Journal of Criminal Law and Criminology

Volume 106 | Issue 1 Article 5

Winter 2016

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0091-4169/16/10601-0081
THE JOURNAL OF CRIMINAL LAW & CRIMINOLOGY Vol. 106, No. 1
 Printed in U.S.A.

CRIMINOLOGY

RECIDIVISM AND TIME SERVED IN PRISON†

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A justification for lengthier stays in prison stems from the belief that spending more time in prison reduces recidivism. Extant studies, however, have provided limited evidence for that belief and, indeed, suggest the effect of time served may be minimal. Few studies have employed rigorous

† We thank the Florida Department of Corrections for permission to use their data; the views expressed here are those of the authors and do not reflect those of the Department of Corrections. We also thank Michela Bia, Sam Field, Carlos Flores, Sonja Siennick, and Brian Stults for their helpful suggestions in the development of this paper. Not least, we thank the anonymous reviewers for their thoughtful guidance in identifying ways to strengthen the paper.

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methodological approaches, examined time spans of more than one to two years, or investigated the potential for the relationship between recidivism and time served to be curvilinear. Drawing on prior scholarship, this paper identifies three sets of hypotheses about the functional form of the time served and recidivism relationship. Using generalized propensity score analysis to examine data on 90,423 inmates released from Florida prisons, we find three patterns: greater time served initially increases recidivism but then, after approximately one year, decreases it, and, after approximately two years, exerts no effect; estimation of the effects associated with durations of more than five years are uncertain. The results point to potential criminogenic and beneficial effects of time served and underscore the need to identify how varying durations of incarceration affect recidivism.

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INTRODUCTION

In recent decades, the United States embarked on a seemingly straightforward approach to reducing recidivism among convicted felons: incarcerating more offenders and ensuring that they serve more time.[1] The

[1] *See* EDWARD J. LATESSA ET AL., WHAT WORKS (AND DOESN'T) IN REDUCING RECIDIVISM 6–7 (2014) (describing the changes in the corrections system and the expanded use of incarceration and longer terms of incarceration over time); THE PEW CENTER ON THE STATES, TIME SERVED: THE HIGH COST, LOW RETURN OF LONGER PRISON TERMS 1 (2012), http://www.pewtrusts.org/~/media/legacy/uploadedfiles/wwwpewtrustsorg/reports/sentencin

logic in part has been that additional time in prison exacts greater retribution and creates appreciable incapacitation and deterrent effects.[2] The logic in part, too, has been that prison has a specific deterrent effect that reduces recidivism. Scholars, however, have highlighted that the logic by which prison does, or does not, reduce recidivism may be more complicated. On theoretical grounds, for example, it remains unclear exactly how specific deterrent effects of prison may unfold over varying periods of incarceration.[3] The pains or strains of imprisonment,[4] which could contribute to deterrent effects, may be more concentrated in or felt more acutely during early stages than later stages of incarceration.[5] At the same time, varying durations of incarceration may exert different effects on social bonds, social capital, and labeling processes,[6] and in turn, recidivism.[7] Similarly, as Clemmer long ago emphasized in 1958, lengthier

g_and_corrections/prisontimeservedpdf.pdf (stating that the punitive turn in American criminal justice led to lengthier prison terms); Francis T. Cullen et al., *Prisons Do Not Reduce Recidivism: The High Cost of Ignoring Science*, 91 PRISON J. 48S, 50S–51S (2011) (finding that a prison term may have an unintentional criminogenic effect on future criminal involvement). *See generally* David Garland, *Penality and the Penal State*, 51 CRIMINOLOGY 475 (2013) (explaining the emergence of punitive policies in America).

[2] *See* JEREMY TRAVIS, BUT THEY ALL COME BACK: FACING THE CHALLENGES OF PRISONER REENTRY xix (2005); Steven N. Durlauf & Daniel S. Nagin, *Imprisonment and Crime: Can Both Be Reduced?*, 10 CRIMINOLOGY & PUB. POL'Y 13, 15–16 (2011) (describing the rationale for the argument that imprisonment reduces recidivism); *see generally* Garland, *supra* note 1.

[3] *See, e.g.*, David S. Abrams, *How do we decide how long to incarcerate?*, *in* EMPIRICAL LEGAL ANALYSIS: ASSESSING THE PERFORMANCE OF LEGAL INSTITUTIONS, (Yun-chien Chang ed., 2014); Joshua C. Cochran et al., *Assessing the Effectiveness of Correctional Sanctions*, 30 J. QUANTITATIVE CRIMINOLOGY 317, 318 (2014) (reviewing prior literature on the uncertain effects of variable amounts of time served in prison); Thomas Orsagh & Jong-Rong Chen, *The Effect of Time Served on Recidivism: An Interdisciplinary Theory*, 4 J. QUANTITATIVE CRIMINOLOGY 155 (1988) (describing the time served-recidivism relationship).

[4] *See* ROBERT AGNEW, WHY DO CRIMINALS OFFEND? A GENERAL THEORY OF CRIME AND DELINQUENCY *passim* (2005); GRESHAM M. SYKES, THE SOCIETY OF CAPTIVES: A STUDY OF A MAXIMUM SECURITY PRISON 63 (1958).

[5] *See generally* Sheldon Ekland-Olson et al., *Sanction Severity, Feedback, and Deterrence*, *in* EVALUATING PERFORMANCE OF CRIMINAL JUSTICE AGENCIES 19 (Gordon P. Whitaker & Charles David Phillips eds., 1983) (discussing varying effects of incarceration and incarceration length for varying groups); Daniel P. Mears et al., *Incarceration Heterogeneity and its Implications for Assessing the Effectiveness of Imprisonment on Recidivism*, 26 CRIM. JUST. POL'Y REV. 691 (2015).

[6] *See generally* Joseph Murray et al., *Long-Term Effects of Conviction and Incarceration on Men in the Cambridge Study in Delinquent Development*, *in* LABELING THEORY: EMPIRICAL TESTS 209 (David P. Farrington & Joseph Murray eds., 2014).

[7] G. Matthew Snodgrass et al., *Does the Time Cause the Crime? An Examination of the Relationship Between Time Served and Reoffending in the Netherlands*, 49 CRIMINOLOGY

stays in prison may allow for greater acclimation to prison culture and so a greater likelihood of offending after release to society.[8]

Alongside these and other possibilities is the concern that time served may have little appreciable effect on recidivism. Indeed, reviews and studies consistently suggest that, while mixed effects of time served in prison have been identified, overall the duration of incarceration likely exerts minimal influence on post-release offending.[9] Few studies, however, have systematically examined prison durations of more than one or two years or investigated the functional form of the recidivism and time served relationship (i.e., whether the relationship is linear or curvilinear, and if the latter, what is the precise nature of the curvilinearity).[10] In addition, studies of time served effects have been critiqued for employing weak methodological designs that undermine the estimates.[11] Some of the problems include the use of small samples, limited to no inclusion of control variables to address potential confounding, attention only to the first year or two of incarceration, and estimation that allows only for identification of linear effects.[12] These problems compound one another.[13] For example, a study that examines short prison stays cannot easily capture curvilinear functional forms that unfold when individuals experience longer prison stays, and cannot do so at all if such possibilities are not investigated.[14] Similarly, limited sample sizes make it difficult to investigate functional form and simultaneously address confounding.[15]

1149 *passim* (2011).

[8] DONALD CLEMMER, THE PRISON COMMUNITY *passim* (Donald Clemmer ed., 2d ed. 1958).

[9] *See, e.g.*, Charles E. Loeffler, *Does Imprisonment Alter the Life Course? Evidence on Crime and Employment from a Natural Experiment*, 51 CRIMINOLOGY 137 *passim* (2013); Thomas A. Loughran et al., *Estimating a Dose-Response Relationship Between Length of Stay and Future Recidivism in Serious Juvenile Offenders*, 47 CRIMINOLOGY 699, 700–02 (2009) (studying reoffending among serious juvenile offenders who served varying amounts of time incarcerated); Daniel S. Nagin et al., *Imprisonment and Reoffending*, 38 CRIME & JUST. 115 *passim* (2009) (discussing differences in methods and analytic procedures used to assess the effects of a prison term on reoffending); Daniel S. Nagin & G. Matthew Snodgrass, *The Effect of Incarceration on Re-Offending: Evidence from a Natural Experiment in Pennsylvania*, 29 J. QUANTITATIVE CRIMINOLOGY 601 *passim* (2013); Abrams, *supra* note 3; Snodgrass et al., *supra* note 7.

[10] Mears et al., *supra* note 5, *passim*.

[11] *See, e.g.*, Loughran et al., *supra* note 9; Nagin et al., *Imprisonment and Reoffending*, *supra* note 9; Snodgrass et al., *supra* note 7.

[12] *See* Cochran et al., *supra* note 3, *passim*.

[13] *Id.*

[14] *Id.*

[15] *Id.*

Against this backdrop, this study seeks to inform scholarship on punishment and, in particular, efforts to assess the effect of time served on recidivism. Specifically, it investigates whether the relationship between time served and offending may be curvilinear (i.e., whether the magnitude of effect of time served on offending varies depending on the amount of time served). To this end, the paper first situates the study's relevance in the context of mass incarceration. Second, it discusses prior scholarship on incarceration effects and time served effects on future offending. Third, drawing on prior theory and research, we identify three sets of hypothesized relationships between time served and recidivism. Fourth, we describe the data, which include information about 90,423 inmates who served varying lengths of time in Florida prisons, and the analyses, which rely on generalized propensity score modeling to address confounding and to estimate the functional form of the time served and recidivism relationship. Results of the analyses reveal a curvilinear relationship: greater time served initially increases recidivism but then, after approximately one year, decreases it, and, after approximately two years, exerts no effect; estimation of the effects associated with prison durations of more than five years are uncertain.[16] The results assist in clarifying why some prior studies have reported mixed findings, including positive effects, negative effects, and null effects of time served on offending.[17] They also underscore the need for greater attention to specifying and assessing the theoretical and empirical conditions under which incarceration and varying prison durations affect recidivism.[18]

I. BACKGROUND

A. GET-TOUGH CRIME POLICY AND THE ERA OF MASS INCARCERATION

The last several decades have been witness to a historically unprecedented policy shift that emphasized tougher, more punitive sanctioning of offenders, including greater use of incarceration and other types of correctional system punishments.[19] State prison populations, for example, increased by over 700% from 1972 to 2011, as did time served in prison; inmates released in 2009 on average served nine more months in prison than did their counterparts in 1990.[20] Many factors led to this

[16] *Id.*

[17] *Id.*

[18] *See* Cochran et al., *supra* note 3, *passim*.

[19] TRAVIS, *supra* note 2; Garland, *supra* note 1.

[20] THE PEW CENTER ON THE STATES, *supra* note 1, at 1–3.

growth, including efforts to impose greater retribution for offending and to create incapacitation and general deterrent effects that would lower crime.[21] An additional factor was the belief that more time in prison would or could reduce recidivism and that the benefits of increased incarceration—whether through achieving such goals as greater retribution or reduced crime—would outweigh social or economic costs.[22] Other goals, such as the control of "dangerous classes" in American society, have been identified as well.[23] Even so, retribution and public safety constitute the avowed goals expressed by legislatures.[24]

To date, the effects of the era of get-tough policy and of mass incarceration in particular, remain disputed.[25] Scholars have emphasized that the greater reliance on incarceration can create a number of social harms.[26] For example, prison stays may adversely affect ties to family and friends, mental and physical health, employment prospects, and the ability to access public housing.[27] Scholars have also emphasized, the uncertainty that exists about the precise effects of incarceration on crime rates, whether through general deterrence, incapacitation, or other mechanisms.[28] Not least, questions exist as well about whether incarceration reduces recidivism.[29] For example, despite marked increases in incarceration in recent decades, there is no evidence that recidivism rates have improved.[30]

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[21] *See* Marie Gottschalk, *The Carceral State and the Politics of Punishment*, *in* THE SAGE HANDBOOK OF PUNISHMENT AND SOCIETY *passim* (Jonathan Simon & Richard Sparks eds., 2013). *See generally* Durlauf & Nagin, *supra* note 2.

