Incarceration and Population Health in Wealthy Democracies

Christopher Wildeman[1]
University of Michigan

[1]Direct mail to Christopher Wildeman, University of Michigan, School of Public Health, 3648 SPH Tower, 109 Observatory, Ann Arbor, MI 48109. Direct email to wildeman@umich.edu. This research was supported by a postdoctoral fellowship from the Robert Wood Johnson Foundation Health & Society Scholars Program and a grant from the Robert Wood Johnson Foundation Health & Society Scholars Program at the University of Michigan. I thank Jeff Morenoff, Sarah Burgard, Jason Beckfield, Jason Schnittker, André Kuhn, Neil Mehta, Amar Hamoudi, Andy Papachristos, Sigrun Olafsdottir and Chris Muller for helpful comments. Kevin Bradway provided excellent research assistance. The contents of this paper do not necessarily reflect the views of funding agencies.

ABSTRACT

This article considers how incarceration influences population health using data from 21wealthy democracies over the 1981-2005 period (*N*=368). Results support a number of conclusions. First, when all 21 nations are considered, increases in incarceration rates are associated with decreases in life expectancy at birth but no change in the infant mortality rate. Second, point estimates from these models suggest that life expectancy at birth in 2005 in the United States would have been 1.4 years longer had the U.S. incarceration rate remained at the 1981 level. Third, when the U.S. is excluded from the analysis, results change dramatically. Increases in incarceration rates are no longer associated with significant decreases in life expectancy, but they are associated with decreases in the infant mortality rate. Analyses also suggest that increases in incarceration rates in wealthy nations other than the United States are associated with mortality declines for all ages until the late 20s. Taken together, results suggest that among countries with low incarceration rates, increases in the incarceration rate may improve population health. For nations with high incarceration rates, however, increases in the incarceration rate may harm population health.

Starting in the mid-1970s, the U.S. imprisonment rate began to increase so quickly that in only 35 years it grew from around 100 per 100,000 to around 500 per 100,000. The U.S. incarceration rate is not only historically novel, however. When compared to the incarceration rates of other wealthy democracies, it becomes clear that U.S. incarceration is comparatively novel as well. England, which also has a high incarceration rate, incarcerates at a rate only one-fifth as high as the U.S. rate (Western 2006: 14). And Iceland—one of the least-incarcerating nations in the world—incarcerates at a rate only about one-seventeenth as high as the U.S. rate. Although the U.S. incarceration rate tended to be higher than those of other wealthy democracies before the prison boom began, the size of the gap between the incarceration rates of the U.S. and other wealthy democracies is a modern phenomenon. Even when compared to other countries that also experienced much growth in the incarceration rate, changes in the U.S. rate stand out (Figure 1).

[Insert Figure 1 about here.]

Given the novelty of the American incarceration rate, researchers have examined the share of adults ever going to prison and proportion of children who have a parent go to prison (Pettit and Western 2004; Western and Wildeman 2009; Wildeman 2009a), the consequences of incarceration for individuals, families, and communities (Binswanger et al. 2007; Braman 2004; Clear 2007; Comfort 2007, 2008; Massoglia 2008a; Massoglia and Schnittker 2009; Murray and Farrington 2008; Pager 2003; Rosen, Schnoenbach, and Wohl 2006; Schnittker and John 2007; Western 2006; Wildeman *Forthcoming*), and the consequences of the prison boom for inequality in the U.S. (Johnson and Raphael 2009; Massoglia 2008b; Wakefield and Uggen *Forthcoming*; Western 2006; Wildeman 2009b). In general, research finds that having ever been incarcerated diminishes the already-slim life-chances of marginal men and that the negative effects of contact with the penal system spill over to their romantic partners and children. Spillover effects do not

likely end with families, however, and some speculate that living in a neighborhood with a high incarceration rate also has negative consequences for individuals. When these negative effects are combined with the astonishingly high lifetime risks of imprisonment for African American men – especially those who did not complete high school – mass imprisonment likely contributes to inequality not only among adult men, but also among women, children, and communities.

Given the broad social effects of incarceration and what an outlier the U.S. in terms of the incarceration rate, it is odd that little research tests how incarceration affects inequality between nations (but see Western and Beckett 1999). This gap in the research is important for two reasons. First, the gap between the U.S. incarceration rate and the incarceration rate of other wealthy democracies is roughly of the same magnitude as are racial disparities in incarceration in the U.S., so effects on inequality between nations may be as large as effects within the United States. Second, the effects of incarceration on the health of families, communities, and even nations may depend on the level of incarceration. Within the U.S., many researchers have suggested that it is only at very high rates that incarceration has negative effects on community outcomes such as crime (Clear 2007; Nagin 1998) and health (Massoglia and Schnittker 2009). Although the benefits of increases in the incarceration rate *at low levels* are rarely tested in regards to anything other than crime (Clear 2007; Nagin 1998), this research suggests that there may be a tipping point at which incarceration shifts from enhancing wellbeing to harming it. If the effects of incarceration on the wellbeing of a nation vary by the level of incarceration, two conclusions can be drawn. First, the effects of incarceration on between-country inequality in wellbeing may be even greater than anticipated if effects were similar regardless of the level of incarceration. Second, incarceration may actually promote population wellbeing in wealthy democracies other than the United States, since their incarceration rates are still relatively low.

This paper seeks to address these gaps by considering the effects of the incarceration rate on population health using unbalanced panel data from 21 wealthy democracies. Population health is an ideal outcome for a number of reasons. First, the measures of population health considered—life expectancy at birth and the infant mortality rate—are generally considered excellent measures of the wellbeing of a population (Beckfield 2004; Conley and Springer 2001). Second, the health of Americans has declined relative to the residents of comparable nations in recent decades (Oeppen and Vaupel 2002). Finally, since life expectancy at birth represents the cumulative mortality experience of an entire population, it can easily be broken down into its constituent parts—age-specific mortality rates. Thus, this measure allows me to test at which ages incarceration has the largest effects. In testing for effects of incarceration on population health, this article extends the current discussion beyond the role of the welfare state (Conley and Springer 2001), income inequality (Wilkinson and Pickett 2009), and health behaviors (Mokdad et al. 2004) in producing health disparities between the U.S. and comparable nations.

Results from OLS regression models with country fixed effects provide support for a number of conclusions. First, when all 21 countries are considered, increases in incarceration rates are associated with decreases in life expectancy at birth but no significant change in the infant mortality rate. Second, point estimates from these models suggest that American life expectancy at birth in 2005 would have been 1.4 years longer had the American incarceration rate remained at the 1981 level. Thus, initial models suggest that the American penal system may have contributed to the increasingly poor health of Americans over this period, relative to those residing in comparable nations. Third, when the United States is removed from consideration, the results change notably. Increases in incarceration rates are no longer associated with decreases in life expectancy, but they are associated with decreases in the infant mortality rate. Furthermore,

analyses suggest that increases in incarceration rates in wealthy nations other than the United States are associated with mortality declines for all ages until the late 20s. Taken together, these results suggest that increases in the incarceration rate at low levels may improve population health and that the effects of changes in the incarceration rate on population health in America are different than they are in other wealthy nations—suggesting a potential tipping point. They also suggest that researchers interested in between-country health inequities should focus not only on the welfare state, income inequality, and health behaviors but also the incarceration rate.

INCARCERATION AND POPULATION HEALTH

In this section, I review research on the consequences of incarceration for health in three parts. In the first, I consider the effects of prison incarceration and release on the health of individuals. Next, I review the handful of studies on the effects of mass incarceration on the health of family members, communities, and the population more broadly in the United States. I close by discussing how the effects of incarceration on population health outside of the United States—at low starting rates of incarceration—may differ from effects found within the United States.

