 2 presents summary statistics for our sample of interest. We again note that arrestees are disproportionately Black compared to the New Orleans city population, by a factor of 2.46[5]. In the New Orleans courts, one can see significant racial differences at each stage of the CJS, immediately contrasting with the Federal system. The cumulative effect of this is a large and significant Black-white difference – 8.1 percentage points or 31% relative to the white proportion – in the proportion of arrestees that progress to the final sentencing stage. For those who come before a sentencing judge, Black defendants are more likely to receive a custodial sentence, and receive substantially longer sentence lengths.

[5]There are 2.4 Black citizens for every one white citizen in New Orleans in 2000 (http://censusviewer.com/city/LA/New%20Orleans). The equivalent ratio for arrestees in our sample is 5.9:1.

Table 2: Summary Statistics – New Orleans State CJS

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Whites | Blacks | B-W Difference | p-Value of Difference |
| Observations | 21,720 | 128,254 | | |
| **Stage of Sentencing Last Seen** | | | | |
| 0 – Arrest | 0.521 | 0.494 | –0.027 | [0.001] |
| 1 – Filing | 0.144 | 0.108 | –0.036 | [0.000] |
| 2 – Charging | 0.073 | 0.054 | –0.019 | [0.000] |
| 3 – Sentencing | 0.262 | 0.344 | 0.081 | [0.000] |
| **Sentencing Outcomes if Found Guilty** | | | | |
| Any Custodial Sentence | 0.941 | 0.976 | 0.035 | [0.000] |
| | (0.236) | (0.154) | (0.003) | |
| Custodial Sentence Length (Months) | 25.732 | 43.821 | 18.089 | [0.000] |
| | (61.618) | (189.914) | (1.233) | |

**Notes**: Means, standard deviations for continuous variables in parentheses, p-values in square brackets. When testing differences in means, standard errors are clustered at individual level.

## 3 Empirical Specification

The ordered Heckman approach extends the selection equation of the standard Heckman selection model (Heckman, 1979) from a probit to an ordered probit. This allows us to jointly estimate i.) the role of race on individuals' progression through the criminal justice system and ii.) racial sentencing disparities in sentencing, conditional on progressing to the sentencing stage.

If race matters for progression through the criminal justice system, and if there is positive selection in the sentencing equation (i.e., the unobservables, such as unobserved offense severity, that lead an individual to progress further through the CJS are positively correlated with the unobservables that lead to longer sentences), then failing to account for progression when modelling sentences will lead researchers to underestimate racial sentencing disparities.

We directly address this problem, by specifying an ordered Heckman model. The first component to this model is the selection equation, which is where we focus on stadial progression across four stages, where we define stage, $s_i$, as the furthest an individual gets in the CJS. This progression begins with (0) an initial arrest stage and moves to (1) filing of charge(s), (2) charging and ends with (3) sentencing[6,7]. We model this progression with an ordered probit:

[6]In the sentencing stage, an individual may receive a non-custodial sentence of a fine or probation (which we code as a sentence length of zero), or a custodial sentence.

[7]In reality, sentencing is not the final stage, as there is an appeals process. However, for this paper, we consider the sentencing stage as the final stage, as it is this stage that many researchers consider in isolation when estimating sentencing disparities.

$$
\begin{aligned}
s_i^* &= X_i^{'}\alpha_1 + Z_{s,i}^{'}\alpha_2 + \xi_i \\
&= Z_i^{'}\alpha + \xi_i\,; \\
s_i &= \begin{cases} 0 & \text{if } -\infty < s_i^* \leq \mu_1 & \text{[Arrest]} \\ 1 & \text{if } \mu_1 < s_i^* \leq \mu_2 & \text{[Filing]} \\ 2 & \text{if } \mu_2 < s_i^* \leq \mu_3 & \text{[Charging]} \\ 3 & \text{if } \mu_3 < s_i^* < \infty & \text{[Sentencing]}\,, \end{cases}
\end{aligned} \tag{1}
$$

where $X_i$ is a vector of variables available at the arrest stage – and thus available for all individuals in the data – and $Z_{s,i}$ is the exclusion restriction. This vector enters only the selection equation and not the sentencing (or outcome) equation. We detail the specifics of these variables for both the Federal and New Orleans state systems separately below.