[22] *See* Raymond Paternoster, *How Much Do We Really Know About Criminal Deterrence?*, 100 J. CRIM. LAW & CRIMINOLOGY 765, 800–04 (2010) (discussing the role of the deterrence doctrine in punishment); Mears et al., *supra* note 5, at 705–07 (arguing that incarceration has heterogeneous effects). *See generally* Cullen et al., *supra* note 1.

[23] *See* Gottschalk, *supra* note 21, at 205; Garland, *supra* note 1, at 489.

[24] *See generally* JOAN PETERSILIA, WHEN PRISONERS COME HOME: PAROLE AND PRISONER REENTRY (2003); TRAVIS, *supra* note 2; Durlauf & Nagin, *supra* note 2.

[25] DANIEL P. MEARS & JOSHUA C. COCHRAN, PRISONER REENTRY IN THE ERA OF MASS INCARCERATION *passim* (2015).

[26] *See id.*

[27] *See* Christy A. Visher & Jeremy Travis, *Life on the Outside: Returning Home after Incarceration*, 91 PRISON J. 102S, 110S–11S (2011); PETERSILIA, *supra* note 24, at 105.

[28] *See generally* William Spelman, *The Limited Importance of Prisoner Expansion*, *in* THE CRIME DROP IN AMERICA *passim* (Alfred Blumstein & Joel Wallman eds., 2006); Garland, *supra* note 1; Paternoster, *supra* note 22.

[29] *See generally* William D. Bales & Alex R. Piquero, *Assessing the Impact of Imprisonment on Recidivism*, 8 J. EXPERIMENTAL CRIMINOLOGY 71, 97–98 (2012) (finding that using different methodologies to examine the effect of imprisonment on recidivism yields similar results); Cochran et al., *supra* note 3; Nagin et al., *Imprisonment and Reoffending*, *supra* note 9.

[30] *See* MEARS & COCHRAN, *supra* note 25, *passim*.

Recently, for instance, a Bureau of Justice Statistics (BJS) national assessment of recidivism rates among prisoners released from thirty states in 2005 found that, within five years of release, 77% of prisoners were rearrested for a felony or serious misdemeanor, 55% were reconvicted of a new crime, and 28% were sent to prison for a new crime.[31] The three-year levels of recidivism were nearly identical to those reported from a previous BJS assessment undertaken in 2002.[32]

B. THE EFFECT OF INCARCERATION ON RECIDIVISM

The theoretical foundation for anticipating that prison reduces recidivism rests on different lines of reasoning. One is that individuals commit crime due to individual failings that can be remedied through rehabilitation.[33] This perspective rests implicitly on a range of criminological theories of offending, such as general strain theory and social learning theory.[34] Through various programs and interventions, rehabilitation seeks to change an individual in ways that decrease known or assumed causes of offending or that increase an individual's ability to inhibit their effect.[35]

A different explanation is that something about the experience of incarceration produces a specific deterrent effect.[36] From a rational choice theoretical perspective, for example, it produces actual or perceived costs that offset potential crime benefits.[37] The costs (e.g., loss of liberty, severed social ties, foregone employment income, stigma) and benefits (e.g., money, getting "high," prestige) may vary, but the calculus—an assessment of costs relative to benefits—remains the same.[38] Under a deterrence model, the certainty, celerity, and severity of punishment are assumed to be related to punishment costs.[39] Prison presumptively is assumed to constitute a severe punishment, even though the perceived severity of other

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[31] MATTHEW R. DUROSE ET AL., U.S. DEP'T OF JUSTICE, RECIDIVISM OF PRISONERS RELEASED IN 30 STATES IN 2005: PATTERNS FROM 2005 TO 2010, at 8, 15 (2014), http://www.bjs.gov/content/pub/pdf/rprts05p0510.pdf.

[32] *See* PATRICK A. LANGAN & DAVID J. LEVIN, U.S. DEP'T OF JUSTICE, RECIDIVISM OF PRISONERS RELEASED IN 1994 *passim* (2002), http://www.bjs.gov/content/pub/pdf/rpr94.pdf (discussing the recidivism trends among a release cohort of ex-prisoners from a sample of fifteen states).

[33] *See* MEARS & COCHRAN, *supra* note 25, *passim*.

[34] *See* AGNEW, *supra* note 4; Nagin et al., *Imprisonment and Reoffending*, *supra* note 9.

[35] *See generally* LATESSA ET AL., *supra* note 1.

[36] Paternoster, *supra* note 22, *passim.*

[37] *Id.* at 782.

[38] *See* MEARS & COCHRAN, *supra* note 25.

[39] *See id.*

sanctions may be greater for some individuals.[40] However, severity does not necessarily deter. For example, the costs associated with incarceration, such as reduced employability and access to public housing, may decrease the benefits of non-offending to make recidivism upon release the more rational option.[41] Perceptions about other aspects of incarceration, such as the experience of incarceration, prison conditions, or the extent to which actual time served in prison accords with sentence length may affect deterrence and thus offending.[42]

Despite the substantial growth in incarceration and in scholarship on deterrence and rehabilitation in recent decades, "rigorous scientific knowledge [on the effect of imprisonment on reoffending] is in short supply."[43] Indeed, the problem is two-fold. First, reviews of research have identified a mixed body of findings, with some finding beneficial effects, others finding harmful effects, and still others finding no effects on recidivism.[44] Nagin's review and recent studies lend support to the view that prison exerts a criminogenic effect.[45] Even so, the bulk of studies taken as a whole suggest that incarceration effects on recidivism are at best uncertain or minimal.[46] Indeed, the second and related problem consists of the weak methodological rigor of many prior empirical assessments.[47]

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[40] *See* DAVID C. MAY & PETER B. WOOD, RANKING CORRECTIONAL PUNISHMENTS: VIEWS FROM OFFENDERS, PRACTITIONERS, AND THE PUBLIC *passim* (2010); Spelman, *supra* note 28.

[41] Paternoster, *supra* note 22, at 820.

[42] *See* Shawn D. Bushway & Emily G. Owens, *Framing Punishment: Incarceration, Recommended Sentences, and Recidivism*, J.L. & ECON. 301 *passim* (2013); M. Keith Chen & Jesse M. Shapiro, *Do Harsher Prison Conditions Reduce Recidivism? A Discontinuity-based Approach*, 9 AM. L. & ECON. REV. 1, 2 (2007); Mears et al., *supra* note 5, at 697–98.

[43] Nagin et al., *Imprisonment and Reoffending*, *supra* note 9, at 116.

[44] *See* PAUL GENDREAU ET AL., THE EFFECTS OF PRISON SENTENCES ON RECIDIVISM *passim* (1999); PATRICE VILLETTAZ ET AL., THE CAMPBELL COLLABORATION, THE EFFECTS OF CUSTODIAL VS. NON-CUSTODIAL SENTENCES ON RE-OFFENDING: A SYSTEMIC REVIEW OF THE STATE OF KNOWLEDGE *passim* (2006) (reviewing literature about the effects of imprisonment on reoffending).

[45] *See generally* Avinash Singh Bhati & Alex R. Piquero, *Estimating the Impact of Incarceration on Subsequent Offending Trajectories: Deterrent, Criminogenic, or Null Effect?*, 98 J. CRIM. L. & CRIMINOLOGY 207 (2008) (describing the trajectories of future offending patterns among ex-prisoners); Bales & Piquero, *supra* note 29; Cochran et al., *supra* note 3; Nagin et al., *Imprisonment and Reoffending*, *supra* note 9.

[46] *See* Nagin & Snodgrass, *The Effect of Incarceration on Re-Offending*, *supra* note 9, at 601; *see e.g.*, Loeffler, *supra* note 9; Snodgrass et al., *supra* note 7. *See generally* Donald P. Green & Daniel Winik, *Using Random Judge Assignments to Estimate the Effects of Incarceration and Probation on Recidivism Among Drug Offenders*, 48 CRIMINOLOGY 357 *passim* (2010) (finding that incarceration has little net effect on the likelihood of future recidivism as measured by rearrest).

[47] *See* Mears et al., *supra* note 5, at 705–07.

Nagin found few studies that employed matching designs or adequately addressed potential confounding influences (for example, many studies failed to control for factors such as age, race, sex, or prior record).[48]

C. THE EFFECT OF TIME SERVED ON RECIDIVISM

Few studies have employed credible methodological assessments of the relationship between time served and recidivism. In *Imprisonment and Reoffending*, the authors identified only two experimental studies and seventeen non-experimental studies of this relationship.[49] The results across the studies were "quite varied,"[50] with some indicating no effect of time served, others suggesting a potential recidivism-reducing effect, and still others suggesting that time served slightly increased recidivism.[51] Their assessment echoed that of prior reviews, which collectively suggest that time served may exert mixed effects and, most likely, a minimal effect on recidivism.[52] For example, recent studies that employ methodologically rigorous analyses have found little effect of time served on reoffending among juveniles or adults.[53] More broadly, reviews and research have raised a range of concerns.

First, as emphasized forcefully by Nagin, with rare exception, non-experimental studies have not employed a matching design capable of addressing confounding across dose levels.[54] That is, they did not apply an approach that would ensure that across levels of time served, potential confounders are balanced.[55] Research on incarceration effects has increasingly relied on more methodologically rigorous approaches, and several counterparts that focus on time served also exist.[56] In general, however, the bulk of prior work has not, as Nagin and colleagues have noted, systematically addressed the confounding associated with different "dose" levels of time served.[57]

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[48] Nagin et al, *Imprisonment and Reoffending*, *supra* note 9, at 154–55.

[49] *Id.* at 167–69.

[50] *Id.* at 169.

[51] *Id.* at 175.

[52] *See* GENDREAU ET AL., *supra* note 44; VILLETTAZ ET AL., *supra* note 44.

[53] *See, e.g.*, Benjamin Meade et al., *Estimating a Dose-Response Relationship Between Time Served in Prison and Recidivism*, 50 J. RES. CRIME & DELINQ. 525 *passim* (2012); Green & Winik, *supra* note 46; Loughran et al., *supra* note 9; Snodgrass et al., *supra* note 7.

[54] *See generally* Nagin et al., *Imprisonment and Reoffending*, *supra* note 9.

[55] *Id.* at 177.

[56] *See, e.g.*, Cochran et al., *supra* note 3; Green & Winik, *supra* note 46; Loeffler, *supra* note 9; Loughran et al., *supra* note 9; Meade et al., *supra* note 53; Nagin & Snodgrass, *The Effect of Incarceration on Re-Offending*, *supra* note 9.

[57] *See* Nagin et al., *Imprisonment and Reoffending*, *supra* note 9, at 167–77, 183.

Second, many studies examine short time-served durations (i.e., one to two years) and use either linear estimates or blocks of time (i.e., 1-year intervals) to contrast short or long stays and so cannot readily assess the functional form of the time served and recidivism relationship. A failure to model such an effect can risk mis-estimating the true relationship and obscure different effects that arise at varying amounts of time served. For instance, in a situation where relatively short prison stays decrease recidivism and longer stays increase it, a linear estimate—one that allows no variation in the functional form of the time served and recidivism relationship—might well yield a null finding as a result of the two effects counteracting one another. Indeed, Orsagh and Chen have suggested that just such a U-shaped association exists. Yet, recent studies suggest—but do not find statistically significant evidence—that instead an upside-down U-shaped association exists.[58] This issue assumes considerable importance given that conflicting linear estimates may stem from an averaging across negative and positive effects of time served. For example, Gendreau found that studies that compared "more" incarceration (thirty months on average) versus "less" incarceration (thirteen months on average) identified estimated recidivism rates that were approximately 3% higher for the "more" incarceration groups.[59] Had the studies allowed for precise estimation of nonlinear effects, they might have identified some durations of time served exerting a negative effect and other durations exerting a positive effect.

