Kin Availability in the Era of Mass Imprisonment

Pil H. Chung & Peter Hepburn

Abstract: *The prison boom of the 1980s and 1990s has left an indelible mark on the biographies of not only the imprisoned, but of the families within which they are embedded. In order to provide a fuller accounting of these affected kin than presently available, we employ microsimulation techniques to construct complete genealogical data for black and white Americans born before and during the prison boom. Using these data, we characterize the risk and prevalence of imprisonment within full kinship networks, focusing particularly on the imprisonment of working-age kin. Our analysis suggests that the life course trajectories of familial imprisonment experienced by black and white Americans take on qualitatively distinct forms: the average black American born at the height of the prison boom experiences the imprisonment of a relative for the first time at age 7, and by age 65, is expected to belong to a family where over 1 in 7 working-age relatives have ever been imprisoned. On the other hand, the average white American who experiences the imprisonment of a relative does not do so until age 39, and by age 65, is expected to belong to a family where 1 in 20 working-age relatives have ever been imprisoned. Future reductions in the national rate of imprisonment have the potential to meaningfully reduce these racial disparities in family imprisonment burden.*

Introduction

A number of studies have detailed variation, by cohort, race, and education, in the lifetime risk of own and paternal imprisonment (Thomas P Bonczar, 2003; Thomas P. Bonczar & Beck, 1997; Pettit & Western, 2004; Western & Wildeman, 2009; Wildeman, 2009). These studies employ formal demographic methods to convert period measures of current imprisonment into cohort measures of cumulative risk. This body of research has been important in demonstrating the growing reach of the criminal justice system, especially for less-educated black men and their children.

What this literature does not provide, however, is insight into how the prison boom has affected the risk and prevalence of imprisonment within extended family networks. That is, while we know an individual's risk of own imprisonment or father's imprisonment, we do not have similar estimates detailing, for example, cousin or uncle's imprisonment or – more importantly – the overall number of family members likely to ever be imprisoned. This is, we expect, at least in part a function of the available data. The Surveys of Inmates in State and Federal Correctional Facilities (SISFCF) – the major data sources for the previously-cited studies – include questions about children and partners, but not on relations beyond the nuclear family.

A related body of research explores the "connectedness" of prisoners to friends, family, and local communities (e.g., T. R. Clear, 2007; Dina R Rose & Clear, 2004). Lee and colleagues (2015) use the 2006 General Social Survey (GSS) to estimate the probability of having a currently imprisoned family member (of any relation): 44% for black women (32% for black men) and 12% for white women (6% for white men). Wildeman and Wakefield

(2014) use Project on Human Development in Chicago Neighborhoods (PHDCN) data to explore the concentration of imprisonment within family networks, demonstrating that children of incarcerated parents are likely to have significantly more other relatives simultaneously incarcerated. While both of these papers shed light on imprisonment within broader families, the data used in both cases lead to a number of limitations. First, neither analysis allows for any conclusions about changing rates of connectedness over time. Second, neither data source allows for identification of the *previously*-imprisoned within family networks; we argue below that previous imprisonment may be just as salient as current imprisonment for families. Third, reliance on respondent recall of imprisonment (and for the construction of family network data) is a serious limitation in both cases, especially in light of Sykes and Pettit's (2014) recent findings on racial differences in the likelihood of reporting imprisonment of family members.

In this study, we attempt to marry the methodological innovation of the earlier demographic work on lifetime imprisonment risk with the research imperative of the "connectedness" literature. We leverage microsimulation techniques to infer, from cross-sectional counts and rates of imprisonment, lifetime trajectories of imprisonment. This approach allows us to account for dramatic differences by race in the magnitudes of death and imprisonment risk over historical time and in the distribution of that risk over ages. It also allows us to explore full kin networks in ways that traditional survey data collection preclude. Thus we offer a considerably more complete picture of the full reach of mass imprisonment into the modern American family than has been previously available. In so doing we are able to show that parents, partners, and children – the family relations typically

studied in research on the collateral consequences of imprisonment – constitute less than half of the overall prevalence of imprisonment within complete kinship networks. Across both cohorts analyzed, blacks have higher simultaneous risk of kin imprisonment and higher levels of ever- and currently-imprisoned kin at all ages. We highlight the increasing unavailability of working-age kin – those who should be most able to provide support – to children and the elderly, especially in black families.

We begin the paper with a review of the evidence on racial differentials in kin contact and support and on the various immediate and long-term costs of imprisonment, highlighting those that are borne, directly or indirectly, by extended family members. We then outline the microsimulation methods and the data inputs employed here. In the results section we describe the risk and prevalence of kin imprisonment for black and white individuals from two birth cohorts, with a focus on availability of kin support for young and old individuals. We close with a discussion of findings and suggestions for future research.

Background

Imprisonment curtails the benefits that arise from social networks in which currently- and formerly-imprisoned individuals are embedded (Braman, 2004; Comfort, 2007; Hagan & Dinovitzer, 1999). These meso-level collateral consequences of imprisonment have been theorized and demonstrated in a number of domains. Neighborhoods and communities, for instance, suffer declines in informal social control and collective efficacy as the proportion of residents who are current or former prisoners increases (Comfort, 2007; Hagan & Dinovitzer, 1999; Lynch & Sabol, 2004; Dina R. Rose & Clear, 1998; Tonry & Petersilia, 1999). Hagan and Foster have argued for schools as another affected meso-level institution

(Foster & Hagan, 2015; Hagan & Foster, 2012). They demonstrate that not only do the children of incarcerated mothers and fathers do worse in school, but that these children's schoolmates *without incarcerated parents* also fare worse as the proportion of incarcerated parents increases (Hagan & Foster, 2012).

The extended family is a similar meso-level institution within which higher rates of imprisonment yield poorer average outcomes. As we detail below, higher rates of imprisonment within a kin network curtail available resources because (1) family members – including extended kin – pay significant immediate and long-term costs associated with imprisonment and (2) former prisoners are less able to contribute to kin support. The combination of these two factors can lead to the the weakening of ties within the network (Braman, 2004). Before detailing the costs entailed by kin imprisonment, we briefly describe racial variations in kin contact and support.