The second component to the ordered Heckman model is the sentencing equation:

$$
y_i = \begin{cases} X_i^{'}\beta + \epsilon_i & \text{if } s_i = 3 \\ \text{missing} & \text{otherwise}\,, \end{cases} \tag{2}
$$

where $y_i$, which is only observed if the individual reaches the sentencing stage, is the log of sentence length in months +1, and $\epsilon_i$ has mean zero, variance $\sigma^2$ and is bivariate normally distributed with $\xi_i$ with correlation $\rho$. In all of the selection-corrected models that we estimate, we present $\rho$ and a test of whether it is significant or not, as this reflects whether or not there is sample selection bias in the sentencing equation. We estimate equations (3) and (4) jointly using FIML[8,9].

There is an element of our approach that is somewhat constraining. Given that i.) we jointly model stadial progression of arrestees and sentencing outcomes of those who progress to the sentencing stage and ii.) $X_i$ should be a subset of $Z_i$ for identification purposes, the vector $X_i$ is a set of *arrest-level* offense type and offender characteristics. It would not be logical to include variables, such as criminal history or presumptive sentence – commonly used control variables in a sentencing equation – as these are available *only* for those individuals that we observed at sentencing, and would these presuppose reaching the sentencing stage.

In the federal data, the $X_i$ vector includes an indicator for Black, and a series of dummies for district, year of arrest, arrest offense code dummies, age decile, marital status and state/country of birth dummies. The exclusion restrictions in $Z_i$ are leave-out district-by-year means of the proportion of individuals who are last seen in stage 0, stage 1 and stage 3.

In the New Orleans data, the $X_i$ vector includes an indicator for Black, and a series of dummies for arresting agency, lead arrest charge dummies, arrest year, age decile, a dummy for multiple arrest charges, and a criminal history dummy. The exclusion restrictions are the leave-out screening prosecutor mean interacted with a non-missing dummy, and a dummy for

[8] To implement the ordered Heckman routine, we use the user-written Stata package of Chiburis and Lokshin (2007).

[9] The parameter estimates from the FIML procedures are as good as identical to those from the two-step approach, hence we present the more efficient FIML estimates.

missing information on screening prosecutor[10].

# 4 Results

## 4.1 Federal CJS

Table 3 presents the main set of results based on the federal courts. Column 1 replicates the unconditional differences between Black and white defendants that we see in Table 1. The frequently-made point to note here is that these differences will not just reflect racial disparities in the CJS, but also the fact that Black and white individuals are arrested for a different set of crimes. This point is valid here too. At the same time, the unconditional gap is staggeringly large. Moving to column 2, we see that the sentencing gap is attenuated to a large degree by the inclusion of a rich set of arrest-level defendant and offense characteristics. The estimated sentencing gap falls from .831 to .349, a 58% decline. The conditional gap is still extremely large and highly statistically significantly different from zero[11].

Column 3 shows the coefficient estimate for the Black indicator from the linear index model that underlies the ordered probit. A positive and significant estimate here would indicate that Black is associated with higher values of $s_i^*$ from equation 3, which would imply a higher value of $s_i$ ceteris paribus. This is clearly not the case – the coefficient from the selection equation is small and statistically insignificant. This corroborates the lack of racial differences in the unconditional patterns we see in the summary statistics in Table 1.

Column 4 presents the results from an ordered Heckman specification, where equations (3) and (4) are estimated jointly. First note that when jointly estimating the two equations, we again find no difference in racial progression across the stages – the coefficient on Black is small and statistically insignificant, even with a sample size of almost 400,000 observations. Second, the estimate of $\rho$ – the correlation between the unobservables that impact stadial progression and sentencing outcomes – is extremely small, and has a $p$-value of .52. For these two reasons, the sentencing gap we estimate using a selection adjusted approach is identical to what we found using a simple OLS.

This null result is useful in highlighting that both differential selection (a significant term on Black in the ordered probit equation) *and* evidence of sample selection bias (an estimate of $\rho$ that is significant in both magnitude and statistically significantly different from zero) are required for the ordered selection approach to yield different estimates from a standard OLS.