The theoretical rationale for anticipating increasing, decreasing, or curvilinear effects of time served on recidivism in fact is varied and depends on assumptions about the timing of causal mechanisms, their intensity, and the number of them.[60] For example, deterrent effects may be most likely in the initial months of incarceration; at that point the "pains of imprisonment" may be felt most acutely and criminogenic experiences that reduce social bonds or increase strain may be nominal.[61] In addition, the marginal specific deterrent effect may decline with time because of "the general tendency of individuals to place relatively less value on experiences . . . that occur more distantly in time."[62] Viewed in this light,

[58] *See generally* Loughran et al., *supra* note 9; Meade et al., *supra* note 53; Orsagh & Chen, *supra* note 3.

[59] GENDREAU ET AL., *supra* note 44, at 9.

[60] *See* Nagin et al., *Imprisonment and Reoffending*, *supra* note 9, at 167–77; Paternoster, *supra* note 22, at 805–06; Snodgrass et al., *supra* note 7, at 1174.

[61] *See generally* Kenneth Adams, *Adjusting to Prison Life*, 16 CRIME & JUST. 275 *passim* (1992); SYKES, *supra* note 4.

[62] *See* Orsagh & Chen, *supra* note 3, at 158.

the initial months of incarceration may be associated with deterrent effects that offset countervailing criminogenic effects. However, criminogenic experiences, including greater difficulty finding legitimate work, then may accumulate and increasingly offset deterrent effects of lengthier stays.[63] Orsagh and Chen interpret their results as indicating a U-shaped effect. The identified regression models, however, have a largely linear, positive relationship between time served and recidivism.[64] It is equally plausible that criminogenic effects begin immediately and escalate. Clemmer, for example, long ago argued that short incarceration stays decrease the likelihood that individuals will acculturate to the "prison community" and that longer stays greatly increase it.[65]

Alongside of theoretical reasons to anticipate curvilinear relationships are several empirical studies that suggest warrant for anticipating them. Loughran, for instance, investigated whether recidivism among a sample of serious juvenile offenders varied by length of stay in prison or length of time on probation, and found no statistically or substantively significant effect of either.[66] Similarly, Meade used propensity score analyses to examine recidivism among inmates grouped into different time durations.[67] They found that the likelihood of recidivism increased slightly for the group of inmates who served 13–24 months (30%) as compared to those who served one year or less (27%), and that the likelihood of recidivism steadily declined thereafter.[68] As the authors emphasized, however, only the decline in recidivism from one year or less (27%) to five years or more (14%) was statistically significant.[69] In both studies, then, there is suggestive evidence of, but not strong statistical support for, a curvilinear association between time served and recidivism.

Separately, Snodgrass examined time served effects among Dutch inmates and found no effect of time served on recidivism.[70] Snodgrass employed a variety of methodologies and grouped inmates into six categories (one month or less, 1–2 months, on up to twelve months or more).[71] Budd and Desmond found that sex offenders who served more time in prison were less likely to recidivate (the study did not examine

63 *See generally* Orsagh & Chen, *supra* note 8*;* Paternoster, *supra* note 22.

64 Orsagh & Chen, *supra* note 3, at 163.

65 CLEMMER, *supra* note 8, at 300.

66 *See* Loughran et al., *supra* note 9, at 723.

67 *See generally* Meade et al., *supra* note 53.

68 *Id.* at 538.

69 *Id.* at 540.

70 *See* Snodgrass et al., *supra* note 7, at 1172–75.

71 *Id.* at 1158.

whether the relationship was curvilinear).[72] In a study of first-time offenders in Nevada, Abrams reported negative effects of time served for inmates serving relatively short prison terms and no effect for inmates serving longer terms.[73] In additional analyses using alternative modeling approaches, Abrams found no statistically significant effect of time served.[74] He concluded: "The evidence seems to suggest that increasing sentences may reduce recidivism for short sentence lengths, but that the effect rapidly diminishes."[75] Green and Winik, in a study of drug defendants in Washington, D.C., found little evidence that randomly assigned months of time served in prison (or probation) reduced recidivism.[76] Finally, Cochran found that longer versus shorter stays in prison were associated with a greater likelihood of recidivism as compared to being sentenced to jail.[77]

Several of these recent studies are notable for examining the functional form of the time served and recidivism relationship. However, the focus on relatively short time-served durations, juveniles, or smaller samples constrained the ability to estimate the functional form more precisely and robustly. For example, many youths serve less than one year in prison, and comparing the first year of incarceration to a second year ignores the potential for nonlinear time served effects to surface within the first year after release. Even so, these studies underscore that theoretical and empirical grounds exist for anticipating nonlinear effects of time served on recidivism.

II. HYPOTHESES

Although a central purpose of lengthier terms of incarceration is to reduce recidivism, prior theory and research suggest that time served may have positive effects, negative effects, or null effects. These observations and scholarship point to three sets of possible relationships that may exist between time in prison and recidivism. In each instance distinct variations may occur. Each of the three sets of possibilities and the variations are discussed below in the form of hypotheses. We present the different possibilities as hypotheses because, as prior scholarship indicates, the

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[72] *See, e.g.*, Kristen Budd & Scott A. Desmond, *Sex Offenders and Sex Crime Recidivism: Investigating the Role of Sentence Length and Time Served*, 58 INT'L J. OFFENDER THERAPY & COMP. CRIMINOLOGY 1481, 1493–96 (2014).

[73] *See generally* Abrams, *supra* note 3.

[74] *Id.* at 74.

[75] *Id.*

[76] *See* Green & Winik, *supra* note 46, at 381.

[77] *See* Cochran et al., *supra* note 3, at 340–41.

specific anticipated relationship in each instance depends on theoretical assumptions about the experiences and psychological processes that occur during imprisonment.[78]

H1. TIME SERVED DECREASES RECIDIVISM

H1a (linear decrease). Greater time served will be associated with a linear decrease in the likelihood of recidivating.[79] Under this assumed relationship, each month of incarceration provides a constant additional reduction in recidivism. Incarceration experiences, including perceived "pains of incarceration," thus operate independently of experiences unique to the transition to or from prison and regardless of time already served.[80]

H1b (decelerating decrease). Greater time served will be associated with a lower likelihood of recidivism, but there will be diminishing returns associated with increasingly greater amounts of time served.[81] Here, initial months of incarceration provide greater recidivism reductions than do later months of incarceration. This model accords with the idea that it is the transition to prison, and the realization of the deprivations that incarceration entails, that induces the greatest deterrent effect. Thereafter, individuals adapt to prison and develop coping strategies.[82]

H1c (accelerating decrease). Greater time served will be associated with a lower likelihood of recidivism, but there will be increasingly greater reductions in recidivism associated with more time served.[83] That is, in contrast to hypothesis 1b, later months of incarceration reduce recidivism more so than do the early months. Why? One possibility is that inmates may view the initial months of imprisonment as more endurable. As time progresses, they may become increasingly aware of and affected by the deprivations that they face. Time served during these later months thus may provide a stronger deterrent effect.

H2. TIME SERVED INCREASES RECIDIVISM

H2a (linear increase). Greater time served will be associated with a linear increase in the likelihood of recidivating. Under this assumed

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[78] *See generally* Bushway & Owens, *supra* note 42; Cochran et al., *supra* note 3; Loughran et al., *supra* note 9; Nagin et al., *Imprisonment and Reoffending*, *supra* note 9; Orsagh & Chen, *supra* note 3; Paternoster, *supra* note 22; Snodgrass et al., *supra* note 7.

[79] *See* Budd & Desmond, *supra* note 72, at 1493.

[80] *See* SYKES, *supra* note 4.

[81] *See* Abrams, *supra* note 3, at 63–91; Loughran et al., *supra* note 9, at 726; Meade et al., *supra* note 53, at 538; Snodgrass et al., *supra* note 7, at 1174.

[82] *See* Adams, *supra* note 61, at 285.

[83] Orsagh & Chen, *supra* note 3, at 158.

relationship, each additional month of incarceration provides the same increase in the probability of recidivism. As per hypothesis 1a, this model anticipates that each month in prison provides the same additive effect. Here, though, the effect is an increase in recidivism, presumptively due to increasingly greater exposure to criminogenic influences, such as increased strain, reductions in social bonds, additional opportunities to learn about or become committed to criminal activity, and more exposure to actual or perceived procedural injustice, in turn contributing to defiant behavior.

H2b (decelerating increase). Greater time served will be associated with a higher likelihood of recidivism, but there will be diminishing returns associated with more time served. In this scenario, the initial months of incarceration provide greater increases in recidivism than do later months. The logic is the converse of that for hypothesis 1b. That is, the first part of a prison stay may be the most criminogenic for individuals; the severing of social bonds and the loss of social capital, for example, may be most likely to occur at this time. Subsequently, incarceration may exert a criminogenic effect on individuals, but to a lesser degree.

H2c (accelerating increase). Greater time served will be associated with a higher likelihood of recidivism, but there will be increasingly greater increases in recidivism associated with lengthier amounts of time served. Here, in contrast to hypothesis 2b, later months of incarceration provide greater increases in recidivism. This model may arise through different possibilities. For example, the initial period of incarceration may be primarily criminogenic, but there may be offsetting deterrent effects that mute the effect. However, after a period of time has passed, inmates may become more susceptible to criminogenic influences and be less deterred. A longer period of time in prison, for example, provides more opportunities to adopt or accept "criminal" labels, to associate with other criminals, and to become frustrated with perceived injustice. It also may lead some inmates to feel more shut out of their former social networks and to give up on the possibility of resuming a 'normal' lifestyle.

H3. TIME SERVED HAS A U-SHAPED ASSOCIATION WITH RECIDIVISM

H3a (U-shaped effect). In the initial period of incarceration, greater time served will decrease recidivism; subsequently, it will increase recidivism. Put differently, time served will have a U-shaped association with the probability of reoffending. As Orsagh and Chen have argued, rational choice theory suggests that "if the specific deterrent effect is positive, its marginal effect will decline with an increase in time served. This is based on the general tendency of individuals to place relatively less

value on experiences . . . that occur more distantly in time."[84] Lengthier prison stays, however, may result in adverse effects on employment and earnings that "counteract specific deterrence."[85] In addition, they may increasingly and adversely affect social bonds to family, friends, and community—in essence, they may sever these ties permanently—and social capital as well as create disruptions and strains that are criminogenic.[86] This model assumes that deterrent effects are greatest in the initial months of incarceration and that criminogenic effects are greatest, whether through an additive or interactive process, in the later months of incarceration.

H3b (inverted U-shaped effect). In the initial period of incarceration, greater time served will increase recidivism; subsequently, it will decrease recidivism. Recent studies have identified the potential for this inverted U-shaped association between time served and reoffending to exist.[87] The logic is similar to that for hypothesis 3a. However, the timing and relative strength of the intervening mechanisms change. For example, disruptions to social bonds and social capital and the inducement of social strains may occur most profoundly in the early months of incarceration and exert a criminogenic influence that overwhelms any potential specific deterrent effect. Subsequently, with these disruptions already in place, inmates adapt and, simultaneously, specific deterrent effects assume greater prominence and increasingly offset potential criminogenic effects of incarceration. In addition, rehabilitative programming is more likely to have occurred with sufficient intensity and duration to exert a beneficial effect.[88]

To date, prior studies have been used to point to support for one or the other hypotheses. However, few have directly examined the possibility that time served and recidivism may be associated in a curvilinear manner. One consequence of this situation is that many identified null effects of time served on recidivism may have masked countervailing U-shaped effects.[89] Some studies examine relatively short prison stays and so potentially capture only one aspect of the time served and recidivism relationships.[90] In addition, reviews and recent studies have highlighted that many extant empirical assessments of the time served and recidivism relationship have relied on weak research designs, such as using small samples and failing to

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[84] *Id.*

[85] *Id.*

[86] *See* Ekland-Olson et al., *supra* note 5, at 129.

[87] *See, e.g.*, Abrams, *supra* note 3; Loughran et al., *supra* note 9; Meade et al., *supra* note 53.