Racial Disparities in Kin Support

Not all kin networks are likely to be equally affected by the imprisonment of a member. Looser, more disconnected families that have limited interactions may feel few effects; tightly-knit extended families engaged in regular contact and mutual support may feel these effects more strongly. It goes beyond the scope of this paper to provide a test of the relation between network structure and the *effects* of kin imprisonment; our results detail the *incidence and prevalence* of kin imprisonment. Nonetheless, in considering the stratifying consequences of the rates that we report, it behooves us to consider well-documented variations in social support. Put simply, if there are no racial differences in kin contact and support then, on the aggregate, the effects of kin incarceration should be felt equally across

black and white families. If, however, one racial group displays consistently higher levels of contact and support, then that group may be particularly hard-hit by the effects of kin imprisonment.

Blacks are far more likely to co-reside with a family member than whites (Cohen & Casper, 2002; Hofferth, 1984; D. P. Hogan & Parish, 1990; Keene & Batson, 2010; Lofquist, 2012; W. L. Parish, Hao, & Hogan, 1991; Peterson & Kern, 1996; Raley, 1995; Ruggles, 1994; Tienda & Angel, 1982). Even for those not co-residing with family, there is consistent evidence that, compared to whites, blacks live in closer physical proximity to their kin and have more kin available locally (Ajrouch, Antonucci, & Janevic, 2001; Cantor, Brennan, & Sainz, 1995; D. P. Hogan & Parish, 1990; Raley, 1995) and have more frequent contact with those family members (Ajrouch et al., 2001; Hays & Mindel, 1973; C. L. Johnson & Barer, 1995; Raley, 1995; Taylor, Chatters, Woodward, & Brown, 2013).

Findings on the exchange of support within black and white families are mixed and, as several scholars have argued, potentially systematically biased by research and sampling strategies that reproduce white, middle-class norms (Gerstel, 2011; C. L. Johnson & Barer, 1995; N. E. Johnson, 2000; Pyke & Bengtson, 1996). A number of studies find that whites are more likely to exchange financial assistance with family members (Hofferth, 1984; D. P. Hogan & Parish, 1990; W. L. Parish et al., 1991), though much research in this vein is limited to the parent-child dyad (Eggebeen, 1992; Eggebeen & Hogan, 1990; D. P. Hogan, Eggebeen, & Clogg, 1993; Jayakody, 1998; Y.-J. Lee & A., 1998). By contrast, blacks appear more likely than whites to give and receive emotional support and childcare and to do care work generally (Benin & Keith, 1995; Gerstel & Gallagher, 1994; D. P. Hogan & Parish, 1990; C. L.

Johnson & Barer, 1995; W. L. Parish et al., 1991; Sarkisian & Gerstel, 2004). Notably, several studies document the regularity with which blacks incorporate extended kin into such exchange patterns (Jayakody, Chatters, & Taylor, 1993; C. L. Johnson & Barer, 1995; Raley, 1995).

Costs of Kin Imprisonment

These findings suggest that black families are often organized in ways that would exacerbate negative effects of kin imprisonment. What, though, are these consequences and do they indeed affect extended kin? Most attention has been paid to the collateral consequences of imprisonment for immediate family members. Direct effects of parental (typically paternal) imprisonment on the mental health, behavioral outcomes, and/or delinquency (Geller, Cooper, Garfinkel, Schwartz-Soicher, & Mincy, 2012; Geller, Garfinkel, Cooper, & Mincy, 2009; Murray & Farrington, 2005, 2008; Murray, Janson, & Farrington, 2007; Roettger & Swisher, 2011; Turney, 2017; Wakefield & Wildeman, 2011, 2014; Wildeman, 2010; Wildeman & Turney, 2014); future civic disengagement (Foster & Hagan, 2007; H. Lee, Porter, & Comfort, 2014); and educational attainment (Cho, 2009; Hagan & Foster, 2012; Murray & Farrington, 2008) of the children of prisoners has been a primary focus. A number of studies have explored the consequences of imprisonment for prisoners' spouses or romantic partners (or relationships generally) (Braman, 2004; Comfort, 2008; Edin, 2001; Lopoo & Western, 2005; Turney, Schnittker, & Wildeman, 2012; Western & McLanahan, 2000; Wildeman, Schnittker, & Turney, 2012) and mothers (Braman, 2004; Green, Ensminger, Robertson, & Juon, 2006; Turney, 2014). We acknowledge here that little quantitative research has examined the direct effects of kin imprisonment beyond these close

ties (H. Lee, Wildeman, Wang, Matusko, & Jackson (2014) represents an exception; Braman (2004) is the prime example of qualitative work on consequences beyond the immediate family). This is, in some ways, unsurprising. The major data sources that have served as fodder for the preceding studies (particularly the Fragile Families and Child Well-Being Study and the National Longitudinal Study of Adolescent to Adult Health) do not include sufficient information on kin networks and distal imprisonment to support analysis. This lack of data and inquiry is hardly unique to research on imprisonment; analysis of extended kin networks has been extremely rare within the sociology of the family over the last 20-plus years (Gerstel, 2011; N. E. Johnson, 2000). There is, however, ample reason to believe that imprisonment *does* affect extended kin in at least two ways: by imposing costs on families and by reducing current- and former-prisoners' ability to contribute to kin support.

A growing body of literature details the various costs of imprisonment. Evidence suggests that many of these costs are either borne directly by or, at the very least, indirectly affect non-immediate kin members. These start with the significant expenses and burdens of having a family member currently in prison (Braman, 2004; Comfort, 2007, 2008). Grinstead and colleagues estimate that it costs – in packages, phone calls, and visits – nearly $300 per month to stay in contact with a prisoner (Grinstead, Faigeles, Bancroft, & Zack, 2001). Additionally, family members are often called on to deposit commissaDeVuono-Powell2015ry funds and provide copayments for prison health care services (DeVuono-Powell, Schweidler, Walters, & Zohrabi, 2015). The majority of state and federal prisoners are parents (Mumola, 2000); family members regularly pay for childcare or directly house and care for the children of these prisoners (Braman, 2004; Green et al., 2006; E. I. Johnson &

Waldfogel, 2002; Mumola, 2000). Some costs are non-monetary. Family members of the imprisoned are at greater risk of developing a number of medical conditions (Braman, 2004; DeVuono-Powell et al., 2015). Lee and colleagues, for instance, detail how the material hardship and stress of kin imprisonment result in a range of cardiovascular problems, particularly for women (H. Lee & Wildeman, 2013; H. Lee et al., 2014). Braman provides evidence of multiple domains in which the stigma of kin imprisonment leads family members to withdraw from relationships, endangering social support and exacerbating depressive symptoms (Braman, 2004).