Finally, the results in column 5 serve as a sensitivity analysis. Here we binarize the variable $s_i$, assigning non-sentencing stages a value of zero, and the sentencing stage a value of one. We then implement a standard sample selection model. The core patterns, and resulting sentencing equation estimates, are very robust to this simplified approach.

[10] 6.6% of the sample have missing information on screening prosecutor. Instead of just dropping these individuals, we assign them a value of zero for the leave-out screening prosecutor mean, and then create a dummy indicating missing prosecutor information. The results are robust to the alternative approach of merely dropping these observations.

[11] The conditional gap that we document is larger than other papers in the literature. For instance, using a sample that is a subset of ours, McConnell and Rasul (2021) document an unconditional Black-white sentencing gap of a similar magnitude, but a conditional sentencing gap that is smaller by a factor of 3. The key difference is their paper uses a richer set of covariates, some of which are determined post-arrest, which, as discussed in Section 3, our empirical strategy precludes.

Table 3: Black-White Sentencing Disparities in the Federal CJS

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Ordered Probit | Ordered Heckman | Heckman |
| **Sentencing Equation** | | | | | |
| Black | .831*** | .349*** | | .349*** | .349*** |
| | (.0448) | (.0214) | | (.0214) | (.0214) |
| **Selection Equation** | | | | | |
| Black | | | .0116 | .0116 | .00941 |
| | | | (.0114) | (.0114) | (.0107) |
| Full Set of Controls | | X | X | X | X |
| $\rho$ | | | | .0185 | .0107 |
| p-value: $\rho = 0$ | | | | .52 | .68 |
| p-value: Exclusion Restriction(s) | | | .000 | .000 | .000 |
| $R^2$ | .0595 | .419 | | | |
| Observations | 186,436 | 186,436 | 388,123 | 388,123 | 388,123 |

**Notes**: *** denotes significance at 1%, ** at 5%, and * at 10%. The dependant variable in the sentencing equation is the log(sentence length in months +1). The +1 is to allow for zero sentence lengths (fines, probation) in the sentencing stage. In the selection equation, the dependant variable is stage, which takes values 0, 1, 2 or 3. Th exception is in specification 6, where we binarize the stage variable (stages 0-2 = 0, stage 3=1). All specifications, with the exception of specification 1, include the following control variables: district dummies, year of arrest dummies, arrest offence code dummies, age decile dummies, marital status dummies and state/country of birth dummies. The exclusion restrictions for the ordered probit selection model are leave-out district×year means of the proportion of individuals who are last seen in stage 0, stage 1 and stage 3. For the probit selection model, the exclusion restriction is the leave-out district×year mean of the proportion of individuals who are last seen in stage 3. Standard errors are clustered at district level.

## 4.2 New Orleans State CJS

We now move to the New Orleans state court system, presenting our core results in Table 4. The column 1 estimates reiterate the large and statistically significant unconditional sentencing gaps that we see in Table 2. Moving from column 1 to 2 we see that differences in arrest offense and individual characteristics accounts for over half of the raw Black-white sentencing differential, yet a large conditional gap still remains. So far, the analysis follows a similar pattern to the federal case above.

Where the New Orleans system differs becomes apparent in column 3 – we see a positive and significant coefficient on Black in the ordered probit equation, which informs us that the unconditional pattern of differential racial stadial progression that we document in Table 2 persists even when we condition on a rich set of controls.

Turning to column 4, we note a second point of departure from the federal estimates. Our estimate of $\rho$ is large, and highly statistically significantly different from zero. That is, the unobservables that determine individuals' progression through the stages of the New Orleans CJS are positively correlated with those that impact sentence severity. Given both the higher likelihood of ending up at the sentencing stages that Black individuals face, and the presence of positive sample selection bias, the coefficients we using the ordered sample selection procedure yield a larger Black-white sentencing gap. Not accounting for differential stadial progression leads to an underestimation of the Black-white sentencing gap by 13.5%.