[88] Loughran et al., *supra* note 9, at 727.

[89] *See, e.g.*, Orsagh & Chen, *supra* note 3.

[90] *See, e.g.*, Loughran et al., *supra* note 9, at 700–02.

address potential confounding.[91] In short, how exactly time served is associated with the likelihood of recidivating remains largely unknown.

H4. TIME SERVED HAS NO EFFECT ON RECIDIVISM

Several grounds exist for anticipating no effect of time served on recidivism. First, research has identified mixed effects; some studies find that greater time served increases recidivism, others find that it decreases it, and still others find a null effect. The 'true' effect of time served, then, may lie in the middle—that is, it may have no consistently appreciable beneficial or harmful effect on recidivism. Second, more recent and methodologically rigorous studies suggest that null effects are likely.[92] Presumptively, based on prior reviews and recent studies, then, one might anticipate null effects to be the hypothesis most likely to be supported.

III. DATA AND METHODS

Data come from the Florida Department of Corrections (FDOC) Sentencing Guidelines database and include information on all imprisoned individuals who were convicted of felonies and released between 1994 and 2002 (N = 90,423). These data were matched to the FDOC's Offender Based Information System (OBIS), which provides information on inmate prior records, release dates, and recidivism.[93] The measures for the study are described below and in table 1.

Table 1. Descriptive Statistics (N=90,423)

Variables	Mean	S.D.	Min	Max
Outcome: Reconviction within 3 years (1/0)	.47	.50	0	1
Treatment: Time served (no. of months)	23.97	16.00	1	106
Male (1/0)	.92	.28	0	1
White (1/0)	.38	.49	0	1
Black (1/0)	.56	.50	0	1
Latino (1/0)	.06	.24	0	1
Age (years)	32.63	9.63	13	90

[91] *See, e.g.*, GENDREAU ET AL., *supra* note 44; Abrams, *supra* note 3; Green & Winik, *supra* note 46; Meade et al., *supra* note 53; Nagin et. al., *Imprisonment and Reoffending*, *supra* note 9.

[92] *See, e.g.*, Green & Winik, *supra* note 46; Loughran et al., *supra* note 9; Meade et al., *supra* note 53; Snodgrass et al., *supra* note 7.

[93] *See* Bales & Piquero, *supra* note 29, *passim*.

Variables	Mean	S.D.	Min	Max
Primary offense (PO)–murder (1/0)	.02	.13	0	1
Primary offense (PO)–sex crime (1/0)	.04	.19	0	1
Primary offense (PO)–robbery (1/0)	.08	.28	0	1
Primary offense (PO)–other violent (1/0)	.16	.37	0	1
Primary offense (PO)–burglary (1/0)	.18	.39	0	1
Primary offense (PO)–property (1/0)	.14	.34	0	1
Primary offense (PO)–weapons (1/0)	.03	.18	0	1
Primary offense (PO)–drug (1/0)	.28	.45	0	1
Primary offense (PO)–other (1/0)	.07	.26	0	1
Prior convictions (PC)–violent (count)	.26	.79	0	13
Prior convictions (PC)–sex crime (count)	.03	.29	0	33
Prior convictions (PC)–property (count)	.84	2.70	0	103
Prior convictions (PC)–drug (count)	.44	1.42	0	69
Prior convictions (PC)–other (count)	.15	.55	0	19
Prior prison commitments (count)	1.25	1.59	0	12
Prior supervision violations (count)	1.38	1.45	0	11
Offense severity score (continuous)	37.24	22.23	4	116
Prior record score (continuous)	17.24	18.19	0	653
Year–1994 (1/0)	.07	.26	0	1
Year–1995 (1/0)	.13	.33	0	1
Year–1996 (1/0)	.13	.34	0	1
Year–1997 (1/0)	.14	.35	0	1
Year–1998 (1/0)	.14	.35	0	1
Year–1999 (1/0)	.15	.36	0	1
Year–2000 (1/0)	.14	.34	0	1
Year–2001 (1/0)	.08	.27	0	1
Year–2002 (1/0)	.01	.11	0	1
Judicial circuit 1 (1/0)	.04	.20	0	1
Judicial circuit 2 (1/0)	.03	.16	0	1
Judicial circuit 3 (1/0)	.01	.11	0	1
Judicial circuit 4 (1/0)	.07	.26	0	1
Judicial circuit 5 (1/0)	.04	.20	0	1
Judicial circuit 6 (1/0)	.10	.30	0	1
Judicial circuit 7 (1/0)	.04	.20	0	1
Judicial circuit 8 (1/0)	.03	.16	0	1
Judicial circuit 9 (1/0)	.07	.25	0	1
Judicial circuit 10 (1/0)	.05	.22	0	1
Judicial circuit 11 (1/0)	.07	.26	0	1
Judicial circuit 12 (1/0)	.03	.17	0	1
Judicial circuit 13 (1/0)	.09	.28	0	1

Variables	Mean	S.D.	Min	Max
Judicial circuit 14 (1/0)	.03	.17	0	1
Judicial circuit 15 (1/0)	.05	.21	0	1
Judicial circuit 16 (1/0)	.01	.08	0	1
Judicial circuit 17 (1/0)	.15	.35	0	1
Judicial circuit 18 (1/0)	.03	.18	0	1
Judicial circuit 19 (1/0)	.03	.18	0	1
Judicial circuit 20 (1/0)	.03	.17	0	1

The main dependent variable for this study is recidivism, measured as the first felony conviction for a new offense within three years after prison release. For this measure, the date on which the offense occurred serves as the date of recidivism. Use of conviction necessitated reliance on statewide court data on felony convictions. Consistent with national estimates, 47% of the sample was reconvicted within three years of release.[94] In some studies, reconviction may be problematic as a measure of recidivism because it may miss the fact that some ex-prisoners may violate conditions of parole and be re-incarcerated. That, in turn, would result in a form of censoring that would make it appear that an individual had not recidivated when in fact that had violated conditions of parole.[95] This issue is not problematic for the present study because in Florida, the legislature abolished parole in 1983.[96] Accordingly, in our sample, which used a release cohort from 1994–2002, substantially fewer than one percent of inmates were released to parole.

A focus on felony conviction ensures that more serious offending is examined and reduces, but does not eliminate, some of the problems associated with using arrest, such as the greater likelihood that recidivism in such instances includes situations where no offense occurred or measures both reoffending and differential police responses.[97] Additionally, it is consistent with the bulk of studies that examine recidivism, which as a Campbell Collaboration review highlighted, that typically operationalize recidivism using reconviction.[98] Although ideally it would be possible to replicate the analyses using re-arrest, these data were not available for this

[94] *See* DUROSE ET AL., *supra* note 31, at 8.

[95] *See* Michael Ostermann et al., *How Different Operationalizations of Recidivism Impact Conclusions of Effectiveness of Parole Supervision*, 52 J. RES. CRIME & DELINQ. 771, 776 (2015) (finding that parole violators may be reincarcerated without being reconvicted).

[96] Bales & Piquero, *supra* note 29.

[97] *See* MICHAEL D. MALTZ, RECIDIVISM *passim* (1984) (describing the various ways to conceptualize, operationalize, and measure reoffending).

[98] *See* VILLETTAZ ET AL., *supra* note 44.

study. Even so, little evidence exists to suggest that the estimated effects of time served vary depending on the measure of recidivism.[99] Use of a three-year post-release observation window ensures that the analyses do not focus primarily on individuals likely to fail immediately upon reentry.[100]

Given the study's focus, the independent variable is time served, measured in months. The average time served was twenty-four months and the range was 1 month to 106 months. Only prison time, not jail time, was counted. Accordingly, for all inmates, the time served measure underestimates total time served but should not influence the estimated effect of time served on recidivism.

For the analyses, matching covariates were included to address potential confounding that might bias the estimated time-served effect. The study includes confounders that prior work and reviews have identified.[101] These include: sex (male, female); race and ethnicity (non-Latino white, non-Latino black, Latino); age (measured in years); primary offense type (murder, sex crime, robbery, other violent, burglary, property, weapons, drug, other); prior conviction counts, by offense type (violent, sex crime, property, drug, other); prior prison commitments (count); prior supervision violations (count); an offense severity score created by the FDOC using their OBIS database (lower scores indicate less serious crimes and higher scores indicate more serious crimes); a prior record score, also created by the FDOC, that uses the Guidelines data and that counts all prior violations, felonies, and classifications as violent career criminal or habitual offender (lower scores indicate a more serious prior record and higher scores indicate a less serious prior record); the year of release from prison (measured using dummy variables); and the judicial circuit in which inmates were sentenced (measured using dummy variables). This last measure was included because cases are clustered in circuit courts. By including dummy variables in the statistical model, the non-independence of nested observations can be addressed. It was included as well because judicial circuit may be an important matching measure if there is important variation in, for example, the average length of sentences in circuits or in the types of experiences offenders have with the court system in a given judicial circuit, which may affect both the amount of time served in prison and the likelihood of recidivism upon release.

One of the central challenges in assessing the effect of time served, or

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[99] *See* Loughran et al., *supra* note 9, at 726.

[100] *See* DUROSE ET AL., *supra* note 31, at 8. *See generally* Cochran et al., *supra* note 3.

[101] *See generally* GENDREAU ET AL., *supra* note 44; Abrams, *supra* note 3; Meade et al., *supra* note 53; Nagin et al., *Imprisonment and Reoffending*, *supra* note 9; Snodgrass et al., *supra* note 7.

the "dose" of imprisonment, is the fact that confounding may be unevenly distributed across dose levels; as with an experiment, there ideally is balance on covariates across these levels.[102] An approach is needed that can address this situation and, simultaneously, allows for estimation of a nonlinear relationship between time served and recidivism.[103]

Accordingly, we employ generalized propensity score (GPS) modeling using Stata's doseresponse.ado package.[104] GPS analyses extend the logic of propensity score matching (PSM) to a dose-response context in which the treatment is continuous rather than binary.[105] The steps, discussed below, include: (1) estimating the generalized propensity score; (2) assessing balance on covariates across dose levels; and (3) generating the dose-response curve and standard errors via bootstrapping.[106] A central advantage of using GPS is that it allows for more systematic adjustment for observed confounding and for estimation of diverse functional forms.[107]

IV. FINDINGS

In the first step of the analyses, we estimated the conditional distribution of time served given the matching covariates in table 1. The prediction model, shown in table 2, was estimated using ordinary least squares regression and the natural log of time served as the dependent variable to satisfy the normality assumption.[108] As inspection of the table highlights, many factors are associated, as anticipated, with serving more time. Males, blacks, and older inmates, on average, serve lengthier prison

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[102] *See* Nagin et al., *Imprisonment and Reoffending*, *supra* note 9, at 177.

[103] *See generally* Abrams, *supra* note 3; Loughran et al., *supra* note 9; Meade et al., *supra* note 53; Orsagh & Chen, *supra* note 3.

[104] *See, e.g.*, Michela Bia & Alessandra Mattei, *A Stata Package for the Estimation of the Dose-Response Function Through Adjustment for the Generalized Propensity Score*, 8 STATA J. 354 *passim* (2008).

[105] *Id.*

[106] *See generally* Keisuke Hirano & Guido W. Imbens, *The Propensity Score with Continuous Treatments*, *in* APPLIED BAYESIAN MODELING AND CAUSAL INFERENCE FROM INCOMPLETE DATA PERSPECTIVES 73 *passim* (Andrew Gelman & Xiao-Li Meng eds., 2004); Sascha O. Becker et al., *Too Much of a Good Thing? On the Growth Effects of the EU's Regional Policy*, 56 EUR. ECON. REV. 648 *passim* (2012); Jochen Kluve et al., *Evaluating Continuous Training Programmes by Using the Generalized Propensity Score*, 175 J. ROYAL STAT. SOC'Y 587, 594–600 (2012); Anke Ramakers et al., *Imprisonment Length and Post-Prison Employment Prospects*, 52 CRIMINOLOGY 399, 409–19 (2014); Michela Bia et al., *A Stata Package For The Application Of Semiparametric Estimators Of Dose-Response Functions* (CEPS/INSTEAD, Working Paper No. 2013-07, 2013); Bia & Mattei, *supra* note 104.