Costs extend well beyond the period of imprisonment. The majority of prison inmates hold legal financial obligations (LFOs) that result from their conviction (Harris et al., 2010). While the magnitude of these LFOs is hard to ascertain, one recent report estimates the mean debt incurred in court-related fines and fees to be $13,607 (DeVuono-Powell et al., 2015). The majority of formerly-imprisoned individuals report that family members – including extended kin – are the primary source of support in paying off these debts (Beckett, Harris, & Evans, 2008; DeVuono-Powell et al., 2015; Nagrecha, Katzenstein, & Davis, 2015). Families often house recently-released kin: two months after leaving prison, 85% to 90% of ex-prisoners are living with a family member (N. G. La Vigne, Naser, Brooks, & Castro, 2005; Visher, Yahner, & La Vigne, 2010). Multiple sources document heavy reliance of former prisoners on family members for financial assistance (above and beyond servicing LFOs), emotional support, food, and transportation (Harding, Wyse, Dobson, & Morenoff, 2014; N. G. La Vigne et al., 2005; Visher, Kachnowski, La Vigne, & Travis, 2004; Visher et al., 2010).

In addition to these costs of imprisonment, kin networks suffer from long-term reductions in prisoners' ability to support themselves or others (Braman, 2004). Felons are excluded from a range of jobs (Comfort, 2007; Uggen, Manza, & Thompson, 2006) and employers are loath to hire ex-prisoners, especially black ex-prisoners (Pager, 2003). The formerly imprisoned face lower wages, less stable employment, and less chance of advancement than their never-imprisoned peers (Hagan & Dinovitzer, 1999; Western, 2006). Ex-prisoners suffer a range of long-term health problems (Massoglia, 2008b, 2008a; Schnittker & John, 2007); poor health may further inhibit ex-prisoner's economic prospects and represents an additional strain – emotional and financial – on family members. imprisonment leads to a drop in annual income between 32.2% (for Hispanics) and 36.9% (for blacks), and lifetime earnings losses of between $86,300 and $114,3000 (Western, 2006). imprisonment also limits wealth accumulation: imprisonment lowers net worth and the odds of holding a bank account, owning a vehicle, and homeownership (Maroto, 2015; Turney & Schneider, 2016). Many ex-prisoners are permanently ineligible for benefits such as public housing, Temporary Assistance for Needy Families (TANF), or the Supplemental Nutrition Assistance Program (SNAP) (DeVuono-Powell et al., 2015; Harding et al., 2014). Former prisoners are found to contribute less financially to their children (Geller, Garfinkel, & Western, 2011) and the immediate families of prisoners face higher levels of material hardship (Schwartz-Soicher, Geller, & Garfinkel, 2011). We believe there is ample reason to expect that they likewise contribute less to extended family as well.

In sum, this evidence suggests that (1) family members face considerable financial and emotional costs as a function of kin imprisonment and (2) that currently- or previously-

imprisoned individuals will be poorly situated to reciprocate the support they receive from kin. As such, former prisoners represent a unique sort of negative social capital: a node in one's kin network that offers little social support (and no social leverage) (de Souza Briggs, 1998) but that may regularly make demands (O'brien, 2012). Evidence suggests that the compounding effects of these two factors may lead to the fraying of family ties. Braman demonstrates how the stigma of imprisonment and the breakdown of reciprocal exchange can lead kin to withdraw from one another (Braman, 2004). As he puts it, "the relationships and norms described as social capital have increasingly become burdens rather than benefits to many inner-city families" [Braman (2004); p.7]. This account matches findings that women with children by recently-imprisoned fathers report less perceived instrumental social support; social retrenchment on the part of either these women or their families are hypothesized to be responsible for the decline (Turney et al., 2012). The breakdown of kin networks represents an additional – perhaps even more severe – cost of kin imprisonment.

Given all of this, it bears asking just how many imprisoned or formerly-imprisoned family members an individual can expect to have, either at a given age or over the course of their lifetime. At what ages do individuals first experience the imprisonment of a family member? How many prime working-age kin members do the young and the elderly lose to imprisonment? How have the answers to these questions changed over time? Keeping in mind the evidence on racial disparities on kin contact and support that we detail above, how do the answers vary by race?

Methods

This paper provides estimates of imprisonment within extended kinship networks of black and white Americans over the course of the prison boom of the 1980s and 1990s. To accomplish this, we rely on data generated by a simulation technique that takes observed rate schedules in population fertility, mortality, and imprisonment as inputs and returns complete estimates of genealogical relatedness for all simulated individuals over their entire lifespans. In the sections that follow we describe this simulation model, the data and assumptions upon which it is based, and the specific questions that we seek to answer with it.

Data Limitations and Microsimulation

The kind of data that is necessary to explore kinship trends are difficult to find. Datasets that include information on family networks are rarely complete enough to encompass the full range of familial relations held by respondents throughout the course of their lives. Family data in the U.S. Census, for example, miss all kin relations not contained within household boundaries (e.g. adult siblings and independent children).

While the Surveys of Inmates in State and Federal Correctional Facilities (SISFCF) offer the possibility of addressing any number of important questions, their utility is limited when it comes to analyzing broader kin relations, kin availability over the life course, and certain population-level exposure rates. These surveys include information on prisoners' close kin relations (e.g. parents, children, sibling, and significant others), but do not collect data on extended kin relations like grandparents, grandchildren, uncles/aunts, and cousins. The data that are collected on close kin are also time-invariant, which forecloses analyses of shifting kin availability over the life course. We are, at the time of this writing, unaware of any survey

data that would allow us to directly measure the connectedness of prisoners to their extended kinship networks over the life course.

To overcome these data limitations, we employ a microsimulation framework to characterize the lifetime trajectories of kinship and imprisonment of non-Hispanic black and white U.S. populations over the course of the prison boom.[1] In practice, we achieve this by utilizing SOCSIM, a well-validated microsimulation tool developed and maintained at UC Berkeley[2], to simulate fictive groups of individuals calibrated to match the demographic behavior of black and white populations born between 1960 and 2010. Within SOCSIM, these simulated individuals "live" out their digital lives, partnering, creating offspring, becoming imprisoned, and dying within the parameters set by externally-imposed rate schedules. At the conclusion of each simulation, SOCSIM returns a complete dataset with the full demographic characteristics of each individual, including all the genealogical variables necessary to reconstruct that individual's entire kinship network (including the imprisonment status of the kin that make up those networks).