Incarceration, Release, and Health

Researchers have long had interest in the health effects of incarceration and release on those who have ever been incarcerated. Most research in this area has focused on the consequences of incarceration for mortality risk (Binswanger et al. 2007; Clavel, Benhamou, and Flamant 1987; Farrell and Marsden 2007; Mumola 2007; Rosen et al. 2008), but some research considers the broader health implications of this experience (Massoglia 2008a; Massoglia and Schnittker 2009; Schnittker and John 2007). In general, research finds that individuals have lower mortality risks

while incarcerated than comparable individuals on the outside (Clavel et al. 1987; Mumola 2007) but much higher risks than comparable individuals after being released, especially immediately following release (Binswanger et al. 2007; Farrell and Marsden 2007; Rosen et al. 2008).[2]

Unfortunately, it remains unclear based on these studies whether incarceration or release are responsible for these differences in mortality rates—in large part because prisoners are matched with controls only on age, race, and sex. Research on the broader health effects of having ever been incarcerated, however, suggests that incarceration may indeed have a causal effect on mortality risk—although these studies generally provide insight only into post-release mortality effects. A number of studies show that having ever been incarcerated not only increases the risk of having infectious or stress-related diseases (Massoglia 2008a), but also increases the risk of having severe functional limitations (Schnittker and John 2007), for instance. Since these health problems are associated with elevated mortality risk, this research suggests that once prisoners have been released from penal institutions, they are likely at greater mortality risk than comparable individuals and that their status as ex-prisoners is at least partially responsible for this elevated risk. Although it is less clear whether imprisonment lowers mortality during the time that an individual is incarcerated, it could plausibly decrease mortality risk by lowering homicide- and overdose-related mortality for the duration of the imprisonment.

Unfortunately, it is difficult to generate hypotheses about the effects of incarceration on the health of a population based on these studies because it is unclear whether the mortality-reducing effects of imprisonment trump the mortality-producing effects of release from prison or vice versa *over the entire life-course*. Thus, it is difficult to know whether the total effect on

[2] Most research has considered U.S. prisoners (Binswanger et al. 2007; Mumola 2007; Rosen et al. 2008), but research from other wealthy democracies finds similar patterns (Clavet et al. 1987; Farrell and Marsden 2007).

population health will be positive or negative based on these studies. Nonetheless, I expect that incarceration rates will be positively associated with mortality rates of men in their 30s and 40s. Prior research shows that recently released prisoners are at elevated mortality risk and that former prisoners have high burdens of disease (Binswanger et al. 2007; Massoglia 2008a). Because of these negative effects, former prisoners who never return to prison will be at elevated risk of mortality relative to comparable (never-imprisoned) individuals. It is difficult to know at what age men fully "age out" of crime, however, some research suggests that few continue to be criminally active after their late 30s (Laub and Sampson 2003:86). Thus, offenders released in their 30s and 40s are unlikely to return to prison. Given negative effects of prior incarceration on health, incarceration may increases mortality among men in these ages. For younger men still in the cycle of incarceration and release, however, it is unlikely that incarceration will be linked with substantial changes in their mortality risk. Thus, if incarceration influences population health only through the mortality risk of ever-incarcerated men, then the only population-level effects should manifest themselves as elevated mortality risks among men in their 30s and 40s.

(Mass) Incarceration and Population Health

Regardless of the size of the effects of incarceration on the health of men, if incarceration rates only affect population health through them, then it is unlikely that incarceration will substantially alter population health. Since only around seven percent of American men ever go to prison (Bonczar 2003), for the penal system to have large effects on population health, incarceration rates would need to have effects that extend beyond the effects on ever-incarcerated men. Little research considers such population health effects, but research on the effects of incarceration on

families, communities, and relevant population-level outcomes suggests that the consequences of high incarceration rates for population health may not be limited to the ever-incarcerated.

The majority of research on spillover effects of incarceration on the never-incarcerated has considered the effects of incarceration on family members. Research shows, for instance, that having a family member incarcerated harms family life (Braman 2004; Comfort 2007, 2008; Wakefield and Uggen *Forthcoming*). Since having a parent (Wildeman 2009a) or other family member (Western and Wildeman 2009) incarcerated has become common for marginalized groups in the U.S., if having a family member incarcerated harms family life, then broader effects of incarceration on population health and inequality in population health are plausible. Relatively little research tests the hypothesis that having a family member incarcerated harms the health of family members. Nonetheless, some evidence suggests that having a parent incarcerated increases infant mortality risk (Wildeman 2009b). Likewise, research shows that high incarceration rates harm community life (Clear 2007; Massoglia and Schnittker 2009) and compromise community health (Thomas and Torrone 2006). These studies suggest, albeit tentatively, that high rates of incarceration may have broad negative effects on population health.

Unfortunately, little research considers the macro-level consequences of incarceration for population health—and most studies that consider research questions at this level of aggregation focus on health disparities rather than total population health. Nonetheless, some studies provide insight into mechanisms through which high rates of incarceration could affect the health of children and adults. The research most directly on point considers children, so I begin there. Research in this area suggests that state-level incarceration rates are positively associated with infant mortality rates (Wildeman 2009b) and foster care caseloads (Swann and Sylvester 2006), even after controlling for state-level fixed effects and other factors that may be associated with

incarceration and the outcome considered.[3] Furthermore, the magnitude of these effects is substantial. Based on results from this handful of studies, therefore, it is likely that increases in the incarceration rate will increase the mortality risk of both infants and young children.

Research also suggests that mass incarceration may be associated with elevated mortality risks for adults. Most research in this area considers the effects of incarceration rates on AIDS prevalence rates (Johnson and Raphael 2009) and the development of more robust strains of tuberculosis (Stuckler et al. 2008).[4] Findings from these studies suggest that high rates of incarceration may be associated with elevated mortality risks not only for the men and women who enter prison walls, but also for the wider population. It also bears mentioning at this point that to the degree that high incarceration rates sap precious resources from state and federal governments, it may diminish social spending that promotes population health. No research tests the relationship between incarceration rates and public expenditures on health. Nonetheless, it is possible that by diminishing state and federal expenditures on public health infrastructure, investment in penal institutions may compromise population health by increase the mortality risks of older Americans, for whom public health infrastructure may be especially crucial.

Taken together, research suggests that the comparatively and historically novel rates of incarceration in the U.S. are likely to compromise population health. Although little research tests the hypothesis that mass imprisonment compromises population health, existing research suggests that high rates of imprisonment are likely to be associated with both elevated infant mortality rates and lower life expectancy at birth. They also suggest, albeit somewhat more

[3] Foster care placement is the area in which female incarceration rates matter most (Swann and Sylvester 2006), although the effects of maternal incarceration on children may also be quite large (Kruttschnitt *Forthcoming*).
[4] Some of this work considers countries other than the United States (Stuckler et al. 2008), however, I include this work in this review because it focuses on the consequences of mass incarceration for these health problems.

tentatively, that to the degree that increases in the incarceration rate correspond with divestment of funds from public health spending on health, it would be reasonable to expect high rates of incarceration to have substantial effects on the health of older individuals in the population.

(Low Rates of) Incarceration and Population Health

In the previous section, I suggested that mass imprisonment compromises population health through a series of spillover effects that influence families, communities, states, and nations. Since high levels of incarceration promote disorder (Clear 2007) and the cost of maintaining the penal state siphons resources away from public funds that could be used to promote population health, for instance, mass imprisonment compromises the health not only of the individuals who enter prison walls, but also the entire population. Assuming uniformly negative effects of incarceration rates on population health may be unwise, however, because the effects of incarceration on population health may differ depending on the level of incarceration. In this section, I suggest that increases in the incarceration rate at low levels may promote population health. The crux of my argument is that although the mortality costs of having ever been imprisoned are unlikely to vary substantially by the level of incarceration, the spillover effects of incarceration observed in the U.S. are likely to occur only at high rates of incarceration. In nations with low incarceration rates, increases in the incarceration rate may improve population health by promoting family life and community wellbeing. In order to make this argument, I rely first on new findings on the incarceration-crime relationship as a general example of how the effects of changes in the incarceration rate on population wellbeing depend on the starting level. I then move on to discuss but two areas in which increases in the incarceration rate at low starting levels could promote population health: (1) child and (2) young adult mortality.