In the final column we again present a sensitivity analysis of our sample selection approach, simplifying the ordered Heckman model to a standard Heckman by binarizing $s_i$ as we did before. The results tell the same story – not accounting for differential stadial progression in the presence of sample selection bias leads to an under-estimation of the Black-white sentencing gap.

Table 4: Black-White Sentencing Disparities in the New Orleans State CJS

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Ordered Probit | Ordered Heckman | Heckman |
| **Sentencing Equation** | | | | | |
| Black | .489*** | .225*** | | .26*** | .268*** |
| | (.0197) | (.0152) | | (.0157) | (.0158) |
| **Selection Equation** | | | | | |
| Black | | | .133*** | .133*** | .188*** |
| | | | (.0126) | (.0126) | (.0134) |
| Full Set of Controls | | X | X | X | X |
| $\rho$ | | | | .424 | .364 |
| p-value: $\rho = 0$ | | | | .000 | .000 |
| p-value: Exclusion Restriction | | | .000 | .000 | .000 |
| $R^2$ | .0133 | .524 | | | |
| Observations | 49,792 | 49,792 | 149,974 | 149,974 | 149,974 |

**Notes**: *** denotes significance at 1%, ** at 5%, and * at 10%. The dependant variable in the sentencing equation is the log(sentence length in months +1). The +1 is to allow for zero sentence lengths (fines, probation) in the sentencing stage. In the selection equation, the dependant variable is stage, which takes values 0, 1, 2 or 3. Th exception is in specification 6, where we binarize the stage variable (stages 0-2 = 0, stage 3=1). All specifications, with the exception of specification 1, include the following control variables: arresting agency dummies, lead arrest charge dummies, arrest year dummies, age decile dummies, a dummy for multiple arrest charges, and a criminal history dummy. The exclusion restrictions for both the ordered probit, and probit, selection models are the leave-out screening prosecutor mean interacted with a non-missing dummy, and a dummy for missing information on screening prosecutor. Standard errors are clustered at individual level.

### 4.3 Accounting for Sentences With Statutory Minima – An Extension

The use of statutory minimum sentence charging is perceived to drive the Black-white sentencing gap (Rehavi and Starr (2014)). In this section, we extend the approach we propose in Section 3, in order to incorporate statutory minimum charging behavior of prosecutors within our framework. To do so, we split the final stage of the ordered probit (see Equation 3) into two stages – sentencing absent of a statutory minimum, and sentencing with a statutory minimum. This results in our estimating conditional sentencing gaps separately based on the presence of a statutory minimum, and we use exclusion restrictions to aide identification of the factors driving statutory minimum regime membership.

The modified selection equation can be written as:

$$
\begin{aligned}
s_i^* &= X_i^{'}\alpha_1 + Z_{s,i}^{'}\alpha_2 + \xi_i \\
&= Z_i^{'}\alpha + \xi_i\,;
\end{aligned}
$$

$$
s_i = \begin{cases} 0 & \text{if } -\infty < s_i^* \leq \mu_1 & \text{[Arrest]} \\ 1 & \text{if } \mu_1 < s_i^* \leq \mu_2 & \text{[Filing]} \\ 2 & \text{if } \mu_2 < s_i^* \leq \mu_3 & \text{[Charging]} \\ 3 & \text{if } \mu_3 < s_i^* \leq \mu_4 & \text{[Sentencing, Statutory Minimum Absent]} \\ 4 & \text{if } \mu_4 < s_i^* < \infty & \text{[Sentencing, Statutory Minimum Present]}\,, \end{cases} \tag{3}
$$

where, as before, $X_i$ is a vector of variables available at the arrest stage – and thus available for all individuals in the data – and $Z_{s,i}$ is the exclusion restriction. We modify the sentencing component, to allow for sentencing to occur in the two final stages:

$$
y_i = \begin{cases} X_i^{'}\beta_3 + \epsilon_{i,3} & \text{if } s_i = 3 \\ X_i^{'}\beta_4 + \epsilon_{i,4} & \text{if } s_i = 4 \\ \text{missing} & \text{otherwise}\,, \end{cases} \tag{4}
$$

We present the results of our extended ordered Heckman approach in Table 5 below.