To facilitate comparisons between black and white experiences, we run two separate batches of these simulations – once with demographic and imprisonment rates for whites and a second with the corresponding rates for blacks. Other than the different rate inputs, the white American and black American simulations are exactly identical in specification. To

[1] We choose to look at non-Hispanic populations primarily due to inconsistent reporting of ethnicity over the period of interest.
[2] Additional information on SOCSIM may be found in E. Hammel & Wachter (1976), K. W. Wachter, Blackwell, & Hammel (1997), and online at http://lab.demog.berkeley.edu/socsim

reduce variation due to the randomness of any single simulation, we run each race-specific simulation 25 times and average measurements, weighted by population size, across all runs.[3]

The Microsimulation Model

We configure our race-specific simulation models with four sets of data inputs: 1) Age-specific fertility rates; 2) Age- and sex- specific mortality rates; 3) Age- and sex- specific prison admission rates; and 4) Age- and sex- specific prison release rates. Fertility and mortality rate inputs for the period 1960-2010 are derived from the U.S. National Vital Statistics System's (NVSS) central fertility rate tables (Heuser, 1976; U.S. Census Bureau, 2012) and life tables (Arias, 2014; B. E. Hamilton & Cosgrove, 2010, 2012), respectively. Prison admission and release rate inputs over this same period, on the other hand, are more difficult to assign due to less consistent reporting of this information.

The Bureau of Justice Statistics (BJS) provides race-stratified annual counts of prison admissions for the years 1960, 1964, 1970, and then every year from 1974 to 2014 (Langan, 1991; United States Bureau of Justice Statistics, 2016b, 2016a); and annual counts of prison releases for every year from 1978 to 2014 (Carson & Golinelli, 2013; United States Bureau of Justice Statistics, 2016b, 2016a). Because these counts are reported at uneven intervals, we must choose a method by which we can "fill in" data for the gap years. Ultimately, we settle on linear interpolation as a reasonably conservative solution.[4] Additionally, unlike the fertility and mortality information derived from the NVSS, counts of prison admissions and releases are not always reported separately by race, sex, and age. Because our SOCSIM

[3] Averaging results across 25 replicate simulations effectively reduces the stochastic error of our estimates to zero.

[4] Appendix table A1-1 provides a detailed summary of how known and interpolated year-specific counts are distributed across all years of simulation.

models require inputs in this stratified form, we must choose a method by which we can distribute our counts of admissions and releases along the different race-, sex-, and age-strata in our simulation model. The strategy we adopt, again, is to linearly interpolate the race-, sex-, and age- distributions for gap years and apply these interpolated proportions when assigning counts to each of the unknown race-, sex-, and age- strata.[5] These admissions and release counts that have been thus harmonized with respect to their distribution across simulation years and across the different race, sex, and age strata, form the numerators for the raw SOCSIM admission and release rate inputs. For the denominators, we rely on the U.S. Census Bureau's historical and intercensal estimates of national population counts (U.S. Census Bureau, 2015), and the BJS's and University of Albany Sourcebook of Prison Statistics' national prison population counts (Carson & Sabol, 2014; Langan, 1991; University at Albany, 2012) for calculating the admissions and release rates, respectively.

For the period extending beyond 2014, we simply hold our simulation rates fixed at the latest specified (i.e. 2010 for fertility and mortality, and 2014 for prison admission and release). For the supplementary analysis of future imprisonment rate trajectories (described below), we run three additional simulations that each modify the 2015 prison admission rates to simulate three potential futures: 1) a dramatic reduction (75%) in imprisonment; 2) a moderate reduction (25%) in imprisonment; and 3) no change in imprisonment.

Finally, to ensure that our simulations reliably reproduce observed population trends in each of our input domains, we employ a rigorous calibration procedure that multiplicatively scales each of the input rate parameters over each decade of simulation until the likelihood of

[5] Appendix table A1-2 provides a summary of how these interpolated year-specific distributions of age, race, and sex are assigned to each simulated year of admission and release count data.

reproducing known population-level measures in those variables (i.e. total fertility rate, life expectancy at birth, and rate of first admission to prison) is maximized in our data.[6] Then, as a final check of our fully-calibrated simulation model's ability to return plausible results, we compare measures of own and family imprisonment reported by three previous studies (H. Lee et al., 2015; Western & Wildeman, 2009; Wildeman, 2009) with those generated by our models. In brief, we find close agreement (within 3 percentage points) between our estimates of own and parental imprisonment risk with those reported by Western & Wildeman (2009) and Wildeman (2009). Similarly, we find reasonably close agreement between our estimates of current family imprisonment prevalence and those reported by H. Lee et al. (2015).[7] The ability of our simulation model to largely replicate the results of these previous studies suggests that our methodological approach is, at least, no worse than the current standard.

Outcomes of Interest

Using the data from our simulation models, we calculate age-specific estimates of *kin imprisonment*: both the *incidence* and *prevalence*, within kinship networks, of relatives who have *ever* been imprisoned. For our purposes, we define "kin" to include all relatives descended from at least one common grandparent – i.e., grandparents (on both father's and mother's side), parents, aunts/uncles (on both father's and mother's side), siblings, and cousins (on both father's and mother's side). We define "incidence" of kin imprisonment to be the probability that a living relative is imprisoned (for the first time) over a particular year

[6] What is thus assumed by our calibration method is confidence in the general shapes of the age-specific mortality, fertility, prison admission, and prison release curves that we input, but uncertainty regarding their exact magnitudes. A more technical treatment of the procedure is provided in appendix section "A2. Calibration of SOCSIM via Maximum Likelihood Estimation".

[7] Full details of this validation exercise, including complete comparison tables, is provided in appendix section "A3. Replication of Prior Findings".

of ego's life; and we define "prevalence" of kin imprisonment to be the proportion of living relatives who have ever been imprisoned by a particular year of ego's life. For our measures of incidence, we count only those kin who are imprisoned *after* the birth of ego in order to capture the disruption that the imprisonment of those family members is liable to entail for the average individual living through the event. On the other hand, for measures of prevalence, we count even those kin who were imprisoned before the birth of the focal ego in order to capture the *lasting* disruption that the imprisonment of those family members may represent for the family network at large. Finally, we choose to focus on those *ever* imprisoned – rather than only those *currently* imprisoned – because the stigma and material costs of the "prison label" do not end with re-entry, but often persist for the rest of former prisoners' lives.