[107] Bia & Mattei, *supra* note 104; Bia et al., *supra* note 106, *passim*.

[108] Bia & Mattei, *supra* note 104, at 357.

terms, and so, too, do murderers, sex offenders, and other violent offenders. Prior convictions (but not prior commitments) and higher offense severity scores and prior record scores were positively associated with time served. Sentence length was not included because of co-linearity problems. All of the identified effects held net of controls for release year and circuit court. Collectively, they explain approximately 31% of the variation in time served. Studies of time-served effects on recidivism typically have not included estimate of the extent to which independent variables predict time served, in part because the modeling typically has not employed a propensity score analysis approach; instead time served is included along with control variables to predict recidivism. The variance explained in time served is lower than what is found in some studies of sentence length but is on par with that found in others and is substantially greater than some studies of time served.[109] As emphasized below, unobserved confounding may exist and influence the estimated effects.

Table 2. Ordinary Least Squares Regression of Logged Time Served on Matching Covariates

	B	S.E.
Male (1/0)	.039***	(.007)
Black (1/0)[a]	.021***	(.004)
Latino (1/0)[a]	.016	(.009)
Age (years)	.003***	(.000)
Primary offense (PO)–murder (1/0)[b]	.396***	(.016)
Primary offense (PO)–sex crime (1/0)[b]	.154***	(.012)
Primary offense (PO)–robbery (1/0)[b]	.112***	(.009)
Primary offense (PO)–other violent (1/0)[b]	.090***	(.006)
Primary offense (PO)–burglary (1/0)[b]	.075***	(.006)
Primary offense (PO)–property (1/0)[b]	.081***	(.007)
Primary offense (PO)–weapons (1/0)[b]	.093***	(.011)
Primary offense (PO)–other (1/0)[b]	.048***	(.008)
Prior convictions (PC)–violent (count)	.019***	(.003)
Prior convictions (PC)–sex crime (count)	.038***	(.007)

[109] *See, e.g.*, Rodney L. Engen & Randy R. Gainey, *Modeling the Effects of Legally Relevant and Extralegal Factors Under Sentencing Guidelines: The Rules Have Changed*, 38 CRIMINOLOGY 1207, 1217 (2000); Evelyn J. Patterson, *Hidden Disparities: Decomposing Inequalities in Time Served in California, 1985-2009*, 49 LAW & SOC'Y REV. 467, 478 (2015); Brent L. Smith & Kelly R. Damphousse, *Terrorism, Politics, and Punishment: A Test of Structural-Contextual Theory and the 'Liberation Hypothesis'*, 36 CRIMINOLOGY 67, 77 (1998).

	B	S.E.
Prior convictions (PC)–property (count)	.013***	(.001)
Prior convictions (PC)–drug (count)	.017***	(.001)
Prior convictions (PC)–other (count)	.006	(.004)
Prior prison commitments (count)	.010	(.002)
Prior supervision violations (count)	-.001***	(.002)
Offense severity score (continuous)	.010***	(.000)
Prior record score (continuous)	.008***	(.000)
Year dummy variables[c]	——	——
Judicial circuit dummy variables[c]	——	——
Constant	2.449***	(.022)
R-squared = .310		

*** p < .001

a. "White" serves as the reference category.

b. "Primary offense (PO)–drugs" serves as the reference category.

c. Year and judicial circuit dummy variables were included in the model but are not shown here to conserve space (coefficient and standard error estimates available upon request).

In studies that examine binary treatments, the propensity score is defined as the conditional probability of being in the treatment or control group.[110] Similarly, the generalized propensity score is defined as the conditional probability of receiving the dosage actually received.[111] The binary treatment case propensity score for an individual in the treatment group is computed as the conditional (on balancing attributes) probability of being in the treatment group; the propensity score for an individual in the control group is computed as the conditional probability of being in the control group.[112] This logic extends to continuous treatments.[113] For example, the generalized propensity score for an individual serving seven months in prison is computed as the conditional (on balancing attributes) probability of serving seven months in prison, based on the estimated model. The difference with GPS analyses as compared to PSM analyses is that the focus centers on a continuum of possible groups, in this case, different levels of time served.

[110] Peter C. Austin, *An Introduction of Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies*, 46 MULTIVARIATE BEHAV. RES. 399, 402 (2011).

[111] Bia & Mattei, *supra* note 104, at 357.

[112] Austin, *supra* note 110, at 402–03.

[113] *See generally* Bia & Mattei, *supra* note 104.

Central to GPS analyses is assessment of covariate balance across treatment levels or, in this study, amounts of time served. The end goal is to estimate the effect of treatment by addressing confounding across various levels of treatment. Following the GPS procedure detailed in Hirano and Imbens, propensity scores were created using the GPS equation and the parameter estimates from the model in table 2, as implemented in Stata's gpscore.ado program.[114] Kluve has emphasized that "the GPS has a balancing property that is similar to the balancing property of the propensity score in binary treatments."[115] The main assumption underlying the approach is that treatment level assignment is "weakly un-confounded given [a] set of observable variables."[116] This assumption, when "combined with the balancing score property, implies that assignment to treatment is weakly un-confounded given the GPS."[117]

In short, the GPS allows for removal of potential bias if the covariates are balanced across levels of treatment.[118] Accordingly, following recommendations by Hirano and Imbens, we created four equal-sized time-served intervals.[119] We then compared the covariate means for each group with those of the other three after balancing the covariates using the GPS adjustment. The resulting post-matching t-test comparisons are presented in table 3.

[114] *See generally* Bia & Mattei, *supra* note 104; Hirano & Imbens, *supra* note 106, at 73.

[115] Kluve et al., *supra* note 106, at 596.

[116] *See* Bia et al., *supra* note 106, at 3.

[117] *See id.* at 4.

[118] Becker et al., *supra* note 106, at 665.

[119] *See generally* Hirano & Imbens, *supra* note 106.

Table 3. Covariate Balance Statistics Before and After Adjustment by Generalized Propensity Score

	Pre-Adjustment		Post-Adjustment		% Mean Diff.	% Remaining
Interval 1: 1-12 Mos.	Mean Diff.	*t*-value	Mean Diff.	*t*-value	Reduction	Mean Diff.
Male	.03	15.72	.01	4.04	-72.2	.91
White	.00	.12	.00	-.42	-513.1	-.18
Black	-.01	-2.80	.00	-.56	-77.0	-.24
Latino	.01	5.66	.01	2.84	-41.3	.59
Age	.32	4.36	-.02	-.26	-106.8	-.03
PO-murder	.02	19.02	.01	9.53	-34.1	1.19
PO-sex	.03	19.73	.01	7.86	-49.4	1.45
PO-robbery	.05	23.11	.02	7.47	-60.1	1.92
PO-other viol	.03	11.51	.01	1.55	-84.1	.50
PO-burglary	.05	18.75	.01	2.57	-83.7	.88
PO-property	-.06	-22.52	-.02	-8.57	-59.5	-2.35
PO-weapon	.00	2.10	.00	-3.04	-268.9	-.49
PO-drug	-.10	-29.50	-.02	-5.47	-80.4	-1.93
PO-other	-.03	-13.56	-.01	-5.48	-56.1	-1.17
PC-violent	.10	16.43	.05	6.97	-48.3	.42
PC-sex	.02	10.84	.01	5.18	-38.5	.18
PC-property	.31	15.47	.16	6.51	-47.3	.34
PC-drug	.07	6.28	.04	3.45	-34.1	.30
PC-other	.02	5.55	.01	2.60	-45.2	.14
Pr commit	.11	9.07	.03	1.87	-75.9	.24
Pr violations	-.12	-11.11	-.01	-.85	-91.4	-.09
Off sev score	11.72	72.12	5.03	27.92	-57.1	4.49
Pr rec score	4.23	31.12	2.46	14.64	-41.9	.41

Table 3. Covariate Balance Statistics Before and After Adjustment by Generalized Propensity Score (Cont'd)

	Pre-Adjustment		Post-Adjustment		% Mean Diff.	% Remaining
Interval 2: 13-19 Mos.	Mean Diff.	*t*-value	Mean Diff.	*t*-value	Reduction	Mean Diff.
Male	.01	3.93	.01	2.39	-37.8	.53
White	.00	-.56	-.01	-2.11	297.2	-.84
Black	.00	.48	.01	3.03	563.0	1.23
Latino	.00	.15	.00	-1.00	-813.8	-.19
Age	.46	6.08	.36	4.59	-20.7	.53
PO-murder	.01	14.75	.01	9.12	-28.1	1.05
PO-sex	.02	11.45	.01	4.93	-52.0	.83
PO-robbery	.03	14.92	.02	8.83	-35.8	2.08
PO-other viol	.01	3.39	.01	1.98	-38.9	.59
PO-burglary	.02	7.01	.01	2.38	-64.3	.76
PO-property	-.02	-7.85	-.01	-4.10	-47.7	-1.10
PO-weapon	.00	-.77	.00	1.44	-288.7	.21
PO-drug	-.05	-14.66	-.01	-2.34	-84.3	-.80
PO-other	-.02	-10.55	-.02	-9.12	-12.0	-1.90
PC-violent	.06	9.61	.04	6.02	-32.4	.50
PC-sex	.01	5.09	.01	2.38	-46.7	.10
PC-property	.14	6.60	.07	2.93	-50.9	.10
PC-drug	-.01	-1.05	-.02	-1.93	95.9	-.10
PC-other	.00	.19	.00	-.81	-540.8	-.05
Pr commit	.05	3.81	-.03	-2.24	-154.9	-.22
Pr violations	-.09	-7.62	.08	5.95	-189.5	.86
Off sev score	6.49	37.64	3.79	22.21	-41.6	3.39
Pr rec score	1.80	12.64	1.63	10.43	-9.2	.93

Table 3. Covariate Balance Statistics Before and After Adjustment by Generalized Propensity Score (Cont'd)

	Pre-Adjustment		Post-Adjustment		% Mean Diff.	% Remaining
Interval 3: 20-31 Mos.	Mean Diff.	*t*-value	Mean Diff.	*t*-value	Reduction	Mean Diff.
Male	-.01	-3.02	.00	.28	-109.8	.06
White	.00	.89	.00	.84	-3.5	.32
Black	.00	-.13	-.01	-1.50	1116.1	-.59
Latino	.00	-1.58	.00	-.67	-56.7	-.12
Age	.22	3.03	.46	6.03	103.5	.61
PO-murder	.01	6.97	.00	4.41	-32.3	.46
PO-sex	.00	.41	.01	3.71	791.3	.55
PO-robbery	.01	4.97	.02	7.87	58.6	1.68
PO-other viol	-.02	-5.44	.00	-1.36	-75.0	-.38
PO-burglary	-.02	-6.10	.00	.70	-111.3	.20
PO-property	.01	3.79	.00	-1.45	-139.9	-.40
PO-weapon	-.01	-3.81	.00	-2.27	-40.5	-.32
PO-drug	.01	1.48	.01	2.22	55.0	.79
PO-other	.01	2.80	.00	.53	-80.0	.11
PC-violent	-.03	-4.50	-.01	-1.88	-57.8	-.09
PC-sex	.00	1.48	.00	1.82	29.8	.05
PC-property	.01	.41	.05	2.53	529.0	.09
PC-drug	-.05	-4.31	-.03	-2.59	-39.4	-.11
PC-other	-.01	-2.18	-.01	-1.16	-45.5	-.03
Pr commit	-.07	-5.67	-.03	-2.79	-50.1	-.29
Pr violations	-.03	-2.58	-.05	-4.43	76.3	-.46
Off sev score	-.95	-5.56	1.03	6.02	-208.0	.92
Pr rec score	-5.56	-11.52	-1.11	-7.73	-80.0	-.49

Table 3. Covariate Balance Statistics Before and After Adjustment by Generalized Propensity Score (Cont'd)

