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# On the Weak Mortality Returns of the Prison Boom: Comparing Infant Mortality and Homicide in the Incarceration Ledger

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**Abstract**

The justifications for the dramatic expansion of the prison population in recent decades have focused on public safety. Prior research on the efficacy of incarceration offers support for such claims, suggesting that increased incarceration saves lives by reducing the prevalence of homicide. We challenge this view by arguing that the effects of mass incarceration include collateral infant mortality consequences that call into question the number of lives saved through increased imprisonment. Using an instrumental variable estimation on state-level data from 1978 to 2010, this article simultaneously considers the effects of imprisonment on homicide and infant mortality to examine two of the countervailing mortality consequences of mass incarceration. Results suggest that while incarceration saves lives by lowering homicide rates, these gains are largely offset by the increases in infant mortality. Adjusted figures that count the number of increased infant deaths attributable to incarceration suggest that the mortality benefits of imprisonment over the past three decades are 82% lower than previously thought.

**Keywords**

homicide, infant mortality, mass incarceration

The U.S. incarceration boom represents one of the most significant societal changes over the past half century. Since the mid-1970s, the U.S. incarceration rate increased nearly fivefold. As a result, by 2010 there were approximately 2.3 million people incarcerated in U.S. prisons and jails and over 7 million individuals under supervision of adult correctional authorities (Glaze 2011). The principal drivers of this dramatic expansion have been policy choices that enhanced the severity of punishments for criminal offenders in recent decades (Raphael and Stoll 2013), the justifications for which have focused largely on issues of public safety. Research on the effectiveness of incarceration offers support to claims that tougher sanctions result in public safety benefits. Though there is debate as to the magnitude of the effect, multiple studies suggest that increases in the size of the prison population are associated with decreases in crime (Johnson and Raphael 2012; Levitt 1996). In line with this view, the manifest increases in incarceration in recent decades have coincided with substantial reductions in homicide victimization. Taken together, these trends suggest incarceration yields significant returns in terms of saving lives.

We challenge this view by arguing that the effects of mass incarceration include collateral mortality consequences that make suspect any claims about the number of lives saved through increased

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imprisonment. Specifically, we argue that a focus on crime reduction alone fails to consider the health consequences for the children left in the wake of the prison boom and, more explicitly, the implications of mass incarceration for infant mortality. Between 1980 and 2012, the number of children with an incarcerated parent increased from roughly 1 in 120 to 1 in 25 (Wakefield and Wildeman 2014). As a consequence, approximately 2.6 million U.S. children (about 3%) currently have a parent imprisoned (Sykes and Pettit 2014), and though research in this area is relatively nascent, studies have linked parental incarceration to negative outcomes for children in a variety of social and health domains (Foster and Hagan 2007; Geller et al. 2012).

With few exceptions, however, this body of work has elided a sustained focus on the macrolevel links between parental incarceration and infant mortality. Indeed, we are aware of only one article that examined these connections at the macrolevel (Wildeman 2012), and that study was unable to draw causal inferences between imprisonment and infant mortality rates due to the inability to identify an exogenous source of variation in incarceration (but see Wakefield and Wildeman 2014; Wildeman et al. 2014). This is a significant lacuna given that many of the risk factors associated with infant mortality, such as unemployment, poverty, and crime, are also well-known correlates of incarceration. In other words, any estimation of the incarceration–infant mortality nexus may suffer from an identification problem that likely biases estimates—namely, changes in the underlying structural factors (both observed and unobserved) that increase infant mortality may simultaneously increase incarceration.

In this paper, we present new evidence for the effect of aggregate changes in incarceration rates on changes in infant mortality rates that better accounts for omitted-variable bias in estimating the incarceration–infant mortality relationship. Building on previous work by Raphael and Stoll (2013) and Johnson and Raphael (2012), we use a rich collection of state-level data for the period 1978 through 2010 to produce estimates of the average treatment effect of incarceration on infant mortality rates through an instrumental variable (IV) estimation. Analytically, this instrument attempts to identify exogenous variation in incarceration rates between two years by calculating the disparity between the actual incarceration rate and the steady-state incarceration rate implied by the prison admissions and release rates in the base year (Raphael and Stoll 2013:236). We then use this predicted change to instrument for the actual future increases in incarceration and determine the link (if any) between incarceration and infant mortality.

In doing so, we advance our understanding of the population health consequences of the prison boom in several ways. Perhaps most notably, we provide the first direct mortality cost-benefit assessment of mass incarceration by examining the incarceration–infant mortality link alongside the incarceration–homicide link. Despite growing research attention to the negative health outcomes associated with incarceration (Massoglia and Pridemore 2015), the literature currently lacks a direct comparison of the countervailing mortality consequences of imprisonment. Such comparisons are essential for evaluating the sociological and health implications of mass incarceration. As Sampson (2011) notes, research on the harm parental incarceration causes, alone, yields an opaque understanding of the efficacy of imprisonment because "the counterfactual balance sheet for one offender is potentially made up of interactions with hundreds of people and thus a wide variety of crimes committed or averted" (p. 822). In other words, in order to fully assess the incarceration ledger, researchers need to balance the heterogeneous mortality effects of parental imprisonment (Turney and Wildeman 2015), for while incarceration may cost lives by increasing mortality risks among children, it may also save lives by removing dangerous individuals from society. By comparing these two consequences of the prison boom—one intended and the other collateral—in this article we aim to provide a more comprehensive assessment as to whether mass incarceration has been a net mortality harm or benefit.

Second, because our data cover nearly the entire prison boom, this provides a unique opportunity to examine the role of the prison buildup in explaining the comparatively extreme rate of infant mortality in the United States. While the U.S. infant mortality rate declined in the latter half of the twentieth century, it remains substantially above other advanced countries. In this article, we examine the extent to which American exceptionalism in incarceration helped contribute to American exceptionalism in infant mortality and provide counterfactual estimates of the rate of infant mortality absent mass incarceration. Thus, this study contributes to our knowledge of the intergenerational health consequences of mass incarceration, an especially important area of inquiry given that research suggests the detrimental effects of the prison boom may be more pronounced for children than adult men (Wakefield and Wildeman 2014).

# BACKGROUND

## Incarceration and Crime

Increases in imprisonment can reduce crime through either incapacitation (i.e., mechanically removing the criminally active from the general population) or deterrence (i.e., the increased threat of imprisonment deters others from engaging in criminal activity). Indirect estimates of incapacitation effects come from data on self-reported criminal activity from prisoner surveys. While estimates using this method vary (sometimes substantially), careful reviews of this body of research suggest that between 10 and 20 serious felonies are averted, on average, for each additional prison-year among inmates (Spelman 2000).