The first point to note, viewing columns 1 and 2, is that the Black-white gap is larger for sentences with a statutory minimum attached, confirming that prosecutorial charging plays a role in generating racial sentencing differentials.

Substantial racial sentencing gaps are, however, also present when there are no statutory minima attached to the case. Some studies suggest that controlling for the prosecutor charge decision, racial sentencing gaps disappear.[12] The presence of significant racial sentencing gaps for both sets of defendants suggests that federal judges play an important role in racial disparities even when accounting for charges with a statutory minimum attached.

In a departure from the baseline results in Table 3, the Ordered Probit coefficient for Black is now positive and significant, highlighting that Black defendants are more likely to be face a statutory minimum sentence charge.

As is the case in our baseline framework, the ordered Heckman makes no difference to the Black-white sentencing gap – the estimates from columns 4 and 5 are identical to their OLS

[12] We conducted a set of analyses to relate our findings to those of Rehavi and Starr (2014). There are two key differences that drive the divergence between our respective findings. First, Rehavi and Starr (2014) omit offenses relating to drugs, child pornography, traffic offenses and liquor offenses from their main sample. When we do this, our sample size reduces by almost half. This sample selection decision also reduces the Black-white sentencing gap, an effect driven almost entirely by the omission of drug-related offenses. Second, Rehavi and Starr (2014) use a different set of control variables, most notably for the Black-white sentencing differential, the defendant's criminal history. There are significant differences across the races in the criminal history distribution (part of which may reflect disparate racial treatment with previous interactions with the criminal justice system), and controlling for criminal history vastly reduces the Black-white sentencing differential. It is worth noting that our ordered Heckman approach precludes the possibility of controlling for criminal history, which is only available for those who progress to the sentencing stage. Our approach does, however, allow for a correlation between the error terms in the selection and outcome equations. This approach will thus account for the role of criminal history in determining the sub-sample of those who make it to the final sentencing stages.

Table 5: Black-White Sentencing Disparities in the Federal CJS

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | | Ordered Probit | Ordered Heckman | |
| | Stat. Min. Absent | Stat. Min. Present | | Stat. Min. Absent | Stat. Min. Present |
| **Sentencing Equation** | | | | | |
| Black | .248*** | .316*** | | .248*** | .316*** |
| | (.0234) | (.0193) | | (.0243) | (.019) |
| **Selection Equation** | | | | | |
| Black | | | .0549*** | .0549*** | .0549*** |
| | | | (.0106) | (.0106) | (.0106) |
| Full Set of Controls | X | X | X | X | X |
| $\rho_4$ | | | | -.0091 | -.0091 |
| $\rho_5$ | | | | .0044 | .0044 |
| p-value: $\rho = 0$ | | | | .98 | .98 |
| p-value: Exclusion Restriction(s) | | | .000 | .000 | .000 |
| $R^2$ | .313 | .206 | | | |
| Observations | 120,772 | 65,664 | 388,123 | 388,123 | 388,123 |

**Notes**: *** denotes significance at 1%, ** at 5%, and * at 10%. The dependant variable in the sentencing equation is the log(sentence length in months +1). The +1 is to allow for zero sentence lengths (fines, probation) in the sentencing stage. In the selection equation, the dependant variable is stage, which takes values 0, 1, 2, 3 or 4. All specifications, include the following control variables: district dummies, year of arrest dummies, arrest offence code dummies, age decile dummies, marital status dummies and state/country of birth dummies. The exclusion restrictions for the ordered probit selection model are leave-out district×year means of the proportion of individuals who are last seen in stage 0, stage 1 , stage 3 and stage 4. Standard errors are clustered at district level.

counterparts in columns 1 and 2. The reason for this is that, even though there is differential stadial progression by race, there is no correlation between the unobservables that affect progression and those that drive sentence length – $\rho_4$ and $\rho_5$ are extremely small, and the $p$-value of a joint test of $\rho_4$ and $\rho_5$ is 0.98. This result highlights again that in order for the ordered Heckman approach to deliver estimates that differ from a simple OLS, there needs to be differential racial progression through the CJS *and* a significant correlation between the unobservables influencing progression and those influencing sentencing outcomes.