	Pre-Adjustment		Post-Adjustment		% Mean Diff.	% Remaining
Interval 4: 32-106 Mos.	Mean Diff.	*t*-value	Mean Diff.	*t*-value	Reduction	Mean Diff.
Male	-.04	-16.96	-.02	-7.26	-42.5	-2.07
White	.00	-.47	.01	2.60	-787.6	1.20
Black	.01	2.52	-.01	-2.26	-215.4	-1.11
Latino	-.01	-4.36	.00	-.57	-83.5	-.13
Age	-1.00	-13.50	-.08	-.84	-92.1	-.12
PO-murder	-.04	-41.30	.00	-.60	-98.6	-.06
PO-sex	-.05	-32.03	.00	.45	-101.5	.07
PO-robbery	-.09	-43.71	-.01	-4.34	-88.8	-1.03
PO-other viol	-.03	-9.68	-.02	-6.12	-20.6	-2.16
PO-burglary	-.06	-20.01	-.02	-4.33	-73.8	-1.55
PO-property	.07	27.05	.00	.34	-98.3	.12
PO-weapon	.00	2.42	-.01	-6.85	-474.0	-1.27
PO-drug	.15	43.46	.04	8.35	-74.6	3.75
PO-other	.04	21.51	.02	8.01	-49.5	2.19
PC-violent	-.13	-21.82	.00	-.26	-98.6	-.01
PC-sex	-.04	-17.63	-.01	-3.69	-74.9	-.03
PC-property	-.47	-22.80	-.08	-3.35	-83.2	-.08
PC-drug	-.01	-1.09	.08	6.14	-788.0	.12
PC-other	-.02	-3.69	.02	4.54	-253.8	.24
Pr commit	-.09	-7.37	-.13	-8.49	46.0	-1.20
Pr violations	.24	21.52	.03	2.38	-85.6	.38
Off sev score	-17.65	-110.00	-.74	-4.75	-95.8	-.66
Pr rec score	-4.57	-32.83	-2.04	-12.41	-55.4	-.31

Across each of the four interval comparisons, reduction in covariate differences from pre-adjustment to post-adjustment is considerable. The pre-adjustment mean values are obtained by comparing the average for a given covariate in a given interval to the average of that covariate for all other intervals (i.e., percent male in interval 1 vs. percent male in the other intervals). To test the balancing property requires, as Becker has emphasized, comparing "observed characteristics of units within a specific block of predicted transfer intensity [treatment] across groups of actual

[treatment]."[120] Accordingly, the post-adjustment mean values are obtained by creating decile blocks within each treatment interval, based on the GPS score. Then, the specific algorithm in the gpscore.ado program involves comparing each interval-block to cases in all other "control" blocks—which are based on the GPS score—across the other three intervals.[121]

Column 3 in table 3 presents the resulting mean difference comparisons, weighted to adjust for differences in the numbers of individuals in various blocks. Because of the large number of comparisons, we present only the resulting mean difference comparisons, not the actual mean values. As inspection of column 3 highlights, the mean differences are nearly zero across almost all of the covariates in each of the intervals. This pattern suggests that balance on covariates is achieved through the GPS adjustment. Inspection of column 4 highlights that the GPS adjustment in fact improved covariate balance. In the vast majority of comparisons, for example, covariate differences across the intervals were reduced by 40% or more, which in turn contributes to the near-zero mean differences across the covariates, as shown in column 3.

Even with the adjustment, some non-zero mean differences in several covariates (e.g., the offense severity score and the prior record score) remain, which may signal potential concern about imbalance. However, in these cases, the substantive difference in covariates is minor, as shown in column 5. This column displays the percentage mean difference in covariates between a given interval and all other intervals after the GPS adjustment and taking into account the range of each covariate. We focus here on the percentage mean differences because the large sample size results in large t-test values even when substantive mean differences are trivial. Specifically, the percentage is calculated by dividing the post-adjustment mean difference in a given covariate in a given interval as compared to the covariate mean in the other intervals by the range of a given variable. It, thus, provides an indicator of the relative amount of variation remaining after adjustment, based on any given variable's scale. For example, age, in interval 2, has a remaining post-adjustment mean difference of .36 years, as can be seen in column 3. The range for age is 69 (inmate ages ranged from 15 to 84). Dividing the difference (.36) by the range (69) results in the percentage mean difference of .53, or a less than 1% difference. Notably, in 84% of the 92 covariate comparisons, the remaining difference in means was 2 percentage points or less of the original scale of the variables. In all others, the difference was less than 5%

[120] Becker et al., *supra* note 106, at 656 (emphasis omitted).

[121] *Id.* at 648, 656.

of the original scale.

In short, the GPS adjustment resulted in time served group comparisons that appeared similar with respect to the covariates, thus reducing concern that any estimated effect of time served on recidivism was appreciably influenced by confounding. Even so, it bears emphasizing that bias due to unobservable confounding, which affects any quasi-experimental assessment of time-served effects, still may persist.[122]

Just as when conducting PSM analyses, attention to the common support area of treatment propensity when assessing treatment dosages helps to improve comparability of cases across levels of treatment and in turn the validity of treatment effect estimates. We imposed the common support condition by evaluating GPS values at median treatment intensities across deciles of time served and by excluding any cases in a given decile with an estimated propensity value beyond the range of values estimated for the control cases in the other nine deciles.[123] For the full sample analysis, only sixty-five cases were found to be outside of the region of common support.

The covariate balance achieved through the GPS adjustment sets the foundation for the second step of the GPS analyses—estimation of the outcome, recidivism, as a function of time served and the propensity score. Table 4 presents this model. Logistic regression analysis is used to predict recidivism using time served, the GPS, quadratic specifications of each, and the interaction of time served and the GPS. Following Bia and Mattei, other polynomial specifications were investigated, but this model provided the best fit.[124] Hirano and Imbens emphasized that "there is no direct meaning to the estimated coefficients in [the GPS model]."[125] However, statistically significant GPS coefficients, as in table 4, indicate that the scores and procedure are useful and needed in removing potential bias.[126]

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122 Snodgrass et al., *supra* note 7, at 1166.

123 *See generally* Becker et al., *supra* note 106; Bia et al., *supra* note 106 (detailing this approach).

124 Bia & Mattei, *supra* note 104, at 359.

125 Hirano & Imbens, *supra* note 106, at 82.

126 Kluve et al., *supra* note 106, at 605.

Table 4. Logistic Regression Generalized Propensity Score Analysis Predicting Recidivism

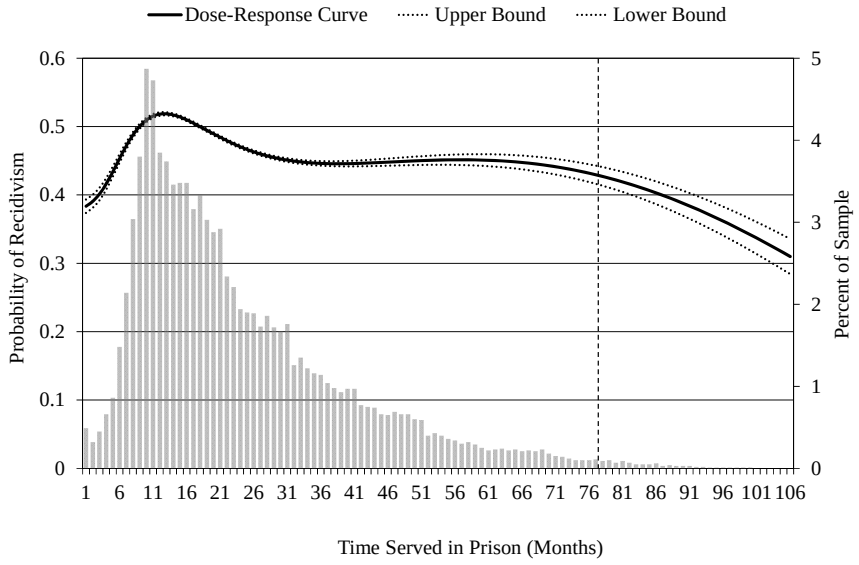
	B	S.E.
Time served	.0250***	(.002)
Time served x time served	-.0003***	(.000)
Generalized propensity score (GPS)	-1.9418***	(.178)
GPS x GPS	-.9883***	(.201)
Time served x GPS	-.0614***	(.002)
Constant	-.4995***	(.039)
Log likelihood = -61,532.419		
Pseudo R-squared = .014		

*** p < .001

The final step involves specifying a second regression model that specifies the conditional expectation of recidivism given the estimated GPS and observed treatment intensity (i.e., time served), with standard errors and confidence intervals generated through bootstrapping.[127] The predicted recidivism values for different values of time served result in a distribution of predicted probabilities referred to as a dose-response function. Figure 1 displays the resulting dose-response curve from the GPS analyses; the y-axis on the left presents the predicted probabilities of recidivism and the x-axis displays values for time served. The response curve and confidence intervals are shown. The y-axis on the right presents the percentage distribution of cases across time served, as indicated by the bars.

[127] Bia & Mattei, *supra* note 104, at 359.

Figure 1. Dose-Response Estimation of Effect of Time Served on Recidivism, Conditional on Generalized Propensity Score



Four distinct patterns warrant mention. First, from 1 to 12 months, greater time served is associated with an increased probability of recidivism, rising from 38% to a peak of 51% at one year. Second, from 13–24 months, greater time served is associated with a decreased probability of recidivism; the decrease levels off at approximately two years. At that point, the probability of recidivism is approximately 47%, below the peak probability of recidivism at one year but above the probability of recidivism associated with incarceration for terms of incarceration spanning one to six months. Third, this probability of recidivism then remains relatively level for incarceration terms of 25–60 months (3–5 years). Fourth, for inmates serving approximately six years or more, the probability of recidivism slowly and monotonically declines. However, the error associated with this estimate increases as well, as reflected in the widening confidence intervals (95% level), in turn suggesting that inferences about time served effects past six years should be made with caution. This situation stems from the fact that fewer than 2% of inmates served prison terms of that length. In short, the results from figure 1 indicate support for hypothesis 3b that an inverted U-shaped association characterizes the time served and recidivism relationship.

Several additional analyses reinforced this assessment. The first set revisited the GPS modeling after eliminating inmates who served six years or more. For inmates serving less than six years in prison, the inverted U-shaped pattern remained. The second set examined whether the use of different modeling approaches—including logistic regression model estimation with a polynomial specification for time served,[128] semi-parametric and non-parametric GPS specifications, and generalized additive models (GAM)—identified a markedly different functional form from that shown here.[129] They did not. Rather, they reinforced the GPS findings, including both the inverted U-shaped effect and the uncertainty associated with estimates of time-served effects among individuals serving more than six years in prison.

Finally, a third set of analyses entailed repeating the GPS procedure for different inmate populations. As inspection of figure 2 highlights, a similar inverted U-shaped association emerged that is largely similar across demographic groups (i.e., age, sex, and race and ethnicity) and among inmates who previously were incarcerated versus those who were not. That is, for inmates with different records of prior commitments, different age groups; males and females; and whites, blacks, and Latinos, the pattern in figure 1 surfaces. For each inmate group, greater time served initially is associated with increased recidivism, then it is associated with decreased recidivism, before tapering off to a relatively flat or slowly declining probability of recidivism.

This up-down-tapering pattern reflects a markedly different probability of recidivism, by month, than that suggested by the overall base rate of recidivism for the 3-year post-release time span for each of the respective groups. The group-specific base recidivism rates were as follows: 0 prior commitments (38%), 1 prior commitment (48%), 2+ prior commitment (58.3%), males (47%), females (39%), age 23 or less (52%), age 24–29 (48%), age 30–35 (48%), age 36–41 (47%), age 41 and older (37%), whites (37%), blacks (54%), and Latinos (38%).