However, such analyses necessarily only partially capture the incarceration–crime relationship since they are unable to detect whether would-be criminal offenders are deterred by the threat of increased imprisonment. As such, several studies have attempted to estimate the overall effect of incarceration on crime using aggregate crime and prison data. Among the first, Marvell and Moody (1994) used state-level panel regressions and found that a 1-percentage-point increase in the prison population reduced overall crime rates by .16% (a crime–prison elasticity of –.16). However, Levitt (1996) illustrates that ordinary least squares (OLS) estimates of the effect of prisons on crime are likely to be biased toward zero due to simultaneity inherent in the relationship. That is, while increased incarceration may reduce the amount of crime, increases in crime will also translate into larger prison populations. Using prison overcrowding legislation as an IV to obtain estimates of the effect of incarceration on crime that are not affected by simultaneity, Levitt estimates a violent crime–prison elasticity of –.40. The magnitude of this estimate, however, has since come under scrutiny as several studies demonstrate considerably less crime reduction from increased imprisonment (Liedka, Piehl, and Useem 2006; Western 2006). That said, multiple aggregate studies using various methods to address simultaneity in the crime–prison relationship have confirmed the same general pattern of findings—increases in incarceration result in decreases in crime and violence (Buonanno and Raphael 2013; Johnson and Raphael 2012; Raphael and Stoll 2013). Moreover, several studies conclude that the scale of incarceration in the 1990s was roughly optimal from a cost-benefit perspective (Donohue and Siegelman 1995; Piehl and DiIulio 1995). For example, Levitt compared the monetary costs of incarcerating additional offenders to the costs saved from decreases in crime (i.e., fewer medical bills, less property loss, etc.), and found that incarceration is, on balance, socially beneficial.

Since that time, however, social scientists have spent a substantial amount of research attention broadening the discourse on the collateral and often unintended costs associated with mass incarceration beyond monetary considerations. Within this body of work, the prison boom has been implicated in, among other things, reducing overall health among those incarcerated (Massoglia 2008), decreasing stable two-parent families among the urban poor (Western 2006), and worsening mental and behavioral health among children of incarcerated parents (Foster and Hagan 2009).

While this body of work has substantially widened the sociological understanding of the collateral consequences of mass incarceration and highlighted incarceration as a primary engine of social inequality (Wakefield and Uggen 2010), it has yet to be fully integrated into the incarceration ledger to determine the efficacy of imprisonment. In other words, these studies have overwhelmingly focused on the costs of incarceration that had largely gone unnoticed in previous cost-benefit analyses but have been relatively silent on how these costs compare to the potential benefits of imprisonment. This is partly a reflection of the difficulty of comparing the pros and cons of imprisonment across different metrics. For example, how does one compare the benefits of decreased assaults to the costs of decreased employment opportunities for ex-convicts? Or the decrease in property crimes to the decrease in two-parent families?

In this study, we obviate this concern by assessing the social costs and benefits of incarceration using the same metric: lives. Specifically, we draw from the health literature on the collateral consequences of incarceration for the children of the prison boom and compare the number of lives lost from increased infant mortality to the number of lives saved through decreased homicide. In so doing, we offer a competing view to the generally well-accepted finding that incarceration yields considerable public mortality benefits.

## Incarceration and Infant Mortality

With dramatic increases in the prison population in recent decades, understanding the link between incarceration and infant mortality is a paramount question among medical sociologists for several reasons. First, a substantial percentage (over 50%) of those incarcerated are parents of minor children (Glaze and Maruschak 2008), the majority of whom were involved in their children's lives and contributed both material (e.g., money) and nonmaterial (e.g., child care) resources toward child-rearing prior to prison. According to Geller (2013), a full 42% of incarcerated fathers and 60% of incarcerated mothers were living with their children prior to prison, and another 40% of nonresident, ever-incarcerated fathers saw their children regularly.

Second, infant mortality is a salient indicator of societal well-being (Reidpath and Allotey 2003), and like incarceration, the scale of infant mortality in the United States is far beyond other advanced countries. In 2010, 6.3 per 1,000 infants died before reaching their first birthday in the United States (World Bank 2015). Among Organisation for Economic Co-operation and Development (OECD) countries, only Mexico, Turkey, and Chile had higher rates of infant mortality. Indeed, every year nearly twice as many American infants die in their first day of life than in all 27 member nations of the European Union combined (Save the Children 2013). Why are American infants more likely to die than children in similarly developed nations? Medical research has identified several risk factors for infant death, such as preterm birth and low birth weight; however, the level of infant mortality in the United States has pointed public health researchers to larger social influences to explain this apparent anomaly (Williams 2013). In this vein, it is important to highlight that during the same period that witnessed an unprecedented rise in the American prison population, the United States separated itself from other industrialized nations as one of the riskiest environments for infant survival. From 1960 to 2010, the United States fell from the 12th-ranked OECD nation in infant mortality to the 33rd (OECD 2015).[1]

Against the backdrop of these two trends, Wildeman (2012) used state-level data from 1990 to 2003 to offer suggestive evidence that parental incarceration could be a contributor to population infant mortality. Building on this work, we leverage insights from one of the major theoretical paradigms in medical sociology—the fundamental-causes perspective (Link and Phelan 1995), which provides a useful conceptual framework for understanding why incarceration may have deleterious intergenerational mortality consequences. Originally developed to explain the persistence of socioeconomic inequalities in health, generally speaking, this perspective suggests that health and mortality outcomes are shaped by access to key resources (e.g., knowledge, money, power, prestige, and beneficial social connections). Taken in the context of an array of research documenting that incarceration negatively impacts many of these vital resources (Wakefield and Uggen 2010), the theory of fundamental causes helps identify several direct and indirect mechanisms through which parental incarceration poses risks to infant survival.

First, the loss of financial contributions to family life associated with paternal incarceration is substantial (Geller, Garfinkel, and Western 2011). Compared to the year prior to a father's incarceration, Johnson (2009) estimates that family income decreases by nearly 25% during a prison spell. Because many of the families of inmates were already financially insecure prior to prison, the result is that they are much more likely to experience periods of poverty during a father's incarceration (Johnson 2009). Second, in the wake of paternal incarceration, families are often burdened with considerable legal debt (Harris, Evans, and Beckett 2010). In addition to the direct costs associated with these debts, failure to make payments can result in damaged credit and loss of property, potentially increasing the risk of family homelessness (Wildeman 2012). Third, the costs of maintaining contact with incarcerated family members—including sending packages, traveling, and taking collect phone calls—is often significant. For example, in their survey of women visiting prisoners, Grinstead and colleagues (2001) estimate that low-income women spend approximately one third of their income to stay in touch with a relative in prison. Fourth, incarceration can reduce the quality of care by creating a gap in household labor, decreasing residential stability, disrupting children's care arrangements, and corroding women's support networks (Hagan and Coleman 2001). Finally, incarceration can have direct consequences for maternal and infant health by increasing the risk of exposure to infectious diseases (Massoglia 2008), subjecting mothers to higher levels of stress, increasing maternal neglect (Turney 2014), and reducing health care coverage (Foster and Hagan 2007).