Our focus on the family centers on its capacity to provide support for members. This entails a focus on two vulnerable life course periods. First, we explore the availability of same- and older-generation kin for children. Second, we describe the availability of younger-generation kin for the elderly. In both cases we pay special attention to the availability of kin who are in their prime working ages (25-54 years-old) and presumed to be able to provide the most material support.

Because of the historically exceptional nature of mass imprisonment and the stark racial disparities of its reach, we produce estimates of kin imprisonment separately for black and white Americans across two cohorts: those born in the period 1960-1970 and those born in the period 1985-1995. These cohorts, spaced 25 years apart, represent those most directly impacted by the prison boom – those reaching adulthood as mass imprisonment began to

ramp up in the ’80s and the ’90s (the *“boom” generation*) – and those who would become the second generation living under the peak of that carceral movement (the *“post boom” generation*).

In 2015 (the calendar year in which this study was initiated), those born in 1960 and 1985 turned 54 and 29, respectively. In order to provide some sense of how the *lifetime* experiences of kin imprisonment are likely to differ across generations, we draw out our plots to age 80 for both birth cohorts assuming that the latest known demographic rate schedules hold constant for unobserved future years.[8] As a supplementary analysis, we examine three possible future trajectories of imprisonment in the United States: 1) imprisonment rates drop 75% by 2035 (roughly, to pre-1980, or pre-“prison boom”, levels); 2) they drop 25% by 2035; 3) they hold steady at the latest known levels. The first of these scenarios represents a future wherein political initiatives to reduce incarceration in the United States (e.g. the “Cut 50” campaign organized by the Dream Corps; for additional details see https://www.cut50.org/) are successful, the second where such efforts are partially successful, and the third where the national trend in imprisonment does not change. To characterize the family network consequences of each of these potential futures, we measure the prevalence of kin imprisonment for the 1985-1995 “post-boom” cohort.

Finally, in an appendix section we conduct an exploratory analysis of variation in these estimates by educational attainment. Education, understood as a proxy for class, has been central to previous analyses of prison and the life course (Pettit & Western, 2004; Western,

[8] Consequently, while the reliability of our kinship estimates for the 1960-1970 cohort is likely to be reasonably good across most ages, our estimates for the later ages of the 1985-1995 cohort are subject to the uncertainties inherent in projection.

2006; Western & Wildeman, 2009; Wildeman, 2009). Those with less education consistently face higher risk of imprisonment. Given correlations in educational attainment within families (Davis-Kean, 2005; Dubow & Huesmann, 2009; Ermisch & Pronzato, 2010; Haveman & Wolfe, 1995), some kin networks likely face considerably smaller or larger risk and prevalence of kin imprisonment. We characterize these educational differences in kin imprisonment in Appendix A4.

Results

The Risk of Kin imprisonment

To characterize the likelihood that an individual experiences the imprisonment of different types of kin over the course of her life, we plot age-specific probabilities of first imprisonment[9] of these kin (contingent on ego surviving to each age[10]). To examine how these patterns differ by race and cohort, we draw separate plots for the black and white populations, and for the "boom" (1960-1970) and "post-boom" (1985-1995) cohorts (Figure 1).

[9] By "first imprisonment" we simply mean the first time a unique member of ego's kinship network is imprisoned. This represents the transition from *never* to *ever* imprisoned status.

[10] If kin imprisonment events occur prior to the birth or following the death of an individual, those kin imprisonment events are not observed for that individual and thus not counted as part of the numerator. Kin imprisonment that occurs before ego's birth does factor into the prevalence calculations in the subsequent sections.

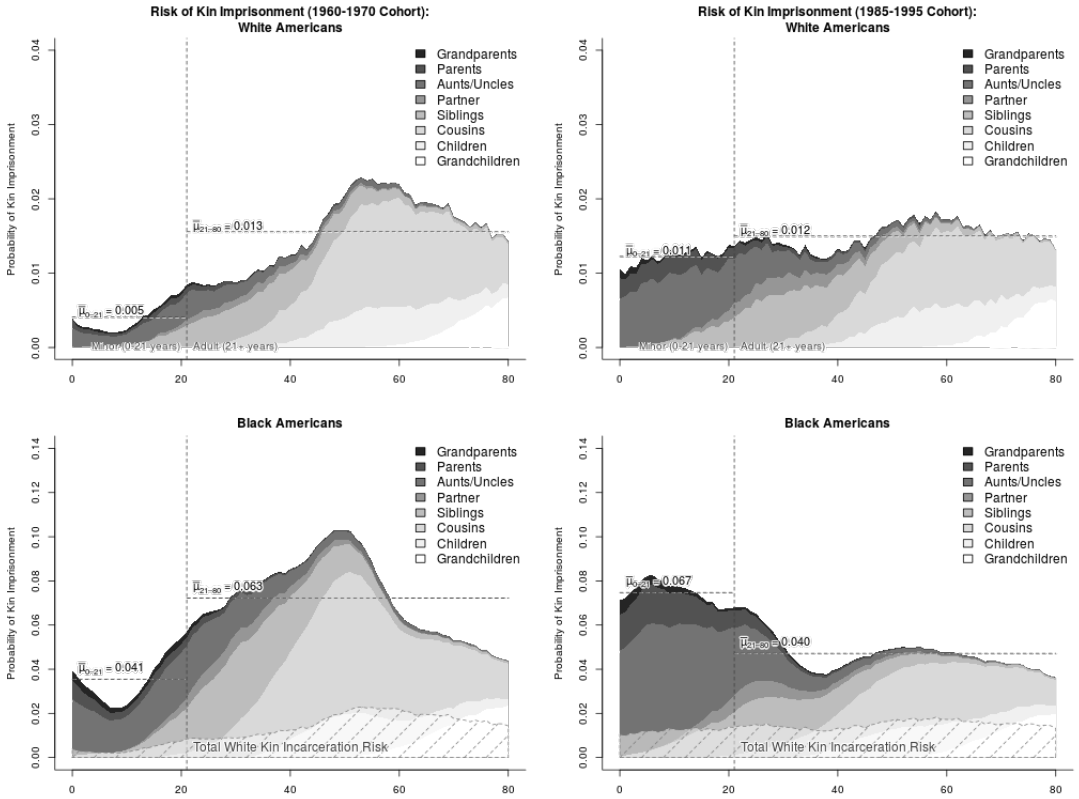

Figure 1. Cohort-specific probabilities of first kin imprisonment over age (by relation). The top plots illustrate the contributions of each kin relation to the overall risk profile for white individuals; the bottom plots illustrate the same for black individuals. Horizontal dashed lines indicate mean overall risk before and after age 21 (which is indicated with the vertical dashed line). The total risk density of the white population is super-imposed on the bottom (black population) plots to aid comparison across the two different y-axis scales.