## 5 Conclusion

Only a sub-sample of individuals who are arrested make it to sentencing. Multiple decision-makers can impact the progression of individuals through the various stages of the criminal justice system. If there are racial disparities in the progression across the CJS stages, then this can bias the measurement of race gaps in sentencing due to sample selection bias. This paper presents and illustrates a methodology to overcome this bias using both a linked dataset from 1994-2010 for the U.S federal system and a data linkage from 1989-1999 for the New Orleans District Attorney's Office. We formally account for the potential sample selection bias induced by the multi-stage journey defendants take from arrest through to sentencing. We show that Black and white individuals have similar progression from arresting to sentencing in the federal sentencing domain. In addition, we find that there is no significant relationship between the unobservables (like neighborhood or individual-level covariates) that may drive progression across the stages, and those that determine sentencing. This should refocus the attention to racial disparities in decision-making by federal judges, even during an era with limited judicial discretion prior to the 2005 *Booker* Supreme Court ruling.

Our approach offers a way to potentially identify sources of racial disparities. A different pattern emerges in the New Orleans court system in the 1990s. Here, Black arrestees are more likely to progress to sentencing than their white counterparts. There is also evidence of sample selection bias – the unobservables that impact progression through the New Orleans court system are positively and significantly correlated with the unobservables that affect sentence length. The consequence of this is that the conditional Black-white sentencing gap that we find using OLS is an underestimate the true gap that one finds once selection is accounted for.

If one finds that race (or any other characteristic of interest) is significant in the selection equation, and that the selection parameter ($\rho$ below) is statistically significantly different from zero, then arguably an approach such as the one we outline in this article should be used to estimate the (correctly adjusted) sentencing differential of interest. To not do so will lead to biased estimates of the sentencing differential of interest.

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# Appendix

## A Robustness

### A.1 Functional Form Sensitivity Analysis

The tables in this section present all the key results from the main body of the paper, but using the inverse hyperbolic sine (IHS) transformation of sentence length instead of the log+1 transformation. Like the natural log, the IHS is a concave transformation, and thus deals with the extreme (right) skewness of the sentencing data. The results presented below confirm what we find in the main analysis (using a log+1 specification), both qualitatively and quantitatively.

Table A1: Functional Form Sensitivity Analysis – Federal CJS

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Ordered Probit | Ordered Heckman | Heckman |
| **Sentencing Equation** | | | | | |
| Black | .908*** | .379*** | | .379*** | .379*** |
| | (.0501) | (.0242) | | (.0241) | (.0241) |
| **Selection Equation** | | | | | |
| Black | | | .0116 | .0116 | .00941 |
| | | | (.0114) | (.0114) | (.0107) |
| Full Set of Controls | | X | X | X | X |
| $\rho$ | | | | .0161 | .00899 |
| p-value: $\rho = 0$ | | | | .53 | .71 |
| p-value: Exclusion Restriction(s) | | | .000 | .000 | .000 |
| $R^2$ | .0557 | .406 | | | |
| Observations | 186,436 | 186,436 | 388,123 | 388,123 | 388,123 |

**Notes**: *** denotes significance at 1%, ** at 5%, and * at 10%. The dependant variable in the sentencing equation is the inverse hyperbolic sine of sentence length in months. In the selection equation, the dependant variable is stage, which takes values 0, 1, 2 or 3. Th exception is in specification 6, where we binarize the stage variable (stages 0-2 = 0, stage 3=1). All specifications, with the exception of specification 1, include the following control variables: district dummies, year of arrest dummies, arrest offence code dummies, age decile dummies, marital status dummies and state/country of birth dummies. The exclusion restrictions for the ordered probit selection model are leave-out district×year means of the proportion of individuals who are last seen in stage 0, stage 1 and stage 3. For the probit selection model, the exclusion restriction is the leave-out district×year mean of the proportion of individuals who are last seen in stage 3. Standard errors are clustered at district level.