Taken together, this body of work suggests that incarceration substantially reduces the amount of resources (both social and monetary) available for effective childcare and significantly compromises maternal health, thus providing a microfoundation for anticipating macrolevel associations between increased incarceration and increased infant mortality. In addition, recent scholarship notes that many of the mechanisms by which incarceration increases infant mortality may be particularly severe in the United States relative to other industrialized nations with welfare services that offer more protection against the financial costs of a family member's imprisonment (Wildeman 2016:364).

There are, however, plausible alternative expectations regarding any incarceration–infant mortality nexus. For one, it is possible that parental incarceration may improve child well-being by removing destructive and destabilizing influences. In line with this view, Wakefield and Wildeman (2014) find that incarcerating fathers with a history of domestic violence may, if anything, decrease the odds of infant mortality. However, because most prisoners do not have an abusive past, they conclude that, on average, parental incarceration tends to make bad situations worse for children.

A second critique concerns the empirical obstacles to estimating the causal influence of incarceration on infant mortality. The incarcerated population is disproportionately made up of poorly educated, minority men (Western 2006), overwhelmingly drawn from disadvantaged areas that are typified by high degrees of economic deprivation and social isolation (Patterson 2010). Thus, even absent incarceration, the children of the prison boom likely face substantial health and developmental challenges, making it difficult to disentangle the effects of incarceration on children from the confounding effects of disadvantage generally.

Related to this point, because population-level factors, such as poverty and poor health, are strong correlates of both incarceration and infant mortality, any association between the two variables could be coterminous rather than causal. In other words, unobserved heterogeneity in the incarceration–infant mortality relationship makes it difficult to establish causal connections. Indeed, while Wildeman (2012) provides a host of robustness analyses to examine the incarceration–infant mortality link, he concludes that "the most important limitation of this study is that it cannot confidently isolate causal effects of imprisonment on infant mortality at either [the state or the individual] level" (p. 247) because the analysis "lack[s] an exogenous shock in imprisonment" (p. 244).

Taking cues from this work and motivated by this methodological concern, we go beyond previous research by utilizing an IV approach to identify any causal link between incarceration and infant mortality. If such a link exists, it would represent an unjust and drastically unequal source of disadvantage. While previous research has shown that prison spells can decrease life expectancy among those formerly incarcerated (Massoglia and Pridemore 2015), policy makers may see the health consequences of criminal wrongdoing as an acceptable trade-off for enhanced public safety. The infants of incarcerated individuals, however, represent the most vulnerable victims of the prison boom, whose harm was least intended and underappreciated. As Hagan and Dinovitzer (1999) argue, the influence of incarceration on children "may be the least understood and most consequential implication of the high reliance on incarceration in America" (p. 122). Thus, understanding the infant mortality consequences of the prison boom is important for understanding the future of health inequality and the intergenerational transfer of disadvantage.

## DATA AND METHODS

We drew from multiple data sources collected annually at the state level (including Washington, D.C.) between 1978 and 2010 to empirically examine the links between incarceration, homicide, and infant mortality during the prison boom. Our measures of crime and homicide came from the Federal Bureau of Investigation Uniform Crime Reports, and our infant mortality measures were taken from the Centers for Disease Control National Vital Statistics Reports.[2] Information on aggregate incarceration rates in both state and federal prisons came from the Bureau of Justice Statistics, and data on the aggregate flows into and out of prison came from the National Prison Statistics database.[3] Finally, data on an array of socioeconomic and demographic characteristics were collectively derived from the U.S. Census, the Bureau of Labor Statistics, and the Bureau of Economic Analysis.

This unique collection of data offered several advantages for this research project. First, unlike other measures of crime and health that can often go unrecorded (e.g., assault, child abuse), both homicide and infant mortality were measured with precision in official sources with very few missing data or little evidence of underreporting (Hawkins 2003; National Center for Health Statistics 2015).[4] Thus, our use of death records obviates long-standing concerns regarding the use of other official crime and health indicators, which scholars have argued reflect a mixture of actual behavior, the reporting decisions made by individuals, and the processing discretion of healthcare providers and police (Hawkins 2003; Noble and Pronovost 2010). Second, the use of state-level analysis was apt because it captures the entire at-risk population for both outcomes of interest (homicide and infant mortality), state panel data have considerable precedent in research on the effects of incarceration (Levitt 1996; Marvell and Moody 1994; Raphael and Stoll 2013), and the instrument for the IV regressions could be defined for nearly all periods and states. Thus, we were able to make generalizable conclusions about the average treatment effect of incarceration on homicide and infant mortality for the United States as a whole. Finally, existing research has largely focused on a relatively narrow temporal range, thus limiting its ability to address the full implications of the prison boom for infant mortality. In contrast, our analysis captured the entire prison buildup (1978–2010), more than doubling the longitudinal scope of any other inquiries into the incarceration–infant mortality link and providing an opportunity to examine the broader consequences of mass incarceration for infant survival rates in the United States over the past three decades.

### Dependent and Independent Variables

Table 1 presents the operationalization of all variables in the analysis along with their means and standard deviations. Our analysis utilized two dependent variables: homicide and infant mortality. Following established practices, the homicide rate was expressed per 100,000 in the population, and the infant mortality rate was measured per 1,000 live births.

Our focal independent variable was the incarceration rate (per 100,000). Drawing from both the imprisonment and public health literatures, we also included multiple relevant demographic and socioeconomic controls to help partially isolate the effect of incarceration, including the population age structure (e.g., the percentage of the population that is 0 to 17, 18 to 24, etc.), the unemployment rate, the poverty rate, and the percentage black. Because we were interested in understanding how changes in incarceration influence changes in both homicide and infant mortality, all variables were expressed as first differences. For example, between 1978 and 1979, the incarceration rate in California increased from 95.7 to 99.7 (per 100,000). Thus, the first-differences value for California in 1978 was 4.0 (99.7 minus 95.7). We also included a complete set of both state and year fixed effects in all models. It is important to note that while adding year fixed effects removed any factor affecting incarceration over time that was stable across states (e.g., national year-to-year changes), the between-state differences were already accounted for in the first-difference specification in these models. Thus, the inclusion of state fixed effects statistically adjusted for all state-specific linear time trends.[5]

### Analytic Strategy

While the inclusion of fixed effects and multiple time-varying controls helped reduce bias in our estimates, concerns remained regarding omitted-variable bias in the infant mortality–incarceration relationship, and controls did little to assuage simultaneity concerns in the crime–incarceration link. To break this simultaneity and address bias from omitted variables, we employed the IV strategy developed by Johnson and Raphael (2012). It bears mentioning that this is the exact identification strategy Wildeman (2012) encourages future researchers to utilize in establishing causal links between incarceration and infant mortality (p. 247). This approach uses annual changes in the prison population to estimate the "disparity between the actual incarceration rate and the equilibrium incarceration rate implied by the current period transition probabilities describing movements into and out of prison" (Johnson and Raphael 2012:276). These transition probabilities are calculated using information on (1) the aggregate flows into prison (prison admissions rate), (2) aggregate annual flows out of prison (prison release rate), (3) the stock of prisoners for a given year (incarceration rate), and (4) the total state population. Using these data, we could then create a measure for the predicted change in incarceration between two years ($t1$ and $t0$), or the implied equilibrium rate, which is highly predictive of future incarceration rates but determined exogenously from them.[6] To give an example, when predicting the increase in incarceration between 1980 ($t1$) and 1981 ($t2$) in a given state, 1980 would be designated as $t1$ and 1979 as $t0$, and the predicted change in the incarceration rate between $t1$ and $t2$ is calculated using the information already determined by time period $t = 1$. Thus, the predicted incarceration rate between $t1$ and $t2$ is based on the one-year lagged values from the total incarceration rate, admissions rate, and release rate. Because "incarceration rates adjust to permanent changes in behavior with a dynamic lag (given that only a fraction of offenders were apprehended in any one period), one can identify variation in incarceration rates that is not contaminated by contemporary changes in criminal behavior" (Johnson and Raphael 2012:276), thus identifying the causal effect of incarceration.