There are three aspects of Figure 1 that we wish to highlight. First, there are clear differences in magnitude in the black and white experiences of kin imprisonment. Averaging across all ages, in both cohorts a black individual faces well over three times higher risk of first kin imprisonment per year than a white individual. At the age of widest racial divergence (age 49 for the "boom" cohort and age 6 for the "post-boom" cohort), the average white individual faces a kin imprisonment risk of about 1 imprisonment per every 100 relatives, while the average black individual faces a risk of about 1 imprisonment per every 10 relatives.

Second, the proportional distribution of kin-specific risk varies by cohort but relatively little by race. Figure 1 disaggregates each cohort- and race-specific risk curve into its kin-specific components. Within cohorts, we see that though the magnitudes of risk differ quite dramatically between the black and white populations, the relative risks contributed by each kin relation are similar. We see that the relative contribution of older generations (grandparents, parents, and aunts/uncles) to the overall kin imprisonment risk increases over cohorts, while the relative contribution of same- or younger-generation kin (partners, siblings, cousins, children, and grandchildren) decreases. This shift reflects two demographic trends: a) declining birth rates, which reduces the number of siblings and cousins subject to the risk of imprisonment; and b) declining mortality rates at older ages, which increases the number of grandparents, parents, and aunts/uncles subject to the risk of imprisonment. For the white population, this translates to a 15.7% reduction in the contribution by same-or-younger generation kin and a corresponding increase in the contribution by older-generation kin to the lifetime risk of kin imprisonment. For the black population, the change in contribution by kin generation is 19.2%.

Third, there is a difference in the timing of first kin imprisonment between the two cohorts. The "boom" cohort tends to experience the first imprisonment of kin later in life than the "post-boom" cohort. This conforms to expectations given that the mass imprisonment movement reached its peak in the '80s and the '90s when the "boom" cohort was just reaching adulthood and the "post boom" cohort were just beginning to be born. The average black and white individuals in the "boom" cohort experience their first kin imprisonment events at ages 17 and 54, respectively. Their counterparts in the "post-boom"

cohort experience this event at ages 7 and 39, respectively. Especially for the black population, this represents a qualitative change in the expected life course; first kin imprisonment is expected to occur during the earliest years of primary school rather than in the years immediately preceding adulthood.

The second and third points highlight the importance of looking at full kin networks. If we were to constrain our focus to just immediate family members – parents, partners, and children – the mean age of experiencing imprisonment of kin for the first time would be 52 for blacks in the "boom" cohort and 37 for blacks in the "post-boom" cohort.[11] This is 30-35 years later than the estimates that we provide above. Taking seriously the claim that the imprisonment of family members represents a disruption to normative life course expectations, these earlier observed ages of first kin imprisonment are likely to herald important developmental consequences for families and their most vulnerable members.

The Prevalence of Kin imprisonment

Imprisonment signals a state change, not just a momentary disruption. To characterize the prevalence of prisoners and ex-prisoners in the kinship networks of black and white individuals, we plot the proportion of living relatives who have ever been imprisoned at each age of ego (Figure 2).

[11] The mean age of first kin imprisonment for whites for this reduced set of kin relations (i.e. the age at which the cumulative sum of annual risk tips past 50%) shoots off the charts well into the post-centenarian years.