Since no research considers the effects of incarceration on population health outside of the U.S. context, this section first considers the relationship between the incarceration rate and the crime rate. Most research shows that incarceration rates diminish crime rates (for examples, see Johnson and Raphael 2006; Levitt 1996; Western 2006). Although most research finds that incarceration diminishes crime, some evidence suggests that as the U.S. incarceration rate has increased, its crime-fighting benefits have decreased (Johnson and Raphael 2006). These findings suggest (if tentatively) that the effects of incarceration on crime vary by the starting level of incarceration. Could the same be the case for other outcomes? Prior research on the spillover effects of incarceration suggests that this may be the case. Research on the effects of incarceration on neighborhood-level crime rates (Nagin 1998) and wellbeing (Clear 2007) suggest, for instance, that it is only at very high levels that incarceration harms communities. At low levels, even the researchers most adamant about the corrosive effects of mass imprisonment on society are likely to agree that increases in the imprisonment rate could promote community wellbeing. Similarly, research on the effects of paternal incarceration on child wellbeing suggests that it is only when the father was neither abusive nor incarcerated for a violent offense that his absence compromises child wellbeing (Wildeman *Forthcoming*). Since it is only in the U.S. that nonviolent offenders are incarcerated at very high rates, this finding suggests that the spillover effects of incarceration on children may be exclusively a U.S. phenomenon since fathers who enter prison in low-incarceration countries may be sufficiently antisocial to harm their children.

Although none of the research considered in this section has thus far considered how increases in the incarceration rate at low starting levels influence population health, results from these studies are nonetheless instructive because they suggest that there may be a tipping point above which incarceration has broadly negative social effects and below which incarceration has

broadly positive social effects. None of these studies yield insight into at which point we might expect incarceration to shift from helping the population to harming it. Nonetheless, they do suggest that increases in the incarceration rate may actually promote population health, provided that the starting incarceration rate was relatively low. Since this suggestion flies in the face of most research on the collateral consequences of incarceration, I provide two examples of how increases in the incarceration rate at low levels could actually promote population health.

Probably the best example of how incarceration could promote population health applies to young adults—especially young men. Much research on crime suggests that there is a small pool of young men who are responsible not only for the lion's share of economically motivated crime, but also violent crime. Likewise, previous research suggests that most homicides take place between individuals who are similar in their race, age, and a host of other demographic characteristics (Papachristos 2009). At very low rates of incarceration, these young men could have quite negative effects on population health—and are especially likely to contribute to elevated mortality risks among other young men. Thus, increases in the incarceration rate at very low starting rates of incarceration are likely to decrease the mortality rates of young men—thereby improving population health. A similar argument could be used for the mortality rates of infants and other small children. Since there is some group of extremely criminally active men who are likely to elevate the mortality risk not only of their own small children but also other small children, increases in the incarceration rate at low starting levels could diminish mortality among small children both by limiting the fertility of these men (Pettit and Sykes 2009) and by removing these men from society for some time and thereby protecting all other children from them. Although not the only examples of how increases in the incarcerate rate at low starting

levels may promote population health, these examples illustrate how there could be a tipping point at which the effects of incarceration on population health shift from positive to negative.

DATA AND ANALYTIC STRATEGY

Data

Unbalanced panel data covering the years 1981-2005 (*N*=368) are used to test the association between incarceration and population health. All 21 countries included were founding members of the OECD or wealthy democracies at the beginning of the period (see Table A1 for countries and years included). Data were drawn from various administrative sources (see Table A2).

Dependent Variables. I use three sets of dependent variables: Measures of life expectancy at birth, infant mortality rates, and age-specific mortality rates. Life expectancy at birth provides an overview of the health of a population. Since the associations between incarceration and health may vary by sex, I consider not only total life expectancy, but also male and female life expectancies. The infant mortality rate is an indicator of the health of women of childbearing age and their infants. Some research proposes that the postneonatal mortality rate is more sensitive to macro-level shifts than is the neonatal mortality rate (LaVeist 1992), so I also predict neonatal and postneonatal mortality rates. The final dependent variables are age-specific mortality rates. I break age-specific mortality rates into five-year age groups (to 65-69), with the exception of considering 0-1 and 1-4 as separate categories. I consider age-specific effects of incarceration on mortality because it allows me to (1) detect implausible effects of incarceration on mortality rates and (2) isolate age-specific variations in the mortality effects of incarceration.

Explanatory Variable. The explanatory variable is the average incarceration rate in the three prior years and is measured per 1,000 individuals in the population. For example, if life

expectancy at birth in 1990 is the dependent variable, then the mean of the 1987, 1988, and 1989 incarceration rates is the explanatory variable. I use this measure instead of a contemporaneous one because the effects of incarceration on population health may not occur instantaneously. I use the incarceration rate, which measures the rate at which individuals are detained in prisons or jails, rather than the imprisonment rate, which measures only prison detainment. I chose this broader measure because it is easier to compare across nations than the imprisonment rate.[5]

As Figure 1 shows, the American incarceration rate is an outlier. Taking the log of the incarceration rate could diminish the influence of the American incarceration rate on the results. Unfortunately, logging the incarceration rate would also make it more difficult to interpret the results since I am interested not in the effects of a relative increase in the incarceration rate but the effects of an absolute increase in the incarceration rate. Furthermore, one goal of this analysis is to demonstrate how distinct the associations between incarceration and population health are in the United States relative to those in other wealthy democracies, so I want to highlight (not hide) the influence of the United States on the results. Thus, I do not log the incarceration rate.

Control Variables. This analysis also includes a host of controls. These include the total fertility rate, the percent of the population aged 65 or older, per capita GDP, the unemployment rate, public expenditures on health, and total social expenditures.[6] All analyses also include controls for the year (which has been centered) and a quadratic term for year in order to account for the somewhat dramatic secular improvements in population health over this period.[7]

[5] Results seem unlikely to change much were the imprisonment rate used instead of the incarceration rate.
[6] Many similar analyses also control for percent urban, but I do not use this measure because of how highly urbanized most of these countries were and how little change there was in the percent urban over this time period.
[7] Results did not change notably when year fixed effects were included in the model, so I opted for using only 2 degrees of freedom (for the linear and quadratic year terms) rather than 24 (for the year dummy variables).

In addition to these standard controls, the analyses also control for income inequality and the homicide rate. Income inequality is included because it is associated with the imprisonment rate and the health and wellbeing of a population (Wilkinson and Pickett 2009:496). Until recently, data on income inequality were limited, making it difficult to control for income inequality in models using repeated observations on countries without losing many observations. However, a new dataset called the SWIID provides information on income inequality for all of the country-years included in this analysis (Solt 2009). Although the procedures used to generate these estimates have limitations, estimates for the country-years I consider are likely reliable (Solt 2009:238). Although changes in the incarceration rate do not correspond closely with changes in the crime rate in the United States over this period (Western and Wildeman 2009), I still include one control for crime—the homicide rate. I do so for a number of reasons. First, homicide is both a crime and a cause of death. Thus, it is likely associated with the dependent and explanatory variables. Second, although incarceration and crime rates may not co-vary in the United States over time, some research suggests a substantial association between incarceration and homicide rates in other countries (Nadanovsky and Cunha-Cruz 2009). Finally, the homicide rate is the only measure of crime unlikely to be defined differently depending on the county.