The actual change in incarceration rate in a given state is then instrumented with the

**Table 1.** Descriptive Statistics for Dependent and Explanatory Variables, 1978 to 2010.

| Variable | *M* | *SD* | Min | Max |
|---|---|---|---|---|
| Dependent variables | | | | |
| Homicide rate (per 100,000 population) | 7.43 | 3.89 | .20 | 80.60 |
| Infant mortality (per 1,000 live births) | 8.64 | 2.49 | 3.80 | 27.30 |
| Focal measure | | | | |
| Incarceration rate (per 100,000 population) | 329.8 | 170.2 | 30.3 | 1859.1 |
| Control variables | | | | |
| Population age structure (%) | | | | |
| 0–17 | 26 | 2 | 17 | 38 |
| 18–24 | 11 | 2 | 8 | 16 |
| 25–44 | 30 | 2 | 24 | 39 |
| 45–64 | 21 | 3 | 14 | 30 |
| Unemployment rate (%) | 6 | 2 | 2 | 18 |
| Poverty rate (%) | 13 | 3 | 3 | 27 |
| % Black | 12 | 8 | .2 | 71 |
| Supplemental measures | | | | |
| % Births to unmarried women[a] | 30.2 | 8.3 | 5.3 | 58.5 |
| % Premature births (less than 37 weeks)[a] | 10.8 | 2.1 | 4.6 | 18.8 |
| % Births with no prenatal care[a] | 2.3 | 2.1 | .0 | 12.4 |
| % Low birth weight (<2,500 g)[a] | 7.4 | 1.2 | 4.4 | 13.2 |
| Violent crime rate (per 100,000) | 572.0 | 245.7 | 47.0 | 2921.8 |
| AFDC or TANF expenditures (in millions)[b] | 1726.7 | 2352.2 | 7.1 | 9131.0 |
| SNAP expenditures (in millions)[b] | 1091.6 | 896.9 | 8.0 | 4471.0 |
| Healthcare expenditures (per capita) | 57.0 | 50.3 | .9 | 225.5 |
| Education expenditures (in thousands) | 15,900,000 | 14,100,000 | 13,498 | 62,400,000 |

*Note: N* = 1,616 state-years. Figures weighted by the total state population. AFDC = Aid to Families with Dependent Children; TANF = Temporary Assistance for Needy Families; SNAP = Supplemental Nutrition Assistance Program.
[a]Measures compose the high-risk birth index.
[b]Measures compose state welfare expenditures.

corresponding change in the incarceration rate implied by the steady-state incarceration rate, as predicted by the admissions and release rates from the base year. When a state's actual incarceration rate is below the steady-state rate, the instrument would predict an increase. On the contrary, the instrument would predict a decrease in the state's incarceration rate when the actual change was above the implied steady-state rate. In essence, this strategy attempted to identify variation in the incarceration rate that would have occurred anyway and used this variation to identify the causal effects of incarceration (Johnson and Raphael 2012:286).

In addition to being able to define the instrument for nearly all states over the prison boom, this identification strategy had several other advantages. First, the dynamic adjustment of the imprisonment rate to *any* permanent shock resulted in exogenous variation in incarceration that could be used to identify the causal influence of incarceration, irrespective of the shock's source (e.g., more severe punishments, increased policing and charging, changes in underlying criminogenic conditions or criminal behavior).[7] Second, the use of exploiting variation in incarceration caused by the adjustment between steady-state incarceration rates has been empirically vetted in previous research (see Buonanno and Raphael 2013; Raphael and Stoll 2013). As we demonstrate in the online supplement, it is likely for this reason that the relationship between the predicted changes in incarceration and the actual changes are remarkably robust in our first-stage regressions (see Table S1 in the online version of the article ). Across multiple model specifications that statistically adjusted for all controls in the analysis as well as state and year fixed effects, the coefficient for the predicted change in incarceration remained positive and highly significant. Moreover, the *F* statistics for the instrument across all specifications were above 10, suggestive of a suitably strong relationship between the instrument and treatment variables (Staiger and Stock 1997). In all homicide models we weighted the regressions by the total state population to yield parameter estimates that reflected the typical relationship between state-level homicide and incarceration rates experienced by the average U.S. resident. Along similar lines, we weighted all infant mortality models by the total number of live births.[8]

This analysis unfolded in three stages. First, we empirically examined the relationship between state-level incarceration rates and state-level homicide rates between 1978 and 2010. Our theoretical expectation—derived from incapacitation and deterrence models of crime and punishment—was that homicide decreased as a result of the prison boom. Our second stage then examined the link between incarceration and infant mortality over this period. Drawing from research on the deleterious consequences of imprisonment for the families of those recently incarcerated, we anticipated an increase in infant mortality that was directly attributable to mass incarceration. Given the specification concerns in the incarceration, crime, and mortality models, we paid particular attention to comparing the IV and OLS estimates throughout both analyses. Finally, we examined the substantive implications of our findings by (1) calculating the *net* mortality consequences of incarceration and (2) examining the extent to which mass incarceration has contributed to American exceptionalism in infant mortality. Taken together, the stages of this analysis answer important questions regarding the mortality costs and benefits of incarceration over the past several decades and help inform the sociological understanding of the incarceration ledger.

## RESULTS

### *Incarceration–Homicide*

Table 2 presents a series of regression models investigating the homicide–incarceration relationship. Across each specification we included an extensive set of controls to isolate the true link between incarceration and homicide rates over the prison boom. Model 1 shows the bivariate IV estimate, Model 2 adds state and year fixed effects, Model 3 adds all measured covariates, and Model 4 provides a standard OLS estimate of the homicide–incarceration relationship for comparison.

Two findings stand out in Table 2. First, consistent with theoretical hypotheses, across all three IV models we observe a statistically significant negative relationship between incarceration and homicide. The magnitude of the incarceration effect in the final IV specification (Model 3) suggests that each additional inmate reduces the number of homicide incidents by .009. Second, the OLS estimate in Model 4 is substantially smaller than the IV estimates and not statistically significant. This comparison suggests that OLS estimates of the homicide–incarceration link are biased toward zero due to the simultaneous determination of incarceration and crime.