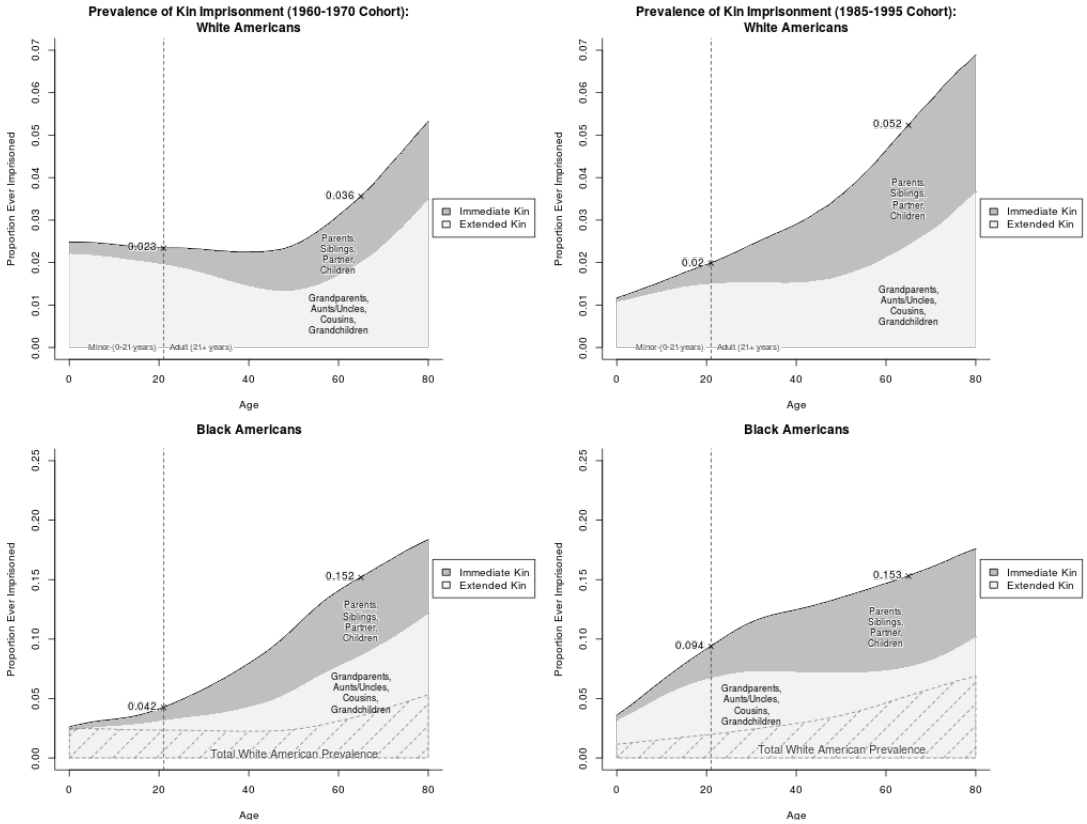

Figure 2. Cohort-specific prevalence of imprisonment within kinship networks over age (by relation). The top plots illustrate the proportion of living kin who have ever been imprisoned for white individuals; while the bottom plots illustrate the same for black individuals. Points marked by x's indicate the proportion of kin ever imprisoned when ego is age 21 and 65. The total prevalence of imprisoned kin in the white population is super-imposed on the bottom (black population) plots to aid comparison across the two different y-axis scales.

The age-specific prevalence of imprisonment within kinship networks is generally similar across races: a steady increase over ages.[12] However, the increasing magnitude of difference between the prevalence of imprisoned members in black kinship networks versus white kinship networks is striking. Within the 1960-1970 cohort, 4.2% of living black relatives have ever been imprisoned by the time ego reaches age 21, while a roughly similar percentage – 2.3% – of white relatives have ever been imprisoned by the same age. Within the 1985-1995

[12] In the case of white Americans born 1960-1970, the prevalence remains largely stable until about age 50 when it begins its upward movement.

cohort, however, the race difference intensifies: by age 21, 9.4% of black relatives have ever been imprisoned, while 2.0% of white relatives have ever been imprisoned. At age 65, 15.2% of black relatives and 3.6% of white relatives in the earlier "boom" cohort have ever been imprisoned; the equivalent figures are 15.3% and 5.2% in the "post-boom" cohort.

While the prevalence of current and former imprisonment within full kinship networks provides useful information regarding the opportunities (or lack thereof) for support in those networks, the large variation in the ages of relatives potentially confounds the true capacity of kin to provide that support. We get better purchase on the issue of kin support if we examine the prevalence of imprisonment among kin who are of prime working age (Figure 3).

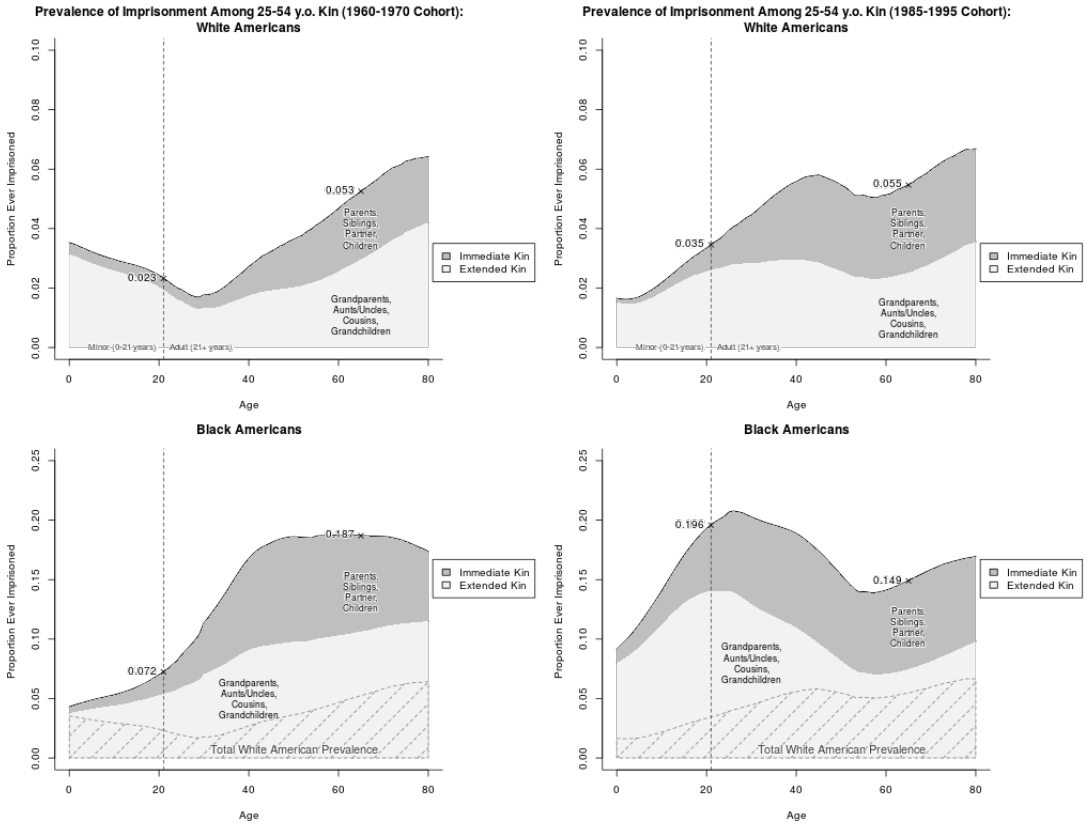

Figure 3. Cohort-specific prevalence of imprisonment within kinship networks over age (by relation) among kin who are of working age (25-54 y.o.). The top plots illustrate the proportion of living kin who have ever been imprisoned for white individuals; while the bottom plots illustrate the same for black individuals. Points marked by x's indicate the proportion of kin ever imprisoned when ego is age 21 and 65. The total prevalence of imprisoned kin in the white population is super-imposed on the bottom (black population) plots to aid comparison across the two different y-axis scales.

When we look exclusively at those relatives of working age (versus all relatives), we see that the proportion ever imprisoned increases at earlier ages. For example, in the "boom" cohort 11.1% of black *working-age* relatives have ever been imprisoned by the time ego reaches age 21, compared to 4.2% of *all* relatives.

Table 1 summarizes the findings on the prevalence of kin imprisonment, splitting by cohort, race, and kin type (all kin and working-age kin).

Table 1. Prevalence of kin imprisonment by age, for two cohorts. Numbers reported by race and type of kin.