For descriptive statistics for dependent, explanatory, and control variables, see Table 1.

[Insert Table 1 about here.]

Analytic Strategy

The method is an OLS regression model with country fixed effects and clustered standard errors. This model is appropriate because it controls for stable (yet unobserved) characteristics of countries that may be associated with incarceration rates and population health. In crossnational

analyses, unobserved heterogeneity is one of the most serious obstacles to causal inference, so including fixed effects improves the reliability of results. Although a GLS model with random effects would have improved efficiency, I did not use that model because Hausman tests revealed significant differences between the GLS and OLS estimates. Since the efficiency gained from using random effects is preferable to fixed effects only when it does not alter the coefficients (Halaby 2004; see also Beckfield 2006), I use the OLS regression model with fixed effects.[8] Another concern is serial correlation. Since the data show serial correlation, I use clustered standard errors, which diminish the risk of falsely rejecting the null (Bertrand, Duflo, and Mullainathan 2004:272). Although sociologists tend to use an AR(1) adjustment to diminish concerns about serial correlation, doing so increases the risk of falsely rejecting the null hypothesis even if the serial correlation is AR(1), which it rarely is (Bertrand et al. 2004).[9]

In the first stage of the analysis, I predict six different measures of population health, three related to life expectancy at birth—total, male, and female life expectancy at birth—and three related to the infant mortality rate—total, neonatal, and postneonatal—using all 21 countries (Table 2). The goal in this stage of the analysis is to consider how incarceration rates associate with population health in the full sample while controlling for country fixed effects and the full range of covariates discussed. Based on point estimates derived from these models, predictions are then made about how different the health of Americans would be if the American incarceration rate were not such an outlier (Table 3). In the second stage of the analysis, the United States is omitted (Table 4), making it possible to consider what the effects of the incarceration rate on population health are when the outlier (the United States) is excluded.

[8] Nonetheless, estimated effects of incarceration were comparable in the GLS models with random effects.
[9] Results were comparable when an AR(1) adjustment for serial correlation was utilized instead.

In the final stage of the analysis, I use the same modeling strategy but predict age-specific mortality rates (Table 5). Some of these models include the United States; others exclude it. Considering age-specific effects of incarceration is important for two reasons. First, it allows me to test for implausible effects. For instance, no research suggests that incarceration rates should increase the mortality rates of young men (age 15-29), so if models suggest that incarceration rates are positively associated with higher mortality risk among those men, effects would seem implausible. This would suggest that the relationship between the incarceration rate and population health was likely spurious—even if models to that point had suggested a causal relationship between the two. Since these are the years in which men are most criminally active, finding incarceration rates to be associated with significant increases in mortality in that range might also suggest that it was crime rather than incarceration that was driving any association. Second, it allows me to consider whether effects are largest at the youngest or oldest ages, and how these effects differ when the United States is included or excluded from the analysis.

RESULTS

Results from Models Predicting Population Health in the Full Sample

In Table 2, I present estimates of the association between the incarceration rate and six measures of population health in 21 wealthy democracies over the 1981-2005 period. Each of the models controls for country fixed effects and other covariates likely associated with the incarceration rate and population health. In the first three models, the outcomes considered are total, male, and female life expectancy at birth. In each of these models, the incarceration rate is associated with significant declines (at the .01 and .001 levels) in life expectancy at birth. The magnitude of the effects is largest for female life expectancy, but this is likely due to the greater life expectancy of

men than women (Table 1). According to these estimates, each additional prisoner per 1,000 population decreases life expectancy at birth between .29 and .36 years. Results from these three models provide initial support for the negative effects of incarceration on population health.

[Insert Table 2 about here.]

The final three models in Table 2 consider the association between the incarceration rate and the infant, neonatal, and postneonatal mortality rates. Since there is a positive association between imprisonment and infant mortality rates in America (Wildeman 2009b), we might expect to find a positive association in these analyses. Interestingly, the association between the incarceration rate and the infant mortality rate is nonsignificant in all models. Based on these models, there is no evidence that the incarceration rate affects the infant mortality rate.

Based on estimates from models presented in Table 2, we might expect growth in the American incarceration rate over the 1981-2005 period to explain some of the declining life expectancy at birth of Americans relative to those from other wealthy democracies. We would not expect that the prison boom played much of a role in the elevated mortality risk of American infants relative to comparable infants born in other nations, however. In Table 3, I use estimates from Table 2 to consider how different population health would have been in America in 2005 had the American incarceration rate remained at the 1981 level or decreased to the sample mean incarceration rate rather than increasing to its 2005 level. All estimates are derived holding all other values at their 2005 levels in America and varying only the incarceration rate. This is a simple way to consider the counterfactual scenario in which the prison boom had not happened.

[Insert Table 3 about here.]

Results from Table 3 suggest that American life expectancy at birth, but not infant mortality, would have changed substantially had the American prison boom not taken place.

According to Table 3, total life expectancy at birth would have been 1.4 and 2.0 years longer had the American incarceration rate stayed at its 1981 level or dropped to the mean incarceration rate. This is not a large percentage increase, but it is substantively important (and large) nonetheless. Over the 1981-2005 period, American life expectancy at birth increased from 74.6 to 77.8 years at birth—an increase of 3.2 years. According to results from Table 2, American life expectancy would have increased an additional 44 percent over this period had the incarceration rate remained at the 1981 level. Furthermore, results for male and female life expectancy are similar, suggesting comparable gains for men and women had the prison boom not happened. Results also suggest that the American infant and postneonatal (although not neonatal) mortality rates would have been somewhat lower in the absence of the prison boom, though those predictions are based on estimated effects that are not statistically different from zero.

Results from Models That Exclude the United States

Results from Table 2, which included all 21 countries, showed that the incarceration rate is negatively associated with life expectancy at birth but not significantly associated with the infant mortality rate. Furthermore, applying these point estimates to a counterfactual scenario in which the American incarceration rate had not increased to its current level suggests that the average American could expect to live about 1.4 years longer had the prison boom not taken place. Since the American incarceration rate is such an outlier, however, results from these models may have been heavily influenced by the American incarceration rate to the point that they may not accurately reflect the relationship between the incarceration rate and population health for the other countries in the sample. This is problematic not only because it suggests that the model

may be misspecified, but also because the effects of incarceration on population health in the United States may differ significantly from their effects in the other countries considered.

In order to address these limitations, I present the same series of models shown in Table 2 but exclude the United States from the analysis. The first three models in Table 4 show how the incarceration rate is associated with life expectancy at birth. In each of these models, the relationship between the incarceration rate and life expectancy at birth is positive, although nonsignificant. These nonsignificant results are substantively interesting because the models in Table 2 suggested effects that not only went in the other direction but were also statistically significant. Thus, based on results from the first three models of Table 4, it appears that life expectancy is at worst not harmed (and at best helped) by increases in the incarceration rate in the 20 countries considered in the analysis. This differs not only from findings shown in Table 2, but also from both macro-level studies considering the relationship between incarceration and population health in the United States (Johnson and Raphael 2009; Wildeman 2009b). Thus, these results suggest that effects in the United States in previous models overwhelmed the effects in all other nations, for which the effects of incarceration on population health are not damaging.

[Insert Table 4 about here.]

In the final three models of Table 4, I present estimates of the effects of the incarceration rate on the infant, neonatal, and postneonatal mortality rates, again with the United States excluded. Results from these three models suggest that the incarceration rate is negatively and significantly associated with both the total infant mortality rate and the postneonatal infant mortality rate (but not the neonatal mortality rate). These results suggest that increases in the incarceration rate may decrease postneonatal and total infant mortality. This finding again differs from what was demonstrated in the models including the United States, where the incarceration

rate was positively (but not statistically significantly) related to the infant mortality rate. According to results from these models, each additional prisoner decreases the infant mortality rate by two infant deaths.[10] Thus, the protective effects of increases in the incarceration rate on the infant mortality rate in little-incarcerating countries appear to be quite substantial.