Table A2: Functional Form Sensitivity Analysis – New Orleans State CJS

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Ordered Probit | Ordered Heckman | Heckman |
| **Sentencing Equation** | | | | | |
| Black | .547*** | .255*** | | .284*** | .291*** |
| | (.0223) | (.0174) | | (.0177) | (.0177) |
| **Selection Equation** | | | | | |
| Black | | | .133*** | .133*** | .188*** |
| | | | (.0126) | (.0126) | (.0134) |
| Full Set of Controls | | X | X | X | X |
| $\rho$ | | | | .325 | .278 |
| p-value: $\rho = 0$ | | | | .000 | .000 |
| p-value: Exclusion Restriction | | | .000 | .000 | .000 |
| $R^2$ | .0135 | .511 | | | |
| Observations | 49,792 | 49,792 | 149,974 | 149,974 | 149,974 |

**Notes**: *** denotes significance at 1%, ** at 5%, and * at 10%. The dependant variable in the sentencing equation is the inverse hyperbolic since of sentence length in months. In the selection equation, the dependant variable is stage, which takes values 0, 1, 2 or 3. Th exception is in specification 6, where we binarize the stage variable (stages 0-2 = 0, stage 3=1). All specifications, with the exception of specification 1, include the following control variables: arresting agency dummies, lead arrest charge dummies, arrest year dummies, age decile dummies, a dummy for multiple arrest charges, and a criminal history dummy. The exclusion restrictions for both the ordered probit, and probit, selection models are the leave-out screening prosecutor mean interacted with a non-missing dummy, and a dummy for missing information on screening prosecutor. Standard errors are clustered at individual level.

## A.2 Post-*Booker*

The Supreme Court decision in *U.S. v. Booker and Fanfan* – that the previously mandatory federal sentencing guidelines should now hereafter be considered merely in an advisory capacity – means that we should consider the pre-*Booker* and post-*Booker* periods as two separate regimes.

In this section we replicate our main analysis (which focused on the pre-*Blakeley* period of 1994-2003), and consider the post-*Booker* period of 2006-2010. Table A3

Table A3: Black-White Sentencing Disparities in the Federal CJS – 2006-2010

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Ordered Probit | Ordered Heckman | Heckman |
| **Sentencing Equation** | | | | | |
| Black | .703*** | .376*** | | .376*** | .376*** |
| | (.0504) | (.0208) | | (.0208) | (.0208) |
| **Selection Equation** | | | | | |
| Black | | | .014 | .014 | .00647 |
| | | | (.0182) | (.0182) | (.0157) |
| Full Set of Controls | | X | X | X | X |
| $\rho$ | | | | .00456 | -.00361 |
| p-value: $\rho = 0$ | | | | .76 | .83 |
| p-value: Exclusion Restriction(s) | | | .000 | .000 | .000 |
| $R^2$ | .048 | .372 | | | |
| Observations | 85,311 | 85,311 | 215,722 | 215,722 | 215,722 |

**Notes**: *** denotes significance at 1%, ** at 5%, and * at 10%. The dependant variable in the sentencing equation is the log(sentence length in months +1). The +1 is to allow for zero sentence lengths (fines, probation) in the sentencing stage. In the selection equation, the dependant variable is stage, which takes values 0, 1, 2 or 3. Th exception is in specification 6, where we binarize the stage variable (stages 0-2 = 0, stage 3=1). All specifications, with the exception of specification 1, include the following control variables: district dummies, year of arrest dummies, arrest offence code dummies, age decile dummies, marital status dummies and state/country of birth dummies. The exclusion restrictions for the ordered probit selection model are leave-out district×year means of the proportion of individuals who are last seen in stage 0, stage 1 and stage 3. For the probit selection model, the exclusion restriction is the leave-out district×year mean of the proportion of individuals who are last seen in stage 3. Standard errors are clustered at district level.