Taken together, the results in Table 2 suggest that while OLS regressions underestimate the effect of incarceration on crime, mass incarceration has indeed saved lives by reducing the prevalence of homicide over the past three decades. However, there are strong theoretical reasons to think that these gains may be substantially offset by the collateral mortality consequences for the children of the prison boom.

### *Incarceration–Infant Mortality*

Similar to the analytical approach taken in Table 2, we examine the relationship between infant mortality and incarceration across multiple specifications, with each model incrementally increasing in empirical rigor. Looking to our most detailed IV specification (Model 3), we observe a statistically significant positive effect of incarceration on infant mortality. Interpreted more substantively, for a one-unit increase in the incarceration rate over this period, there were .005 more infant deaths (per 1,000 live births), net of measured covariates and state and year fixed effects. We also find considerable evidence that OLS estimates of any infant mortality–incarceration link are significantly biased. Comparing coefficients across Models 3 and 4, the magnitude of the incarceration effect is substantially smaller and measured without precision in the OLS model. Moreover, $Z$ tests confirm that the incarceration effects in Models 3 and 4 are significantly different ($p < .05$). This finding suggests that the methodological concerns expressed by Wildeman (2012) are warranted—OLS estimates of the incarceration–infant mortality relationship are likely biased by the confounding effects of unobserved factors. Still, the IV results in Table 3 provide strong evidence that mass incarceration has contributed to higher rates of infant mortality in the United States over the past three decades.

However, because this empirical relationship represents one of our principle innovations, it is important to test the robustness of this finding. We

**Table 2.** Effect of Changes in Incarceration Rates on Changes in Homicide Rates, 1978 to 2010.

| | Model 1–IV | | Model 2–IV | | Model 3–IV | | Model 4–OLS | |
|---|---|---|---|---|---|---|---|---|
| Explanatory Measure | *b* | *SE* | *b* | *SE* | *b* | *SE* | *b* | *SE* |
| Δ Incarceration rate | –.013*** | (.003) | –.010** | (.004) | –.009** | (.004) | –.001 | (.001) |
| Δ Population age structure (%) | | | | | | | | |
| 0–17 | | | | | .108 | (.139) | .102 | (.135) |
| 18–24 | | | | | .133 | (.175) | .078 | (.169) |
| 25–44 | | | | | –.016 | (.165) | –.025 | (.160) |
| 45–64 | | | | | .115 | (.194) | .077 | (.188) |
| Δ Unemployment rate | | | | | –.128*** | (.038) | –.114** | (.036) |
| Δ Poverty rate | | | | | .002 | (.018) | –.001 | (.017) |
| Δ % Black | | | | | –.013 | (.020) | –.021 | (.019) |
| Constant | –.023 | –.035 | .513 | (.494) | .541 | (.496) | .563 | (.483) |
| State effects? | No | | Yes | | Yes | | Yes | |
| Year effects? | No | | Yes | | Yes | | Yes | |
| Model *F* statistic | 22.68*** | | 4.95*** | | 4.73*** | | 4.93*** | |
| $R^2$ | | | .170 | | .179 | | .223 | |
| *N* | 1,616 | | 1,616 | | 1,616 | | 1,616 | |

*Note:* All models weighted by total state population. IV = instrumental variable; OLS = ordinary least squares.
**p* < .05, ***p* < .01, ****p* < .001.

do so in Table 4 by including an array of measures identified in previous infant mortality research in addition to our full analytical specification. We pay particular attention to measures that are likely associated with both the incarceration rate and the infant mortality rate. In Table 4, we sequentially introduce measures that capture the occurrence of high-risk births in each state,[9] the violent crime rate, state welfare expenditures,[10] healthcare expenditures,[11] and educational expenditures.[12] All expenditure variables are expressed in 2010 constant dollars, and all measures are specified as first differences.

It is important to note that while these measures may directly influence infant mortality, one of the core strengths of IV estimation is the ability to account for unmeasured confounders by removing any spurious correlation between the explanatory variable and unobserved characteristics. Thus, if the instrument does indeed capture an exogenous source of variation in imprisonment, then the addition of these measures should not affect the incarceration estimates. Across Models 1 through 6 in Table 4, we find this exact pattern of results: despite the fact that the proportion of high-risk births is a strong predictor of infant mortality rates in each model, the incarceration effect is substantively and statistically indistinguishable across these different specifications. While it remains possible that unmeasured confounders remain even in the face of IV methods, our supplemental analyses bolster confidence that our findings are substantively meaningful. Indeed, in addition to accounting for all unmeasured between-state differences by specifying the variables as first differences, the incarceration effects remain robust even in Model 6, which includes a total of 91 covariates between the substantive measures and the state and year fixed effects. Taken together, this analysis provides strong evidence that mass incarceration has emerged over the past several decades as a unique mortality risk for infants in the United States.

## *Implications*

The results presented thus far have established two of the countervailing mortality consequences of mass imprisonment: incarceration saves lives by decreasing homicide, but these gains have been purchased at the expense of increased infant mortality. In order to more fully evaluate the incarceration ledger and clarify the implications of these findings, it is important to consider the scale of both of these effects. We did so first by calculating what the homicide rate would have been absent incarceration. According to our estimates of the incarceration–homicide effect from Table 2 (–.009), with an average state incarceration rate over the study period of 329.8 (per 100,000), the murder rate during this

**Table 3.** Effect of Changes in Incarceration Rates on Changes in Infant Mortality Rates, 1978 to 2010.

| | Model 1–IV | | Model 2–IV | | Model 3–IV | | Model 4–OLS | |
|---|---|---|---|---|---|---|---|---|
| Explanatory Measure | *b* | *SE* | *b* | *SE* | *b* | *SE* | *b* | *SE* |
| Δ Incarceration rate | .001 | (.002) | .005* | (.002) | .005* | (.002) | .000 | –.001 |
| Δ Population age structure (%) | | | | | | | | |
| 0–17 | | | | | –.092 | (.095) | –.088 | (.093) |
| 18–24 | | | | | –.090 | (.120) | –.058 | (.116) |
| 25–44 | | | | | –.062 | (.112) | –.060 | (.110) |
| 45–64 | | | | | –.087 | (.132) | –.065 | (.129) |
| Δ Unemployment rate | | | | | –.013 | (.025) | –.021 | (.025) |
| Δ Poverty rate | | | | | .009 | (.012) | .012 | (.012) |
| Δ % Black | | | | | .013 | (.013) | .017 | (.013) |
| Constant | .232*** | (.021) | –.868** | (.300) | –.908** | (.303) | –.908** | (.297) |
| State effects? | No | | Yes | | Yes | | Yes | |
| Year effects? | No | | Yes | | Yes | | Yes | |
| Model *F* statistic | .13 | | 2.08*** | | 1.97*** | | 1.99*** | |
| $R^2$ | | | .067 | | .068 | | .104 | |
| *N* | 1,621 | | 1,621 | | 1,621 | | 1,621 | |

*Note:* All models weighted by total number of live births. IV = instrumental variable; OLS = ordinary least squares.
**p* < .05, ***p* < .01, ****p* < .001.

time was reduced by 2.97 (.009 × 329.8). Given that the observed homicide rate over this period was 7.43 (per 100,000), these estimates suggest that the homicide rate would have been 40% higher absent incarceration (10.40 per 100,000).