Age-Specific Effects of Incarceration on Mortality

Results thus far suggest that incarceration seems to harm population health when the U.S. is included and help it when the U.S. is excluded. In Table 5, I consider age-specific effects of incarceration of mortality. Results from the full sample suggest that any mortality-increasing effects of incarceration are concentrated at the older ages (30+) for both men and women. The ages at which the effects appear to be greatest are in the 30s, 40s, and from the late 50s on. It is likely that effects in the 30-49 age range are mostly attributable to the elevated mortality risks of prisoners (Binswanger et al. 2007) and their partners (Johnson and Raphael 2009). At the older ages, it is plausible that some excess mortality associated with increases in the incarceration rate is due to divestment of funding from programs that promote public health in order to cover the costs of imprisoning a larger share of the population. It is also worth mentioning that at no age was the incarceration rate negatively and significantly associated with mortality risk. Thus, at no age did incarceration actually promote population health in the full sample.

[Insert Table 5 about here.]

[10] On first glance, these results may seem implausibly large. I suggest that, although large, they are not implausibly so because the total number of individuals who cycle through the penal system in any year is greater than the incarceration rate. Thus, to the degree that the incarceration rate is a proxy for the total number of people incarcerated in any given year, it will sometimes provide estimates that appear to be implausibly large.

Given substantial differences in results between Tables 2 and 4, it is not surprising that results in the last three models in Table 5, which exclude the United States, differ substantially from the first three models, which included it. In the last three models of Table 5, three findings merit attention. First, increases in the incarceration rate appear to decrease the mortality risk of all children under the age of five. This finding meshes well with the hypothesized protective effects of increases in the incarceration rate (at low levels) on the mortality risk of the young. A second pattern has to do with the mortality of males—and, to a lesser degree, females—in their late teens and early 20s. According to results shown in Table 5, the incarceration rate was negatively and significantly associated with mortality rates among males 15 to 24. This again provides support for the hypothesis that at low levels of incarceration, increases in the incarceration rate may be protective for those most at risk of being a homicide victim.

A final pattern that merits attention is the elevated mortality risk among men ages 35 to 44. Based on the wealth of research showing both what a large share of inmates leave prison in this age range and how high their mortality risk is immediately upon release from prison (Binswanger et al. 2007), it should come as little surprise that men in this age range are at elevated mortality risk. This pattern also bears mentioning because it suggests how different the mortality patterns are when the United States is removed from the analysis. When the U.S. was included in the analysis, the incarceration rate was exclusively associated with increases in age-specific mortality risks. In models not including the U.S., however, the only time that the incarceration was associated with elevated mortality risk was among men in the peak age for being released from penal institutions. Thus, while analyses including the U.S. suggest that incarceration harms population health, analyses excluding the U.S. showed negative effects on

population health in only two age groups—and only for men. This suggests that the potentially negative effects of incarceration on population health are likely to be felt only in the U.S..

It is also worth mentioning in closing this section that results never suggested effects that would immediately seem implausible. Since the most plausible argument for spuriousness would suggest that crime rates (rather than incarceration rates) were the real cause of any effects on population health, we might have expected to see incarceration rates be associated with increases in population-level mortality rates at the most criminally actives ages—the 15-29 age groups. None of the models predicting age-specific mortality rates showed a positive association between incarceration and mortality at those ages, suggesting that spuriousness is not driving the relationship—or at least that high rates of crime are unlikely driving the observed associations.

DISCUSSION, IMPLICATIONS, AND LIMITATIONS

Results from a series of OLS regression models with country fixed effects yield interesting insight into the effects of incarceration at very high and relatively modest levels on population health. Models that included the U.S., which undoubtedly had substantial influence on the results given that its unusually high total incarceration rate and change in that rate were both strong outliers, suggested that incarceration was negatively associated with life expectancy, but not infant mortality. Furthermore, models predicting age-specific mortality rates suggested that the incarceration rate was not significantly and negatively related to mortality risk in any age group and the incarceration rate appeared to have the most detrimental effects on the mortality risk of older adults, especially those around the age of permanent prison release (35-49) and for whom public investments in health are most likely to decrease mortality risk (50+). The magnitude of the effects on life expectancy suggest that had the American incarceration rate remained at the

1981 level, American life expectancy at birth would have been about 1.4 years longer in 2005. Such an increase would have eliminated much of the divergence in life expectancy between the U.S. and other comparable nations that occurred over this period. Taken together, results from models including the U.S. suggest that incarceration rates compromise population health.

When the United States is excluded, however, the findings changed dramatically. After removing the United States from the analysis, the association between the incarceration rate and life expectancy at birth is no longer statistically significant, suggesting that the broad, negative effects of incarceration for population health may be restricted to nations in which the rate of incarceration is already very high. Possibly even more intriguing, increases in the incarceration rate in these models were associated with decreases in the infant mortality rate. Since research shows that incarceration diminishes fertility (Sykes and Pettit 2009), some of this effect is probably due to lower fertility. However, it is also possible that at low rates of incarceration, the individuals removed from society by the criminal justice system may have been antisocial enough that their removal could have broad benefits for child wellbeing. Models considering age-specific mortality effects of the incarceration rate provide some support for this hypothesis, as they suggest not only that increases in the incarceration rate diminish the infant mortality rate, but also that they decrease the mortality rate of all children under the age of five. Furthermore, results suggest that increases in the incarceration rate may diminish the mortality of those males in the most criminally-active years (15-29). Taken together, these results suggest that increases in the incarceration rate at low levels may have broadly positive effects on population health. They also suggest that the effects of incarceration on population health may differ substantially in the United States and the other 20 countries considered throughout these analyses.

This is not to say that effects were totally incomparable, however. Both models including the full range of countries and excluding the United States showed that increases in incarceration rates were associated with elevated mortality risks among men (and women, but only in the models that included the United States) who were roughly the age at which individuals who have been released from prison are unlikely to return—between the ages of 35 and 49. Since studies both within the United States and in a host of other countries have shown that prison release is associated with elevated mortality risk immediately following the release and far into future (Binswanger et al. 2007; Clavel et al. 1987; Farrell and Marsden 2007; Rosen et al. 2008), this finding does not come as a tremendous surprise. Possibly most importantly, this finding suggests that no matter what the rate of incarceration, individuals who are released from prison are likely to experience much higher mortality risks than they would have experienced had they not ever been incarcerated. In fact, the magnitude of these effects appears to be substantial enough that even in rarely-incarcerating nations, they can be detected at the macro-level.

Although these findings are provocative, and this study is the first of its kind, it is still limited in a number of ways. Probably the most serious concerns are endogeneity bias and spuriousness. I have dealt with endogeneity by including fixed effects and with spuriousness by looking for implausible effects, but it is possible that both alternative explanations could be contributing to the findings. Some research considering the effects of incarceration on crime has used exogenous shocks to deal with these obstacles to causal inference (Drago, Galbiati, and Vertova 2009; Levitt 1996), but using such experiments is nearly impossible with such a large sample of countries. Another possibility is that the incarceration rate interacts with fixed characteristics of a country. Since fixed effects models control all bias due to stable characteristics provided those traits do not interact with the treatment, such an interaction would

mean that the estimates presented in these analyses are contaminated. This would be especially unfortunate since many stable traits such as welfare state type are likely to exert a substantial effect on population health, so the bias in coefficients could be substantial. Another concern is that the incarceration rate may not have been the best possible measure of the size and change in the criminal justice system. A more appropriate measure might have been the share of the population having ever been imprisoned, for instance. Nonetheless, most such variables are either unavailable or impossible to calculate using the available data, making these concerns difficult to avoid. A final limitation is that a small sample of countries and years was included, making it impossible to tell if effects of incarceration vary by level of development.