Table A4: Functional Form Sensitivity Analysis – Federal CJS – 2006-2010

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Ordered Probit | Ordered Heckman | Heckman |
| **Sentencing Equation** | | | | | |
| Black | .767*** | .412*** | | .412*** | .412*** |
| | (.0529) | (.0233) | | (.0232) | (.0233) |
| **Selection Equation** | | | | | |
| Black | | | .014 | .014 | .00647 |
| | | | (.0182) | (.0182) | (.0157) |
| Full Set of Controls | | X | X | X | X |
| $\rho$ | | | | .00333 | -.00436 |
| p-value: $\rho = 0$ | | | | .81 | .77 |
| p-value: Exclusion Restriction(s) | | | .000 | .000 | .000 |
| $R^2$ | .0454 | .361 | | | |
| Observations | 85,311 | 85,311 | 215,722 | 215,722 | 215,722 |

**Notes**: *** denotes significance at 1%, ** at 5%, and * at 10%. The dependant variable in the sentencing equation is the inverse hyperbolic sine of sentence length in months. In the selection equation, the dependant variable is stage, which takes values 0, 1, 2 or 3. Th exception is in specification 6, where we binarize the stage variable (stages 0-2 = 0, stage 3=1). All specifications, with the exception of specification 1, include the following control variables: district dummies, year of arrest dummies, arrest offence code dummies, age decile dummies, marital status dummies and state/country of birth dummies. The exclusion restrictions for the ordered probit selection model are leave-out district×year means of the proportion of individuals who are last seen in stage 0, stage 1 and stage 3. For the probit selection model, the exclusion restriction is the leave-out district×year mean of the proportion of individuals who are last seen in stage 3. Standard errors are clustered at district level.

# B Data Appendix

In both the federal and state datasets, we link across multiple stages of the criminal justice system. In this Appendix section we briefly outline the respective processes.

## B.1 Federal Justice Statistics Program (FJSP) Data Linkage

The report by Kelly (2012) was invaluable in conducting the merges across the four federal agency files used for the analysis. These agency files are part of the Federal Justice Statistics Program (FJSP), and are made available as individual Standard Analysis Files (SAF) – standardized files at the individual-case level.

The four sets of agency datasets/SAFs comprise i.) data from the U.S. Marshals Service (USMS) that covers arrests, ii.) data from the Executive Office for United States Attorneys (EOUSA) that covers, amongst other things, case filing, iii.) data from the Administrative Office of the United States Courts (AOUSC) covering charging and iv.) data from the United States Sentencing Commission (USSC) that covers sentencing.

It is possible to link files inter-agency (e.g., USMS In to EOUSA Matters Out), as well as intra-agency (EOUSA Matters Out to EOUSA Cases Out). All linkage files are dyadic, which means in order to link the USMS arrest data to USSC sentencing outcomes, we need to go via the EOUSA and AOUSC agency files.

We refer the reader interested in learning more about the data linkages, and the lengths taken to validate the linking process, to the work of Kelly (2012).

In constructing our main stage variable ($s_i$ in Equation 3), we use information from each of the four agency files, as well as from the linking files. If an individual is seen only in the USMS data (USMS IN), but either a.) not in the EOUSA data (EOUSA Matters Out) or b.) has been removed by the data providers from the EOUSA based on a screening algorithm (in this case if the individual has an arrest code that relates to material witnesses and supervision violations) then we allocate the individual a value of $s_i = 0$. For those seen in the USMS and EOUSA data, but are not present in the AOUSC data (AOUSC Cases Out), the ascribe $s_i = 1$. For those last seen in the AOUSC data (i.e., are not linked to the USSC data(USSC Out)) we code $s_i = 2$. For those linked across all stages, we code $s_i = 3$.[13,14]

## B.2 New Orleans District Attorney's Office (NODA) Data Linkage

The data linkage for the New Orleans state data is considerably more straightforward. There are multiple datasets, including separate files for arrest outcomes, charging details, assistant DA characteristics, judge characteristics, defendant characteristics, and sentencing outcomes. The data are at different levels e.g. charging data is at the defendant-offense-charge level, whereas the assistant DA data is at the attorney level. A series of unique identifiers enables the linkage across both datasets and levels.

[13] The data provider applies another screening algorithm at this linkage, removing any individuals who were not convicted of a charge who appear in the USSC data.

[14] For the extension in Section 4.3, we split those with $s_i = 3$ into $s_i = 3$ for those who are sentenced without a statutory minimum charge, and $s_i = 4$ for those who face a statutory minimum sentence charge.