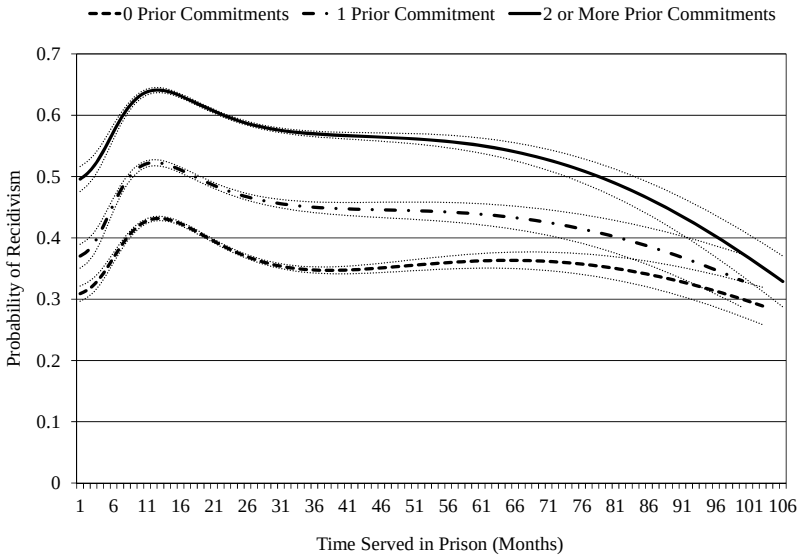
Although these base recidivism rates provide important information, they also obscure the fact that the estimated probability of recidivism associated with a given duration of incarceration varies greatly. For example, as can be seen in figure 1, among inmates incarcerated for one year—and as compared with inmates incarcerated for one month—the probability of recidivism increases by approximately 14% (from approximately 38 percent to 52%). It then declines by approximately 6%

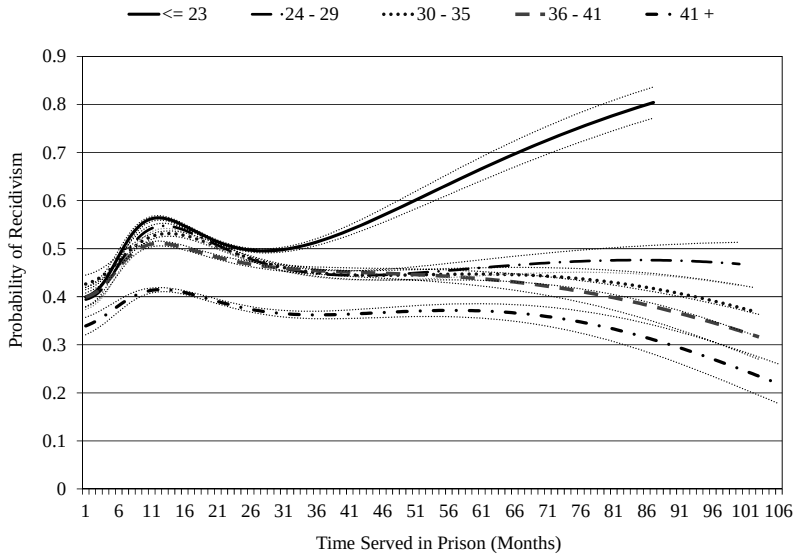
[128] *See* Appendix.

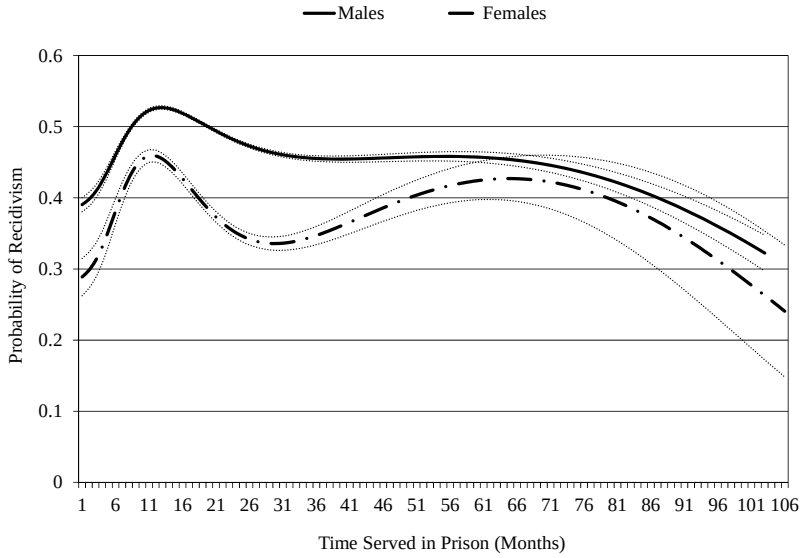
[129] *See* Bia et al., *supra* note 106.

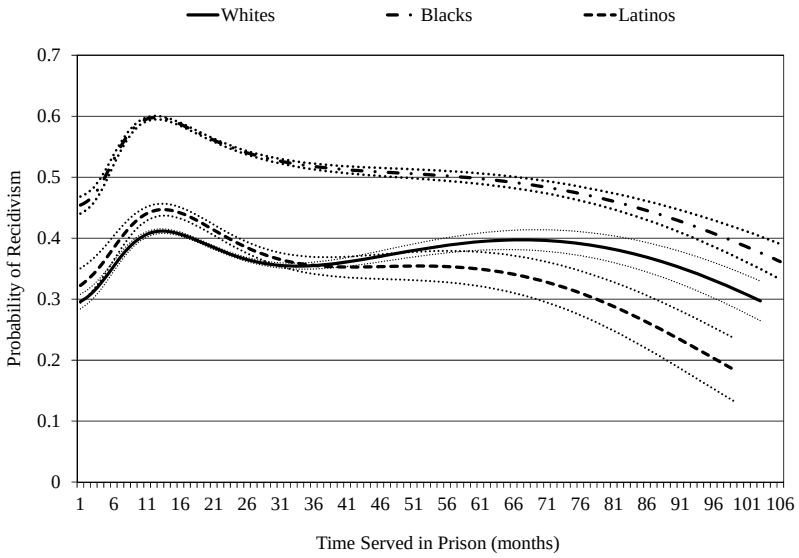
from one year to two years (from 52% to 46%). In figure 2, the magnitude of these up-then-down changes is largely similar across the various groups, with minor fluctuations evident. For example, among females, the decline in recidivism associated with going from one year of incarceration to two years of incarceration is more pronounced than it is for males. Also, for inmates age 41 and older, the magnitude of changes in the probability of offending associated with one month, one year, and two years of incarceration, respectively, is more muted than for other age groups.

Figure 2. Dose-Response Effect of Time Served on Recidivism, Conditional on Generalized Propensity Score, by Inmate Groups




<= 23
24 - 29
30 - 35
36 - 41
41 +
Probability of Recidivism
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 6 11 16 21 26 31 36 41 46 51 56 61 66 71 76 81 86 91 96 101 106
Time Served in Prison (Months)


Males
Females
Probability of Recidivism
0.6
0.5
0.4
0.3
0.2
0.1
0
1 6 11 16 21 26 31 36 41 46 51 56 61 66 71 76 81 86 91 96 101 106
Time Served in Prison (Months)



The only group for which a departure from the inverted U-shaped pattern emerged was for individuals age 23 or younger. For this group, time served up to 2.5 years exerted a similar effect as it did for other groups on the probability of recidivism. Thereafter, however, greater amounts of time served were estimated to increase this probability. This pattern suggests that prison durations of three years or longer may be primarily criminogenic for younger inmates. The well-established age-crime curve—with offending rapidly escalating during adolescence and then rapidly declining during late adolescence and early young adulthood—might explain in part for this finding.[130] Yet, it appears unlikely to do so because the main pattern of results for the 23-and-under inmates parallels that for the other age groups. For example, time served initially is associated with a greater likelihood of recidivism but then after approximately twelve months it is associated with a lower likelihood of recidivism. Among younger inmates, the increase in recidivism associated with terms of incarceration longer than three years is anomalous relative to all other age groups. It is anomalous, too, because an age-crime curve account anticipates that lengthier terms of incarceration for younger inmates would, if anything, be associated with more dramatic declines in recidivism than for other groups. Precisely the opposite holds,

[130] *See* FROM JUVENILE DELINQUENCY TO ADULT CRIME: CRIMINAL CAREERS, JUSTICE POLICY, AND PREVENTION 4 (Rolf Loeber & David P. Farrington eds., 2012) (describing patterns of offending from mid-adolescence to early adulthood).

however, suggesting that for younger inmates, lengthy prison terms may be more criminogenic than for older inmates. Regardless, the fact that the main pattern of results held for all other age groups suggests that identified effects of time served do not appear likely to be influenced by confounding associated with age.

CONCLUSION

Incarceration constitutes one of the central instruments of punishment that can be used to achieve retribution and public safety.[131] Lengthier prison stays have been viewed, at least by policymakers, as a straightforward extension of this logic.[132] Such stays on the face of it appear to be more retributive and to create incapacitation and general deterrent effects.[133] In addition, such stays can be anticipated to exert a specific deterrent effect on recidivism.[134] As many scholars have highlighted, however, the theoretical logic for incarcerated individuals remains far from decided.[135] Prison stays may be criminogenic, they may reduce offending, or they may vary in their effect, depending on the amount of time served and the balance of criminogenic and deterrent or rehabilitative experiences incurred during a prison stay. The bulk of work to date suggests that time served in prison may exert mixed effects on recidivism, though more recent work suggests that the effect may be minimal.[136] As reviews and studies have highlighted, it remains the case that few rigorous empirical assessments of the time served and recidivism relationship exist, and fewer still have assessed whether the relationship is curvilinear.[137]

In response to this situation and to calls by scholars for studies that inform research on the effects of incarceration and, in particular, its influence on the reentry of inmates back into society, this study drew on prior scholarship to identify three sets of hypothesized relationships between time served and recidivism. The analyses did not indicate that time served has no effect on recidivism. Rather, they support the

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131 Mears et al., *supra* note 5, *passim*.

132 *Id.*

133 *Id.*

134 *Id.*

135 *See* Nagin et al., *Imprisonment and Reoffending*, *supra* note 9. *See generally* Mears et al., *supra* note 5.

136 *See, e.g.*, Cochran et al., *supra* note 3; Green & Winik, *supra* note 46; Loughran et al., *supra* note 9; Meade et al., *supra* note 53; Snodgrass et al., *supra* note 7.

137 *See generally* Cochran et al., *supra* note 3; Green & Winik, *supra* note 44; Loughran et al., *supra* note 9; Meade et al., *supra* note 53; Snodgrass et al., *supra* note 7.

hypothesis that there is an inverted U-shaped relationship between time served and recidivism, at least for inmates serving up to five to six years in prison. This relationship surfaced using a variety of different statistical approaches and across different inmate populations. In particular, the study identified: (1) an increasing effect of time served on recidivism for one-year-or-less terms, (2) a decreasing effect of time served for incarceration terms of approximately 13 to 24 months, (3) no appreciable effect from 25 to 60 months, though the level of recidivism was higher than that for individuals who served only a few months in prison, and (4) a possible, though highly uncertain, decreasing effect of incarceration terms of six years or more.

Before turning to implications of the study, several limitations warrant discussion. Although this study relied on a large sample of adult inmates, the fact remains that relatively few individuals experience stays in prison beyond six or more years. Those that do may differ markedly from others who serve shorter sentences. In this study, that problem surfaced and created instability in the estimated effects of serving lengthy prison terms. In addition, the focus on adults necessarily means that the results may not generalize to juveniles. Youth incarcerated in juvenile correctional facilities may have experiences that differ from those of adults, and they typically will serve shorter stays.[138] Also, although the study relied on matching variables recommended by and used in prior work, unobserved confounding may have biased the estimation of the functional form of the time served and recidivism relationship. Accordingly, the results should be interpreted with caution.