Despite these important limitations, the findings presented here nonetheless have a number of important implications for how we think about the consequences of the penal system for health—both within the United States and throughout the rest of the developed world. On the most basic level, they suggest that the American incarceration rate compromises population health. They also suggest, however, that there may be some optimal rate of incarceration at which the appropriate number of potentially dangerous criminal are detained, thereby promoting health and wellbeing in the rest of the population. For many who study the deleterious effects of mass imprisonment on society, this conclusion will likely be quite unpopular. Nonetheless, it bears mentioning since it suggests, as do recent analyses of the crime-incarceration relationship (Johnson and Raphael 2006), that incarceration has non-negligible benefits that diminish only at very high rates of incarceration. It should be remembered, however, that this is the first time this possibility has been tested empirically (outside of the context of the crime-incarceration relationship), so future work should continue testing this hypothesis rigorously and critically.

In addition to considering this research question, future research in this area should also be sure to consider a number of other important questions. Possibly most importantly, more research should consider the effects of incarceration on population health—and inequality in population health—in the United States. More work on wealthy nations that incarcerate little and less developed or transitional nations that incarcerate a great deal also merit attention, although many of the less developed (but heavily incarcerating) nations (such as Malta, some of the former Soviet republics, and South Africa) may lack the high-quality measures of population health over a long period of time needed to provide rigorous empirical tests. Finally, research should provide more tests of the effects of the incarceration rates on those other than the men and women who enter prison walls. Without demonstrating that having a family member imprisoned or living in a high-incarceration community are detrimental to one's health, it remains unclear whether macro-level results presented here are picking up a causal relationship between incarceration and population health. Whether future research considers these questions or other ones, the effects demonstrated here—when coupled with the astonishingly high rates of incarceration in America—suggest that this form of American distinctiveness merits attention.

REFERENCES

Beckfield, Jason. 2004. "Does Income Inequality Harm Health? New Cross-National Evidence." *Journal of Health and Social Behavior* 45:231-248.

-----. 2006. "European Integration and Income Inequality." *American Sociological Review* 2006:964-985.

Bertrand, Marianne, Esther Duflo, and Sendhill Mullainathan. 2004. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119:249-

275.

Binswanger, Ingrid A., Marc F. Stern, Richard A. Deyo, Patrick J. Heagerty, Allen Cheadle, Joann G. Elmore, and Thomas D. Koepsell. 2007. "Release from Prison—A High Risk of Death for Former Inmates." *The New England Journal of Medicine* 356:157-165.

Bonczar, Thomas P. 2003. *Prevalence of Imprisonment in the U.S. Population, 1974-2001*. Bureau of Justice Statistics Special Report. Washington, DC: United States Department of Justice.

Braman, Donald. 2004. *Doing Time on the Outside: Incarceration and Family Life in Urban America*. Ann Arbor: University of Michigan Press.

Clavel, Francoise, Simone Benhamou, and Robert Flamant. 1987. "Decreased Mortality among Male Prisoners." *Lancet* 330:1012-1014.

Clear, Todd R. 2007. *Imprisoning Communities: How Mass Incarceration Makes Disadvantaged Communities Worse*. New York, NY: Oxford University Press.

Comfort, Megan. 2007. "Punishment Beyond the Legal Offender." *Annual Review of Law and Social Science* 3:271-296.

-----. 2008. *Doing Time Together: Love and Family in the Shadow of the Prison*. Chicago, IL: University of Chicago Press.

Conley, Dalton, and Kristen W. Springer. 2001. "Welfare State and Infant Mortality." *The American Journal of Sociology* 107:768-807.

Drago, Francesco, Roberto Galbiati, and Pietro Vertova. 2009. "The Deterrent Effects of Prison: Evidence from a Natural Experiment." *Journal of Political Economy* 117:257-280.

Farrell, Michael, and John Marsden. 2008. "Acute Risk of Drug-Related Death among Newly Released Prisoners in England and Wales." *Addiction* 103:251-255.

Halaby, Charles. 2004. “Panel Models in Sociological Research: Theory into Practice.” *Annual Review of Sociology* 30:507-544.

Johnson, Rucker, and Steven Raphael.2006. “How Much Crime Reduction Does the Marginal Prisoner Buy?” Unpublished Manuscript.

-----. 2009. “The Effects of Male Incarceration Dynamics on Acquired Immune Deficiency Syndrome Infection Rates among African American Women and Men.” *Journal of Law and Economics* 52:251-293.

Kruttschnitt, Candace. Forthcoming. “The Paradox of Women’s Imprisonment.” *Daedalus*.

Laub, John H., and Robert J. Sampson. 2003. *Shared Beginnings, Divergent Lives: Delinquent Boys to Age 70*. Cambridge, MA: Harvard University Press.

LaVeist, Thomas A. 1992. “The Political Empowerment and Health Status of African-Americans: Mapping a New Territory.” *American Journal of Sociology* 97:1080-1095.

Levitt, Steven D. 1996. “The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation.” *Quarterly Journal of Economics* 111:319-351.

Massoglia, Michael. 2008a. “Incarceration as Exposure: The Prison, Infectious Disease, and Other Stress-Related Illnesses.” *Journal of Health and Social Behavior* 49:56-71.

-----. 2008b. “Incarceration, Health, and Racial Disparities in Health.” *Law & Society Review* 42:275-306.

Massoglia, Michael, and Jason Schnittker. 2009. “No Real Release.” *Contexts* 8:38-42.

Mokdad, Ali H., James S. Marks, Donna F. Stroup, and Julie L. Gerberding. 2004. “Actual Causes of Death in the United States, 2000.” *JAMA* 291:1238-1245.

Mumola, Christopher J. 2007. *Medical Causes of Death in State Prisons, 2001-2004*. Bureau of Justice Statistics Data Brief. U.S. Department of Justice, Washington: DC.

Murray, Joseph, and David P. Farrington. 2008. "Effects of Parental Imprisonment on Children." *Crime and Punishment* 37:133-206.

Nadanavosky, Paulo, and Joana Cunha-Cruz. 2009. "The Relative Contribution of Income Inequality and Imprisonment to the Variation in Homicide Rates among Developed (OECD), South, and Central American Countries." *Social Science & Medicine* 69:1343-1350.

Nagin, Daniel S. 1998. "Criminal Deterrence Research at the Outset of the Twenty-First Century." *Crime and Justice* 23:1-42.

Oeppen, Jim, and James W. Vauppel. 2002. "Broken Limits to Life Expectancy." *Science* 296: 1029-1031.

Pager, Devah. 2003. "The Mark of a Criminal Record." *American Journal of Sociology* 108:937-975.

Papachristos, Andrew V. 2009. "Murder by Structure: Dominance Relations and the Social Structure of Gang Homicide." *American Journal of Sociology* 115:74-128.

Pettit, Becky, and Bruce Western. 2004. "Mass Imprisonment and the Life Course: Race and Class Inequality in U.S. Incarceration." *American Sociological Review* 69:151-169.

Rosen, David L., Victor J. Schoenbach, and David A. Wohl. 2008. "All-Cause and Cause-Specific Mortality among Men Released from State Prison, 1980-2005." *American Journal of Public Health* 98:2278-2284.

Schnittker, Jason, and Andrea John. 2007. "Enduring Stigma: The Long-Term Effects of Incarceration on Health." *Journal of Health and Social Behavior* 48:115-130.

Solt, Frederick. 2009. "Standardizing the World Income Inequality Database." *Social Science Quarterly* 90(2):231-242. SWIID Version 2.0, July 2009.