Applying the same calculation to our infant mortality estimate from Table 3, were it not for mass incarceration, we find that the average infant mortality rate over the past three decades would have been 6.99 per 1,000 live births, as opposed to 8.64 (6.99 = 8.64– [.005 × 329.8]). In other words, the infant mortality rate would have been 19% lower over this period absent imprisonment. To put this in perspective, according to the World Bank (2015), as of 2010 the United States was ranked 42nd in infant mortality globally, with a rate of 6.3 infant deaths per 1,000 live births. If we downwardly adjust this rate by 19%, the United States would have moved up to 36th, jumping ahead of New Zealand, Cuba, Lithuania, Malta, Hungary, and Montenegro (and just behind Canada and Poland).

However, the above calculations are based on asking what would have happened if prisons were abolished (i.e., incarceration rates dropped to zero) with no offsetting social investments or criminal justice initiatives. Perhaps it is more practical to ask what would have happened if incarceration had remained at the 1978 rate, prior to the dramatic expansion of the prison population. Based on our estimates, had the incarceration remained at 123.7 per 100,000 (the 1978 rate) over this period, homicide rates would have been 15% higher ([.009 × 123.7 + 7.43] / 7.43 = 1.15), while infant mortality rates would have been 7% lower over the past three decades (1 – [(8.64 – .005 × 123.7) / 8.64] = .07).

Our third set of estimates aims to answer the fundamental question guiding our inquiry—after accounting for infant deaths, how strong is the mortality return of mass incarceration? We answered this by calculating the predicted number of lives saved through reduced homicide over the course of the prison boom and compare this to the predicted number of lives lost through increased infant mortality during this same period. Similar to above, we calculated these estimates using the 1978 incarceration rate as the counterfactual (e.g., what if the incarceration rate remained stable since 1978?). These predictions are relatively straightforward. If the average homicide rate over the study is 7.43 (per 100,000), and the predicted homicide rate is 8.54 (per 100,000) if incarceration remained stable, then one needs only the total population for all state-years (8,372,046,332) to estimate the total number of lives saved from increased incarceration through the following calculation: (8,372,046,332 / 100,000) × 8.54 – (8,372,046,332 / 100,000) × 7.43. Using this equation, we estimate that mass incarceration has resulted in just under 93,000

**Table 4.** Sensitivity Analysis of Incarceration–Infant Mortality Relationship, 1978 to 2010.

| | Model 1–IV | | Model 2–IV | | Model 3–IV | | Model 4–IV | | Model 5–IV | | Model 6–IV | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Explanatory Measure | *b* | *SE* | *b* | *SE* | *b* | *SE* | *b* | *SE* | *b* | *SE* | *b* | *SE* |
| Δ Incarceration rate | .005* | (.002) | .005* | (.002) | .005* | (.002) | .005* | (.002) | .005* | (.002) | .005* | (.002) |
| Δ Population age structure (%) | | | | | | | | | | | | |
| 0–17 | –.092 | (.095) | –.086 | (.095) | –.087 | (.095) | –.087 | (.095) | –.076 | (.097) | –.070 | (.097) |
| 18–24 | –.090 | (.120) | –.093 | (.120) | –.094 | (.120) | –.088 | (.120) | –.093 | (.122) | –.080 | (.123) |
| 25–44 | –.062 | (.112) | –.066 | (.113) | –.065 | (.113) | –.057 | (.113) | –.051 | (.116) | –.049 | (.116) |
| 45–64 | –.087 | (.132) | –.072 | (.132) | –.072 | (.133) | –.065 | (.133) | –.058 | (.136) | –.054 | (.136) |
| Δ Unemployment rate | –.013 | (.025) | –.013 | (.025) | –.012 | (.025) | –.009 | (.026) | –.009 | (.027) | –.010 | (.027) |
| Δ Poverty rate | .009 | (.012) | .008 | (.012) | .008 | (.012) | .010 | (.012) | .008 | (.012) | .009 | (.012) |
| Δ % Black | .013 | (.013) | .014 | (.013) | .013 | (.013) | .014 | (.013) | .014 | (.013) | .014 | (.013) |
| Additional measures | | | | | | | | | | | | |
| Δ High-risk birth index | | | .171* | (.075) | .172* | (.076) | .171* | (.075) | .219* | (.090) | .221* | (.090) |
| Δ Violent crime rate | | | | | .001 | (.000) | .001 | (.000) | .001 | (.000) | .001 | (.000) |
| Δ State welfare expenditures | | | | | | | .000 | (.000) | .000 | (.000) | .000 | (.000) |
| Δ State healthcare expenditures | | | | | | | | | .001 | (.011) | .005 | (.011) |
| Δ Education expenditures | | | | | | | | | | | .000 | (.000) |
| Constant | .908** | (.303) | .894** | (.307) | .931** | (.309) | .942** | (.308) | –.549 | (.320) | –.548 | (.320) |
| State effects? | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| Year effects? | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| *N* | 1,621 | | 1,603 | | 1,598 | | 1,598 | | 1,459 | | 1,459 | |

*Note:* All models weighted by total number of live births. Data are missing in 18 state-years in the original data on the variables that compose the high-risk birth index. State healthcare expenditure data were unavailable for years 1978, 1979, and 2010. Data for the violent crime were unavailable for five additional state-years.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

fewer homicides between 1978 and 2010 (92,930 ± 41,860). However, applying this same equation to infant mortality,[13] incarceration caused an additional 76,459 (± 30,830) infant deaths during this same time. These counteracting effects are displayed graphically in Figure 1.

As demonstrated in Figure 1, the mortality benefits of incarceration through reduced homicide are substantially offset by the increased number of infant deaths. Indeed, the results suggest that any estimate of the number of lives saved over the course of the prison boom need to be downwardly adjusted by a full 82% and, within the 95% confidence intervals, may in fact be negative or null.[14] In sum, the findings suggest that incarceration yields strong mortality benefits only if we ignore its collateral consequences for children. However, once infant mortality is fully accounted for in the incarceration ledger, the returns from mass imprisonment, in terms of saving lives at least, are far less noteworthy.