We turn then, to the study's implications. First, as anticipated by scholars, there may be no single effect of time served on recidivism.[139] That is, the effect of time served may be variable depending on the specific amount of time served. This possibility holds particular relevance for interpreting prior empirical studies, many of which have estimated only linear effects. Such studies may have averaged distinct patterns of time-served effects. Some null effects, for example, may have been identified by failing to take into account the type of variable time-served effect that surfaced in this study. A similar problem attends to studies that have identified modest criminogenic effects. For example, a study that focused only on inmates serving up to two years in prison and that employed linear estimation specifications likely would conclude, if the findings in the

[138] *See* Loughran et al., *supra* note 9, at 718 (showing that youth typically served twelve months or less in confinement).

[139] *See, e.g.*, CLEMMER, *supra* note 8; Abrams, *supra* note 3; Orsagh & Chen, *supra* note 3; Snodgrass et al., *supra* note 7.

present study were to hold, that time served increases the probability of recidivism. Such a "finding" would misrepresent the actual time served and recidivism relationship. The present study, along with suggestive evidence in several recent works, suggests warrant for this concern.[140] More empirical research that investigates the functional form of the time served and recidivism relationship and that simultaneously addresses potential confounding is needed. This study employed measures typically used in recidivism studies. Yet, unobserved confounding may have influenced the estimated effects and so the results should be interpreted with caution.

Second, the uniformity of the time-served effect across different inmate groups suggests a parallel to the observation that Sampson and Laub have offered about desistance.[141] Their analyses of the Gluecks' data indicated that "general desistance processes" are at work for a diverse array of groups, including different categories of offenders.[142] Similarly, the analyses here suggest that time served may have effects that arise through a generalized process. That is, in contrast to the suggestion in some accounts that prison may exert highly heterogeneous effects for some groups, the underlying pattern may be one of highly similar effects.[143] If so, the process may well be a complicated one that entails different theoretical mechanisms, such as those that involve deterrence, social bonds, social capital, social learning, and strain.

Precisely because a wide range of theoretical mechanisms exist, it stands as noteworthy that a three-part generalized process nonetheless may exist. Here, we speculate about this possibility. (1) During the initial period of incarceration, criminogenic effects may accumulate rapidly. For example, social bonds and social capital may rapidly deteriorate, social learning about criminal lifestyles may occur, and strain may be felt acutely.[144] Deterrent effects may exist, but may be modest and overwhelmed by criminogenic first-year experiences and processes.[145] The end result would be an increasingly greater risk of recidivism. (2) After this period, inmates may adjust. Social bonds and social capital may slowly be

[140] *See, e.g.*, Loughran et al., *supra* note 9; Meade et al., *supra* note 53.

[141] Robert J. Sampson & John H. Laub, *Life-Course Desisters? Trajectories of Crime Among Delinquent Boys Followed to Age 70*, 41 CRIMINOLOGY 586, 586 (2003) (arguing that neglecting incarceration length in group-based trajectory models can distort results).

[142] *Id.*

[143] *See generally* Mears et al., *supra* note 5.

[144] *See* Orsagh & Chen, *supra* note 3, for a related discussion about how competing forces may be at play in producing nonlinear effects of time served on recidivism.

[145] Bruce A. Jacobs, *Deterrence and Deterrability*, 48 CRIMINOLOGY 417, 418 (2010) (introducing the concept of risk-sensitivity to understand how some offenders are more or less likely to reoffend).

restored or inmates may adapt to the losses that they have experienced. They may develop strategies for negotiating prison life and adapting to strain.[146] Social learning processes may occur, but may be less pronounced in their influence. Simultaneously, the intended deterrent effects of incarceration may increasingly take hold, as inmates increasingly experience or appreciate the "pains of imprisonment."[147] Not least, rehabilitative programming effects may begin to take hold. The end result is a slowly decreasing risk of recidivism. (3) Subsequently, time served effects may level off. Social bonds and social capital may not be restored, but inmates may have well-developed strategies for coping with prison life. Deterrent effects remain but exist in an equilibrium relative to these countervailing forces. As a result, additional incarceration neither increases nor decreases the likelihood of recidivism.

Juxtaposed against this generalized process is the possibility that for some groups, such as the youngest inmates, the varying experiences throughout a prison stay may result in appreciably different, or even opposite, effects of time served. In this study, among young adults who served more than three years in prison, longer prison stays were associated with increasing probabilities of recidivism; for other groups such stays were associated with decreasing probabilities of recidivism. For younger individuals, disruptions to social bonds may be especially influential and so contribute to this differential effect. With the data at hand, we cannot adjudicate among these possibilities. The study findings, however, suggest warrant for investigating the potential for prison to exert substantially different effects for some groups than for others and for investigating the mechanisms that give rise to any such effects.

Third, theoretical and empirical research on time served effects and desistance is needed. Such work ideally will identify how changes in causal mechanisms throughout a given duration of incarceration unfold and accumulate, relative to one another, to result in a given likelihood of offending. For developing and testing theoretical accounts of punishment and offending, such work is critical. Strong theoretical grounds exist to anticipate a diverse range of effects of time served on recidivism. Here, we find support for one pattern—an increasing, decreasing, and then relatively monotonic effect of time served on recidivism.

A critical question for future research, however, is how different causal mechanisms in prison contribute to this type of pattern. Such work will

[146] See Adams, *supra* note 61, for a related discussion about how inmates, over time, may adapt to prison and how that may affect their behavior.

[147] *See* SYKES, *supra* note 4.

require developing measures of in-prison experiences, including changes in social bonds, social capital, social learning processes conducive to criminal or prosocial behavior, strains, and perceptions that would contribute to deterrent effects.[148] Attention to modeling conditions of confinement also will be important. Custody levels, programming, restrictions, officer-inmate relations, reentry preparation, administrative practices all may contribute to the effect of prison and, by extension, the duration of incarceration.[149] Future research ideally not only will continue to investigate the effect of time served on recidivism but also will incorporate additional covariates to address potential confounding. Ideally, studies will also use a range of measures of recidivism, including self-reported offending, to ensure that estimated effects of time served are not influenced by the measure used.[150] Not least, research should be undertaken that examines the effect of time served for felons sentenced only to jail terms. For such research, the primary question is whether differences exist in the effect of 1 month to 12 months, given that most jail terms entail one year or less of incarceration. Jail experiences and contexts may differ from those in prison, and in turn they may result in different effects of time served, even when the focus is on 12 months or less of time.

Fourth, the results of this study suggest that lengthier terms of incarceration, beyond a few months, do not readily appear to reduce recidivism and, indeed, may increase it. The analyses here suggest that one year of incarceration may result in an approximately 10% increase or more in the probability of offending when compared to one month of incarceration. The probability of recidivism associated with two years of incarceration, however, appears to be approximately 5% less than that associated with one year of incarceration. For one year or two years of incarceration, however, the net effect of incarceration appears to be criminogenic when compared to shorter stays of one to six months. Lengthier prison terms of three years or more do not appear to appreciably reduce recidivism beyond that associated with shorter prison stays. Whether these effects are higher or lower than what would occur if inmates were given non-incarceration sanctions was not addressed in this study.

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148 *See* Shawn D. Bushway & Robert Apel, *A Signaling Perspective on Employment-Based Reentry Programming: Training Completion as a Desistance Signal*, 11 CRIMINOLOGY & PUB. POL'Y 21, 42–45 (2012) (asserting that desistance is better achieved by using multidimensional programs to address prisoners' diverse array of needs); MAY & WOOD, *supra* note 40; Bushway & Owens, *supra* note 42. *See generally* Paternoster, *supra* note 22.

149 *See generally* Mears et al., *supra* note 5.

150 *See, e.g.*, Ostermann et al., *supra* note 95 (showing that how recidivism is operationalized may affect estimates of the effects of punishments).

However, recent reviews and studies suggest that incarceration either exerts little influence or may be criminogenic.[151]

Such findings should not be construed as an argument against lengthy prison sentences. For example, such sentences may be justified as helping to achieve retributive goals or to create general deterrent benefits that offset harms that arise through potential increased recidivism among inmates. The findings warrant consideration of greater reliance on shorter prison stays of less than one year. For example, the Pew Charitable Trusts undertook a study that suggested that 14–24 percent of inmates in three study states could have served shorter prison terms with no adverse effect on recidivism.[152] Whether doing so would adversely affect either society's sense that retribution somehow has been achieved is unknown; it is also unknown how much doing so would affect the amount of public safety gains that arise from incapacitation or general deterrence. What is known, however, is that quantifying retribution does not constitute a straightforward or even possible task and that lengthy terms of confinement may not be required to generate appreciable general deterrent effects.[153] Research ideally will clarify how the goal of retribution might be achieved and whether, if at all, approaches to retribution might be tied to those approaches that best promote public safety.

Finally, there is a need to investigate and address potential criminogenic effects of incarceration. Prison may provide a specific deterrent or rehabilitative effect. However, this benefit may be offset by experiences in prison that make a return to society difficult and increase reoffending.[154] Accordingly, efforts to promote prison experiences that directly build on insights from criminological theory and research may be beneficial. For instance, prisons that rely on practices and programs that emphasize the development of social bonds, social capital, and prosocial strategies for managing strain may reduce recidivism and improve reentry outcomes.[155]

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[151] *See, e.g.*, Cochran et al., *supra* note 3; Green & Winik, *supra* note 46; Nagin et al., *Imprisonment and Reoffending*, *supra* note 9.

[152] *See* THE PEW CENTER ON THE STATES, *supra* note 1, at 36.

[153] *See generally* Bushway & Owens, *supra* note 42; Cochran et al., *supra* note 3; Durlauf & Nagin, *supra* note 2; Paternoster, *supra* note 22.

[154] *See* PETERSILIA, *supra* note 24, *passim*; TRAVIS, *supra* note 2, *passim*.

[155] *See generally* LATESSA ET AL., *supra* note 1; MEARS & COCHRAN, *supra* note 25.

Appendix. Logistic Regression of Recidivism on Time Served and Covariates

	Odds Ratio	B	S.E.
Time served (months)	1.035***	.035***	(.008)
Time served (months)^2	.998***	-.002***	(.000)
Time served (months)^3	1.00003***	.000***	(.000)
Time served (months)^4	.99999***	-.000***	(.000)
Male (1/0)	1.374***	.318***	(.030)
Black (1/0)[a]	1.638***	.493***	(.018)
Latino (1/0)[a]	1.030	.029	(.036)
Age (years)	.964***	-.037***	(.001)
Primary offense (PO)–murder (1/0)[b]	.618***	-.482***	(.076)
Primary offense (PO)–sex crime (1/0)[b]	.637***	-.450***	(.053)
Primary offense (PO)–robbery (1/0)[b]	1.131***	.123***	(.035)
Primary offense (PO)–other violent (1/0)[b]	.884***	-.123***	(.027)
Primary offense (PO)–burglary (1/0)[b]	1.253***	.226***	(.026)
Primary offense (PO)–property (1/0)[b]	1.148***	.138***	(.028)
Primary offense (PO)–weapons (1/0)[b]	.898*	-.107*	(.045)
Primary offense (PO)–other (1/0)[b]	1.150***	.140***	(.034)
Prior convictions (PC)–violent (count)	.467***	-.762***	(.017)
Prior convictions (PC)–sex crime (count)	.338***	-1.086***	(.067)
Prior convictions (PC)–property (count)	.731***	-.313***	(.006)
Prior convictions (PC)–drug (count)	.632***	-.459***	(.010)
Prior convictions (PC)–other (count)	.660***	-.415***	(.022)
Prior prison commitments (count)	1.268***	.237***	(.008)
Prior supervision violations (count)	1.325***	.281***	(.008)
Offense severity score (continuous)	.988***	-.012***	(.001)
Prior record score (continuous)	1.012***	.012***	(.001)
Year dummy variables[c]	——	——	——
Judicial circuit dummy variables[c]	——	——	——
Constant	1.786***	.580***	(.104)
R-squared = .247			

*** p < .001, ** p < .01, * p < .05

a. "White" serves as the reference category.

b. "Primary offense (PO)–drugs" serves as the reference category.

c. Year and judicial circuit dummy variables were included in the model but are not shown here to conserve space (coefficient and standard error estimates available upon request).