Stuckler, David, Sanjay Basu, Martin McKee, and Lawrence King. 2008. "Mass Incarceration Can Explain Population Increases in TB and Multidrug-Resistant TB in European and Central Asian Countries." *Proceedings of the National Academy of Sciences* 105:13280-13285.

Swann, Christopher A., and Michelle Sheran Sylvester. 2006. "The Foster Care Crisis: What Caused Caseloads to Grow?" *Demography* 43:309-335.

Sykes, Bryan L., and Becky Pettit. 2009. "Choice or Constraint? Mass Incarceration and Fertility Outcomes among Male Inmates." Paper Presented at the Annual Workshop on Crime and Population Dynamics. June 1-2. Baltimore, MD.

Thomas, James C., and Elizabeth Torrone. 2006. "Incarceration as Forced Migration: Effects on Selected Community Health Outcomes." *American Journal of Public Health* 96:1762-1765.

Wakefield, Sara, and Christopher Uggen. Forthcoming. "Incarceration and Stratification." *Annual Review of Sociology*.

Western, Bruce. 2002. "The Impact of Incarceration on Wage Mobility and Inequality." *American Sociological Review* 67:477-498.

-----. 2006. *Punishment and Inequality in America*. New York: Russell Sage Press.

Western, Bruce, and Katherine Beckett. 1999. "How Unregulated is the U.S. Labor Market? The Penal System as a Labor Market Institution." *The American Journal of Sociology* 104:1030-1060.

Western, Bruce, and Christopher Wildeman. 2009. "The Black Family and Mass Incarceration." *Annals of the American Academy of Political and Social Science* 621:221-242.

Wildeman, Christopher. 2009a. "Parental Imprisonment, the Prison Boom, and the Concentration

of Childhood Disadvantage." *Demography* 46:265-280.

----. 2009b. "Imprisonment and Infant Mortality." PSC Research Report No. 09-692.

----. Forthcoming. "Paternal Incarceration and Children's Physically Aggressive Behaviors: Evidence from the Fragile Families and Child Wellbeing Study." *Social Forces*.

Wilkinson, Richard D., and Kate E. Pickett. 2009. "Income Inequality and Social Dysfunction." *Annual Review of Sociology* 35:493-511.

Table 1. Descriptive Statistics

Variable	Mean	(SD)	Min	Max
Dependent Variables				
Total Life Expectancy at Birth (in Years)	77.5	(1.7)	73.6	81.8
Male Life Expectancy at Birth (in Years)	74.4	(1.8)	70.2	78.4
Female Life Expectancy at Birth (in Years)	80.5	(1.6)	76.4	85.2
Infant Mortality Rate (per 1,000)	6.0	(1.8)	3.0	11.4
Neonatal Mortality Rate (per 1,000)	3.8	(1.1)	1.6	7.3
Postneonatal Mortality Rate (per 1,000)	2.2	(0.9)	0.8	6.3
Explanatory Variable				
Average Incarceration Rate in Previous Three Years (per 1,000)	1.1	(1.1)	0.3	7.2
Control Variables				
Total Fertility Rate	1.7	(0.2)	1.2	2.4
Percent of the Population 65+	14.3	(2.2)	9.6	19.3
Per Capita GDP in 2000 Dollars (Logged)	10.1	(0.2)	9.5	10.7
Unemployment Rate	7.5	(4.0)	1.6	23.9
Per Capita Public Health Care Expenditures in 2000 Dollars (Logged)	7.4	(0.3)	6.5	8.0
Per Capita Social Expenditures in 2000 Dollars (Logged)	8.5	(0.3)	7.5	9.2
Income Inequality (Gini)	28.9	(4.2)	20.9	37.8
Homicide Rate (per 100,000)	2.0	(1.7)	0.2	9.8
Year	1995.2	(5.7)	1981	2005

Sources: See Table A2. (*N*=368)

Table 2. Results from OLS Regression Models with Country Fixed Effects, 1981-2005

	Life Expectancy at Birth			Infant Mortality Rate		
Covariate	M1 (Total)	M2 (Male)	M3 (Female)	M4 (Total)	M5 (Neonatal)	M6 (Postneontal)
Incarceration Rate	-.32***	-.29**	-.36***	.13	-.10	.24
Total Fertility Rate	-.28	-.01	-.50	.34	.21	.13
Percent of the Population 65+	.03	-.07	.13**	.06	-.06	.12
Per Capita GDP	-.12	-.55	.29	2.42*	.93	1.49
Unemployment Rate	.03*	.03#	.04*	.02	.03	-.01
Public Health Care Expenditures	.92#	.66	1.21*	-1.17	.65	-1.82*
Social Expenditures	-.03	-.27	.23	-1.47	-2.18*	.71
Income Inequality	.03	.03	.03	-.12#	-.12**	.01
Homicide Rate	-.07	-.08#	-.05	-.05	-.06	.01
Year	.21**	.27***	.15*	-.25***	-.06#	-.19***
$Year^2$	.00**	.00**	.00#	.01*	.00	.00*
Intercept	71.81***	77.88***	65.69***	4.94	12.07	-7.13
R^2	.98	.98	.97	.92	.90	.88
N	368	368	368	368	368	368

Notes: Significance levels are as follows: *** <.001; ** <.01; * <.05; #<.10. All t-tests are two-sided. Standard errors are adjusted to account for clustering of observations on countries. Standard errors are omitted to conserve space.

Table 3. Predicted Life Expectancy at Birth (Total, Male, and Female) and Infant Mortality Rate (Neonatal and Postneonatal) in the U.S. at Three Incarceration Levels

	2005 U.S. Incarceration	1981 U.S. Incarceration	Sample Mean Incarceration
Life Expectancy	78.1	78.7	80.1
Male Life Expectancy	75.6	77.1	77.4
Female Life Expectancy	80.5	82.4	82.7
Infant Mortality	6.2	5.5	5.4
Neonatal Mortality	4.2	4.7	4.9
Postneonatal Mortality	2.0	0.8	0.5

Note: All other measures are held at their 2005 values in the United States.

Table 4. Results from OLS Regression Models with Country Fixed Effects for all Countries except the United States, 1981-2005

	Life Expectancy at Birth			Infant Mortality Rate		
Covariate	M1 (Total)	M2 (Male)	M3 (Female)	M4 (Total)	M5 (Neonatal)	M6 (Postneontal)
Incarceration Rate	.21	.24	.14	-2.02**	-.80	-1.22*
Total Fertility Rate	-.19	.09	-.44	-.17	.10	-.27
Percent of the Population 65+	.02	-.09	.12**	.11	-.04	.15*
Per Capita GDP	-.04	-.47	.37	1.96#	.78	1.18
Unemployment Rate	.05*	.04*	.05*	-.04	.01	-.05#
Public Health Care Expenditures	1.12#	.85	1.39#	-1.98	.41	-2.39**
Social Expenditures	-.20	-.45	.07	-.67	-1.95*	1.27
Income Inequality	.02	.02	.02	-.09	-.11**	.02
Homicide Rate	-.10	-.11#	-.10	.05	-.00	.06
Year	.21**	.27***	.15*	-.25***	-.06*	-.19***
$Year^2$	.00*	.00**	.00	.01**	.00	.00**
Intercept	70.74***	76.80***	64.71***	10.46#	13.71#	-3.26
R^2	.98	.98	.97	.93	.88	.89
N	345	345	345	345	345	345

Notes: Significance levels are as follows: *** <.001; ** <.01; * <.05; #<.10. All t-tests are two-sided. Standard errors are adjusted to account for clustering of observations on countries. Standard errors are omitted to conserve space.