## DISCUSSION

Against the backdrop of a historically and internationally unprecedented expansion of the prison

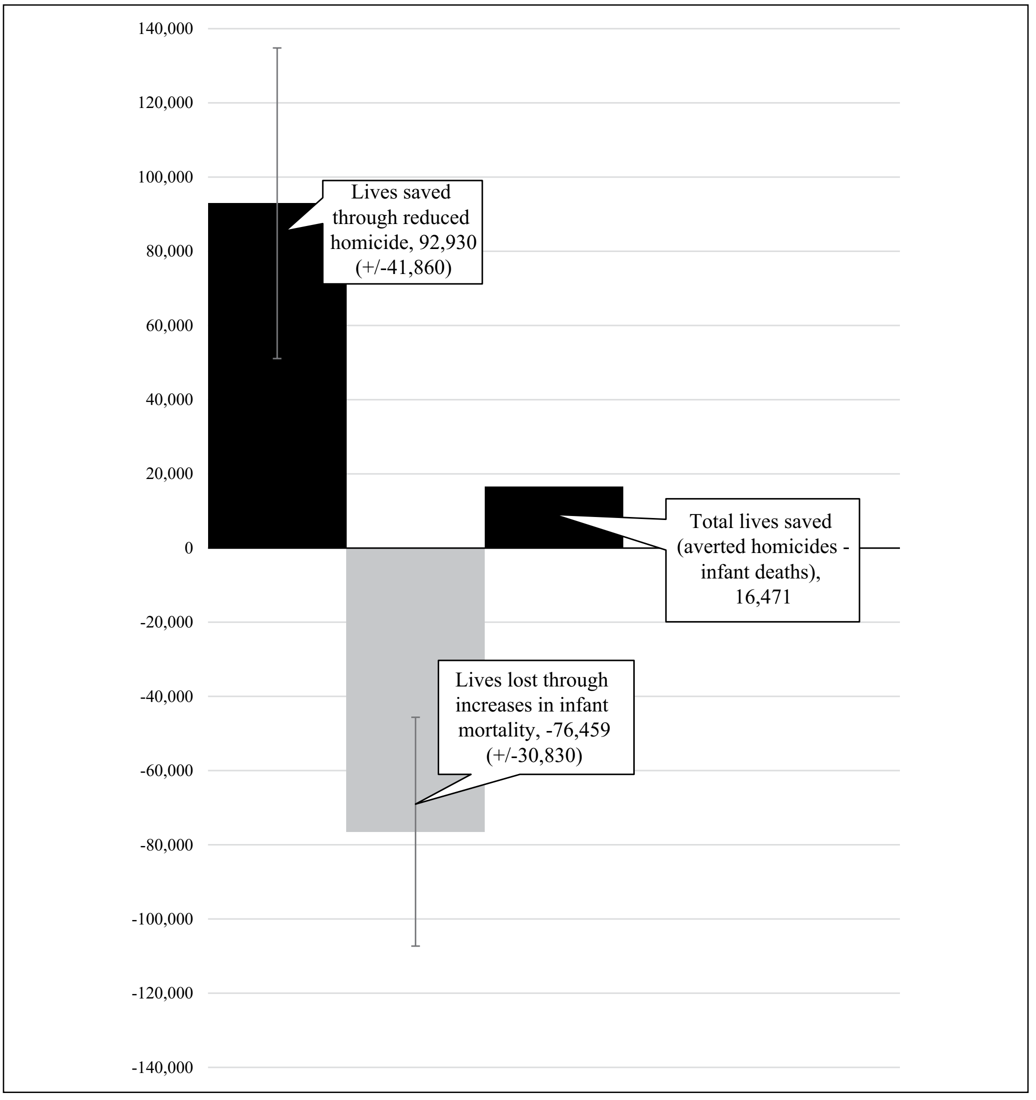


**Figure 1.** Comparison of Lives Saved through Reduced Homicides versus Lives Lost through Increased Infant Mortality.
*Note:* Figures derived from estimates shown in Model 3, Table 2, for homicide reductions, and Model 3, Table 3, for infant mortality increases, holding incarceration at 1978 rates and all other variables at their means.

system in the United States since the late 1970s, research on incarceration has largely gone through two distinct phases (Sampson 2011). While the first phase focused on the deterrent and incapacitation effects of imprisonment, the second phase primarily focused on the negative and collateral consequences of incarceration. Despite considerable research attention to both areas, our knowledge about the net consequences of imprisonment remains limited (but see Turney and Wildeman 2013, 2015). Using the dynamic adjustment path of state-level incarceration rates to isolate exogenous variation in incarceration, this paper attempts to estimate the casual effect of increased imprisonment on both homicide and infant mortality to gain better leverage on the countervailing mortality consequences of the prison boom. In doing so, we answer calls for a third phase of imprisonment research (Sampson 2011), where studies simultaneously consider the positive and negative effects of imprisonment in order to more fully weigh the social ledger of incarceration's effects.

Challenging claims that mass incarceration yields strong returns in terms of saving lives, our estimates suggest that the purported mortality benefits of the prison boom are largely illusory. Adjusted figures that count the number of increased infant deaths attributable to incarceration suggest that the mortality benefits of imprisonment over the past three decades are 82% lower than previously thought. This account of limited mortality benefits from mass incarceration contrasts sharply with earlier research. The finding that incarceration saves lives by reducing homicide is well established in both economic and criminological studies of the crime–incarceration nexus. We challenge this generally accepted finding not by calling into question the incarceration–homicide link but by suggesting that an investigation into this link alone is a myopic strategy for evaluating the mortality consequences of mass incarceration. In this regard, our study extends the scope of previous research that documents prison's deleterious health and mortality costs for those formerly incarcerated by demonstrating that not only has the prison boom had far-reaching indirect mortality consequences but that accounting for the lives of the children unwillingly caught up in the prison boom substantially diminishes any estimate of the mortality benefits associated with mass incarceration. This finding has significant health and policy implications.

In reference to medical sociology, this study highlights the importance of understanding the public health consequences of the penal system. The scale of infant mortality in the United States has puzzled public health officials and researchers alike. By investigating the causal connections between incarceration and infant mortality during the prison boom, the findings from this research help partially answer why the U.S. infant mortality rate exceeds that of nearly all other advanced countries—its incarceration rate also far surpasses these countries. Indeed, our IV estimates suggest the infant mortality rate since the late 1970s would have been 7% lower were it not for prison buildup. Our study also clearly demonstrates the empirical difficulties in estimating the macrolevel effects of incarceration. We find that using an exogenous source of variation to account for the possibility that incarceration and infant mortality are jointly determined yields substantially larger estimates of the effects of incarceration on infant mortality rates than those estimated in standard OLS models. Thus, our results suggest that not only does mass incarceration now represent a unique and substantial risk to infant survival in the United States but also previous research may have underestimated the import of the prison system for understanding American exceptionalism in infant mortality.

Taken in the context of the unequal distribution of incarceration, where poor children are far more likely to experience parental incarceration (Wildeman 2009), this suggests that mass incarceration has taken a particularly acute toll on the survival chances of the most disadvantaged children and has therefore likely contributed to social class inequalities in infant mortality that already exist in the United States (Singh and Kogan 2007). This has important implications for understanding the drivers of contemporary economic inequalities in infant mortality. One of the central tenets of the fundamental-cause perspective is that the association between inequality and health is reproduced over time via the replacement of intervening mechanisms. The results presented here suggest that the prison may have emerged in recent decades as an institutional mechanism linking socioeconomic status to inequalities in infant mortality.