Table 5. Age-Specific Effects of Incarceration Rates on Mortality Rates from OLS Regression Models with Country Fixed Effects, 1981-2005 (*N*=368 for full, 345 without the U.S.)

	Full Sample			All Countries Except the U.S.		
Age	All	Male	Female	All	Male	Female
<1	.000124	.000142	.000138	-.002163**	-.002698**	-.001654**
1-4	-.000004	-.000013	.000005	-.000109**	-.000139**	-.000064*
5-9	.000005	.000003	.000008	-.000040*	-.000046	-.000028
10-14	.000001	.000010	-.000007	-.000050*	-.000031	-.000065*
15-19	.000021	.000040	-.000003	-.000168**	-.000256**	-.000040
20-24	.000015	.000017	.000005	-.000276**	-.000419**	-.000094#
25-29	.000005	-.000010	.000013	-.000070	-.000098	-.000044
30-34	.000023	.000004	.000034**	.000153#	.000280#	.000001
35-39	.000082**	.000066	.000088***	.000248**	.000395**	.000073
40-44	.000157***	.000186**	.000118***	.000245**	.000431**	.000066
45-49	.000145***	.000168**	.000108***	-.000041	.000067	-.000089
50-54	.000120	.000203*	.000026	-.000363	-.000218	-.000342
55-59	.000208***	.000299**	.000096	-.000414	-.000182	-.000334
60-64	.000470**	.000660**	.000265*	-.000249	-.000110	-.000121
65-69	.000781***	.000881*	.000685***	-.000468	-.000832	-.000036

Notes: All models include the same controls as those shown in Tables 2 and 4. Coefficients for control variables are omitted to conserve space. Significance levels are as follows: *** <.001; ** <.01; * <.05; #<.10. All t-tests are two-sided. Standard errors are adjusted to account for clustering of observations on countries. Standard errors are omitted to conserve space.

Figure 1: Incarceration Trends in Four Wealthy Countries

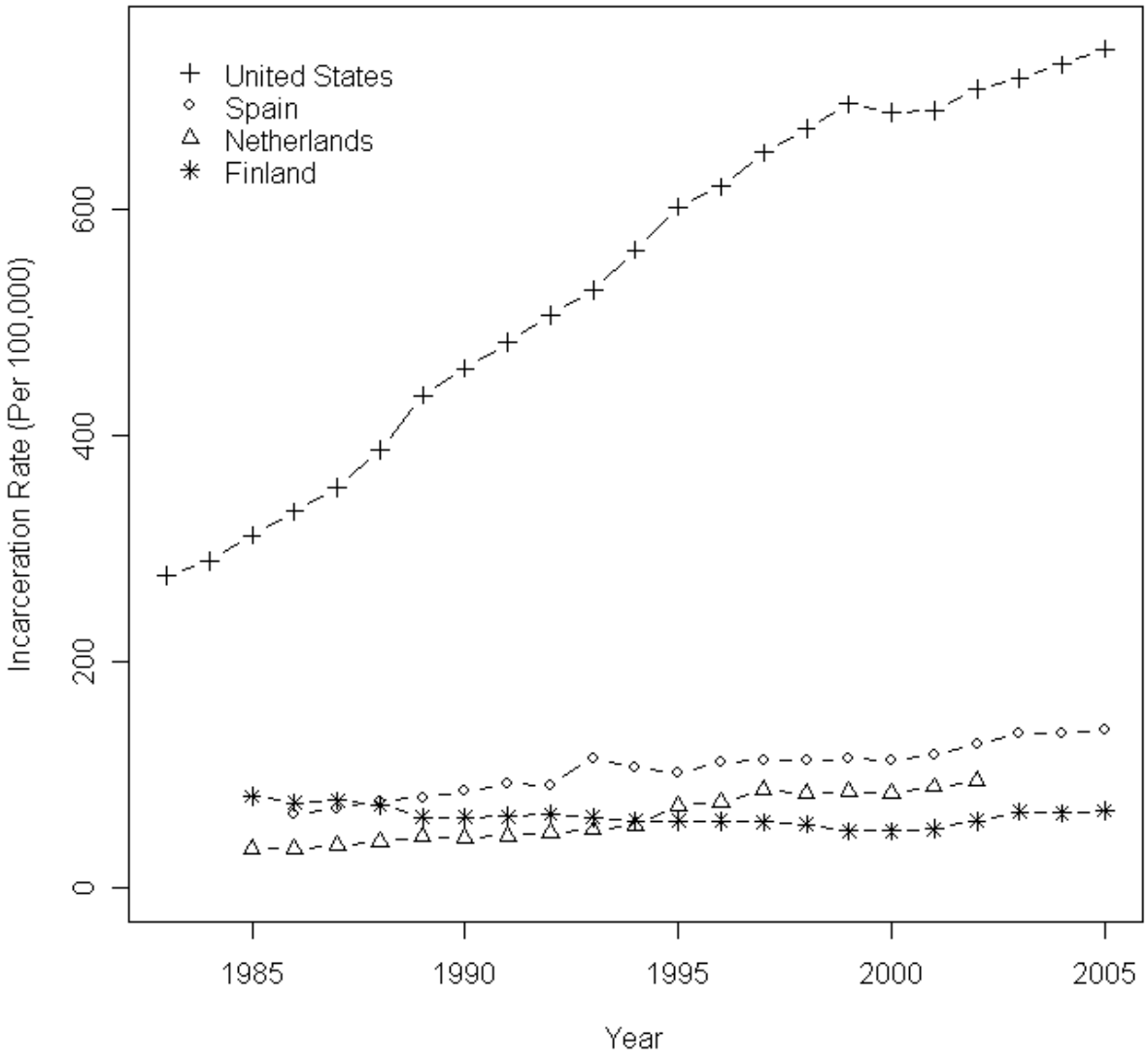

Table A1. Availability of data by Country and Year (* = Data Available)

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Australia						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Austria						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Belgium															*	*									
Canada	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Denmark					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Finland					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
France					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Germany											*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Ireland						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Italy								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Japan						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
Luxembourg															*	*	*	*	*	*	*	*	*		
Netherlands					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
New Zealand					*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Norway										*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Portugal										*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Spain						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Sweden						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Switzerland											*	*	*	*	*	*	*	*	*	*	*	*	*	*	
United Kingdom						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
United States	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Table A2. Data Sources by Variable

Variable	Sources
Total Life Expectancy	OECD Health Data ECO-SANTE
Male Life Expectancy	OECD Health Data ECO-SANTE
Female Life Expectancy	OECD Health Data ECO-SANTE
Infant Mortality Rate	OECD Health Data ECO-SANTE
Neonatal Mortality Rate	OECD Health Data ECO-SANTE
Postneonatal Mortality Rate	OECD Health Data ECO-SANTE
Age-Specific Mortality Rates	Human Mortality Database
Incarceration Rate[a]	United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems, the Council of Europe, the European Sourcebook of Criminal Justice, Eurostat, Australian Institute of Criminology, Asian Pacific Conference of Correctional Administrators, U.S. Bureau of Justice Statistics, Statistics Canada
Total Fertility Rate	OECD Health Data ECO-SANTE
Population 65+	OECD Health Data ECO-SANTE
GDP	OECD Health Data ECO-SANTE
Unemployment Rate	OECD Health Data ECO-SANTE
Public Health Expenditures	OECD Health Data ECO-SANTE
Social Expenditures	OECD Health Data ECO-SANTE
Income Inequality	SWIID Database
Homicide Rate	United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems, the European Sourcebook of Criminal Justice, Statistics Canada

[a] In some cases, multiple sources had calculated the incarceration rate independently. The rates from different sources were not always identical (often because they were collected at different times of the year), but the correlation between various sources was always around .99. Since the correlation between these rates was always so high, the rate chosen has little effect on the results. For further information or to see robustness checks, contact the author.