In line with this view, our analysis provides a framework for future studies to more fully assess the incarceration ledger and the potential offsetting consequences of the prison boom for health inequalities. We think a particularly fruitful path for future research is examining the import of imprisonment for existing racial health disparities. The prison boom has been vastly unequal across racial groups. Nearly 21% of black men born between 1965 and 1969 could expect to serve a prison sentence by age 34, compared to just 3% of white men (Western 2006). For the children born during this period, 14% of black children had experienced paternal incarceration by age 14, compared to 2% among white children (Wildeman 2009). These racial disparities in imprisonment, for both adults and children, have increased over time (Western 2006; Wildeman 2009). However, the aggregate effects of this form of inequality for mortality are not yet known. On the one hand, research shows that increasing racial disparities in incarceration have led to reductions in racial disparities in homicide (Light and Ulmer 2016). On the other hand, racial stratification in parental incarceration has been linked to increased racial inequality in infant mortality (Wakefield and Wildeman 2014). Taking guidance from this analysis, future studies could compare the reductions in homicide inequality to the increases in infant mortality disparities. Doing so would not only substantially advance our understanding of the net mortality harms associated with incarceration but also provide a more holistic account of the implications of the prison boom for racial health inequalities.

As policy makers continue to reexamine the efficacy of incarceration in light of massive prison overpopulation juxtaposed with strained state and federal budgets, our results call for increasing policy attention to the intergenerational consequences of incarceration. The findings from this study suggest that doing so would substantially temper expectations regarding the benefits of imprisonment and call into question one of the chief motivations for the prison buildup. The prison boom is a reflection of policy choices that were aimed ostensibly at improving public safety. By demonstrating that these policies have had the unintended consequence of increasing infant mortality in recent decades, our analysis fundamentally changes the policy calculus of the incarceration ledger. While incarceration has indeed saved lives by reducing the prevalence of homicide victimization, these gains have been purchased at great cost—decreased survival rates for the most vulnerable members of society. Any set of criminal justice policies going forward should be attuned to this reality by minimizing the harmful effects of incarceration (e.g., residential instability, economic hardship, disruptions in caregiving) for the family members left behind. For starters, the interests of children should be considered at each stage of the criminal justice process (e.g., arrest, sentencing, reentry). For example, state laws could be amended so that judges explicitly consider the effects of a parent's incarceration on children, or states could require presentence investigations that include family impact statements and recommendations to ensure support during a parent's imprisonment (Christian 2009).

However, a broader set of policies that lie outside the criminal justice system is likely to be more fruitful. Policies directed at enhancing overall community conditions through economic investment, social welfare, spending on education, drug treatment, and work training programs not only will improve well-being for disadvantaged children in general but also will help ameliorate the criminogenic conditions that foster crime in the first place, thus simultaneously reducing the need for, and burden of, mass incarceration.

We close by returning to our central research question: what are the mortality returns to mass incarceration? By providing the first simultaneous comparison of the effects of incarceration on homicide and infant mortality rates, we draw the following conclusion: far weaker than originally presumed. And this is after considering only one of the collateral mortality consequences of the prison boom; this downward adjustment would be even more pronounced if one were to consider the direct mortality consequences for those who are incarcerated. For instance, Noonan, Rohloff, and Ginder (2015) show that almost 9,000 inmates died between 2000 and 2013 due to alcohol intoxication, suicide, and accidents while in incarcerated. And after release, former inmates continue to face substantial mortality risks in terms of substance abuse, self-harm, and other hazards (Binswanger et al. 2007; Pridemore 2014). Moreover, research links incarceration to the spread of AIDS in the general population (Johnson and Raphael 2009), and recent longitudinal work associates parental incarceration with increased risk of biomarkers that predict cancer and cardiovascular disease (Boch and Ford 2015). Taken together, this body of work further underscores our central claim that the ancillary costs of mass incarceration negate many of the perceived benefits. In this regard, our study adds to the growing body of research suggesting that the benefit-cost ratio of mass incarceration is likely well below one after taking into consideration the adverse effects of the prison system on other domains of U.S. society.

## SUPPLEMENTAL MATERIAL

Table S1 is available in the online version of the article.

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## NOTES

1. These rankings include the following non–Organisation for Economic Co-operation and Development member economies: Brazil, China, Colombia, Costa Rica, India, Indonesia, Latvia, Lithuania, Russia, and South Africa.

2. Prior to 1998, these data were reported as Monthly Vital Statistics Reports.
3. Due to the qualitatively different nature of jail and prison terms, jail inmates are not included in the incarceration counts.
4. Incarceration information is missing for Washington, D.C., after 2001, when the city abandoned its prison system, and for one year in Alaska.
5. We also tested for nonlinearity using a metric measure of time (ranging from 1 to 32). We then created a quadratic term and interacted both of these measures with the incarceration rate. For both incarceration and infant mortality, the quadratic interactions were not statistically significant.
6. Though the exogeneity requirement is necessarily unobservable, we note that the difference between the implied and actual incarceration rates does not correlate with the residuals from ordinary least squares specifications where the instrument is excluded.
7. See pages 286 to 289 and the appendix from Johnson and Raphael (2012) for a detailed discussion of the theoretical conditions under which this instrument identifies exogenous variation in incarceration.
8. The infant mortality results are substantively identical when we weight by the total state population.
9. Following Wildeman (2012), we measure high-risk births using a factor score obtained via principle component analysis of the following variables: proportion of births to unmarried women, proportion of births at less than 37 weeks, proportion of births to women with no prenatal care, and proportion of births weighing less than 2,500 g. Data are available from the U.S. Centers for Disease Control and Prevention for 1978 to 2002 and the Annie E. Casey Foundation for 2003 to 2010.
10. Figures comprise either Aid to Families with Dependent Children or Temporary Assistance for Needy Families expenditures (depending on year) plus food stamp/Supplemental Nutrition Assistance Program expenditures. Data obtained from the *Statistical Abstracts of the United States*.
11. Data obtained from the U.S. Centers for Medicare and Medicaid Services.
12. Education spending obtained from National Center for Education Statistics for 1987 to 2010. Data for 1978 to 1986 are from the *Digest of Education Statistics*.
13. The total number of live births over this period is 123,320,548. Thus, the equation for calculating the number of increased infant deaths is as follows: (123,320,548 / 1,000) × 8.64 – (123,320,548 / 1,000) × 8.02 = 76,459.
14. An alternative method is to examine the number of lives lost and saved in the average state-year. To do so, one needs only substitute the mean population for the total population (mean total population = 5,129,930; mean live births = 75,564). Using this alternative calculation, we find identical results: the mortality returns to incarceration need to be downwardly adjusted by 82%:

$$\frac{\left[(75{,}564/1{,}000)\times 8.64-(75{,}564/1{,}000)\times 8.02\right]}{\left[(5{,}129{,}930/100{,}000)\times 8.54-(5{,}129{,}930/100{,}000)\times 7.43\right]}=.82$$

    One could also predict rates of homicide and infant mortality if incarceration were zero. However, as the numerator and denominator of the equation would change relative to one another, the result would still be .82.

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