1960-1970 Cohort

		0	**5**	**10**	**21**	**65**	**75**
White	all kin	2.5%	2.5%	2.4%	2.3%	3.6%	**4.7%**
	working-age kin	3.5%	3.2%	3.0%	2.3%	5.3%	**6.3%**
Black	all kin	2.5%	3.0%	3.2%	4.2%	15.2%	**17.4%**
	working-age kin	4.3%	4.9%	5.3%	11.1%	15.9%	**15.2%**

1985-1995 Cohort

		0	**5**	**10**	**21**	**65**	**75**
White	all kin	1.2%	1.3%	1.5%	2.0%	5.2%	**6.4%**
	working-age kin	1.6%	1.7%	2.2%	3.5%	5.5%	**6.4%**
Black	all kin	3.6%	5.0%	6.5%	9.4%	15.3%	**16.8%**
	working-age kin	9.1%	11.2%	14.0%	19.6%	14.9%	**16.5%**

Finally, in Figure 4, we re-situate the information presented in Figure 3 within the context of full kinship networks. This allows us to illustrate the total "availability" of kin who are least constrained in their ability to provide material support for their relatives: those of working age, who don't have a prison record.

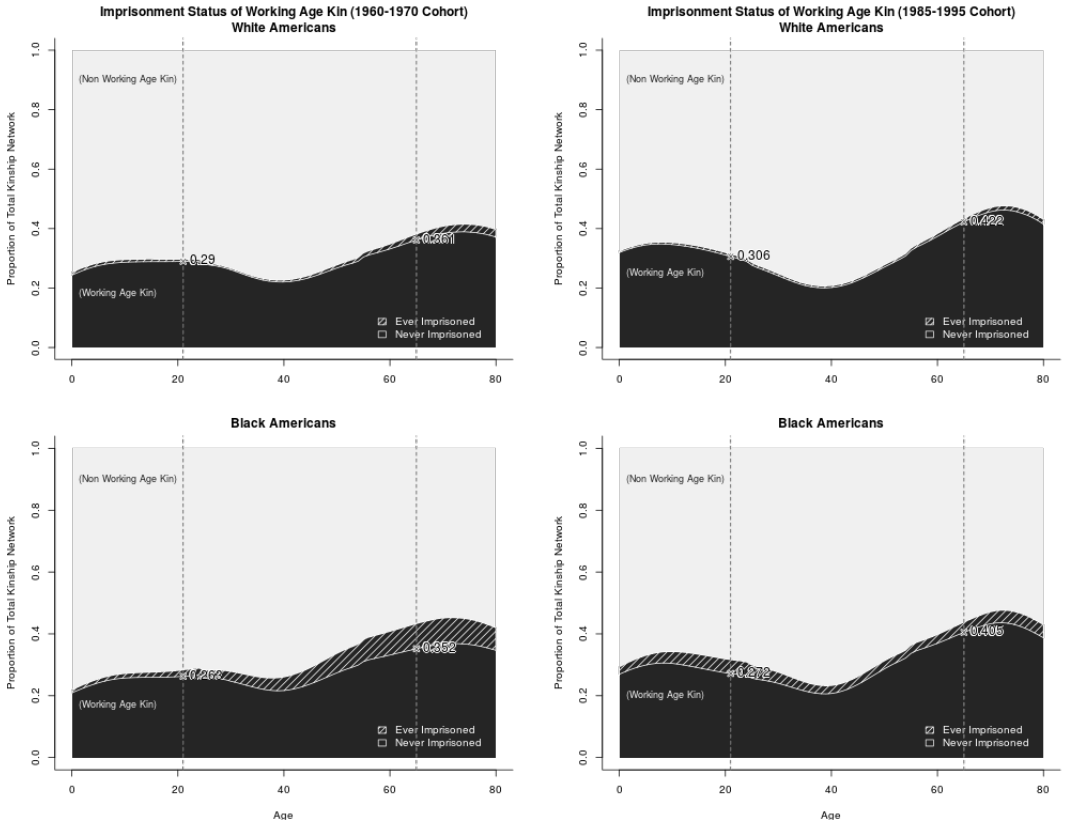

Figure 4. Cohort-specific proportion of working-age (25-54 y.o.) kin who have never been imprisoned. The top plots illustrate the proportions of working-age kin for white individuals; while the bottom plots illustrate the same for black individuals. The shaded regions indicate the share of working-age kin who have ever been imprisoned. Points marked by x's indicate the proportion of kin who are working age and have never been imprisoned when ego is age 21 and 65.

Though the proportions of all kin who are of working-age and have *never* been imprisoned are similar between the black and white populations, the proportions of all kin who are of working-age and who have ever been imprisoned are substantially higher in black kinship networks. Put another way: if all imprisonment histories were eliminated from all kinship networks, black individuals in the "boom" and "post-boom" cohorts would stand to gain 16.7% and 19.2%, respectively, in the lifetime prevalence of working-age kin without a prison record. In comparison, the average white individual would stand to gain 4.0% and 4.8%, respectively. When we translate these proportions into person-years of kin support

lost, the comparison becomes much more tangible: over the course of life, black individuals in the "boom" and "post-boom" cohorts lose 90.1 and 83.3 person-years of potential support from working-age kin. White individuals lose 20.4 and 19.1 person-years, respectively.

We want to highlight two major findings here. First, for both the black and white populations, a greater proportion of the total kin imprisonment prevalence is due to the imprisonment of extended kin rather than immediate kin. Over the course of life, more than half of all currently and formerly imprisoned relatives in both black and white kinship networks are relatives of the sort that are typically missed in studies of the collateral consequences of imprisonment. Second, imprisonment reduces the lifetime availability of never-imprisoned working-age kin for blacks much more dramatically than it does for whites. Furthermore, this "deflation" comes at the heavy cost of increased prevalence of imprisonment among black working-age relatives – converting potential fonts of kin support into sources of kin strain.

Future Trajectories of Kin Imprisonment

In order to assess the consequences of different possible trajectories of imprisonment in the United States, we plot the prevalence of kin imprisonment for the "post-boom" (1985-1995) cohort under three scenarios: 1) no change in prison admission rates; 2) a linear 25% reduction in prison admission rates by the year 2035; and 3) a linear 75% reduction in prison admission rates by the year 2035. Because these future scenarios start in the year 2015 (imprisonment rates are known up through 2014), we start our plot at age 20 – when the youngest members of the "post-boom" cohort enter the year 2015.

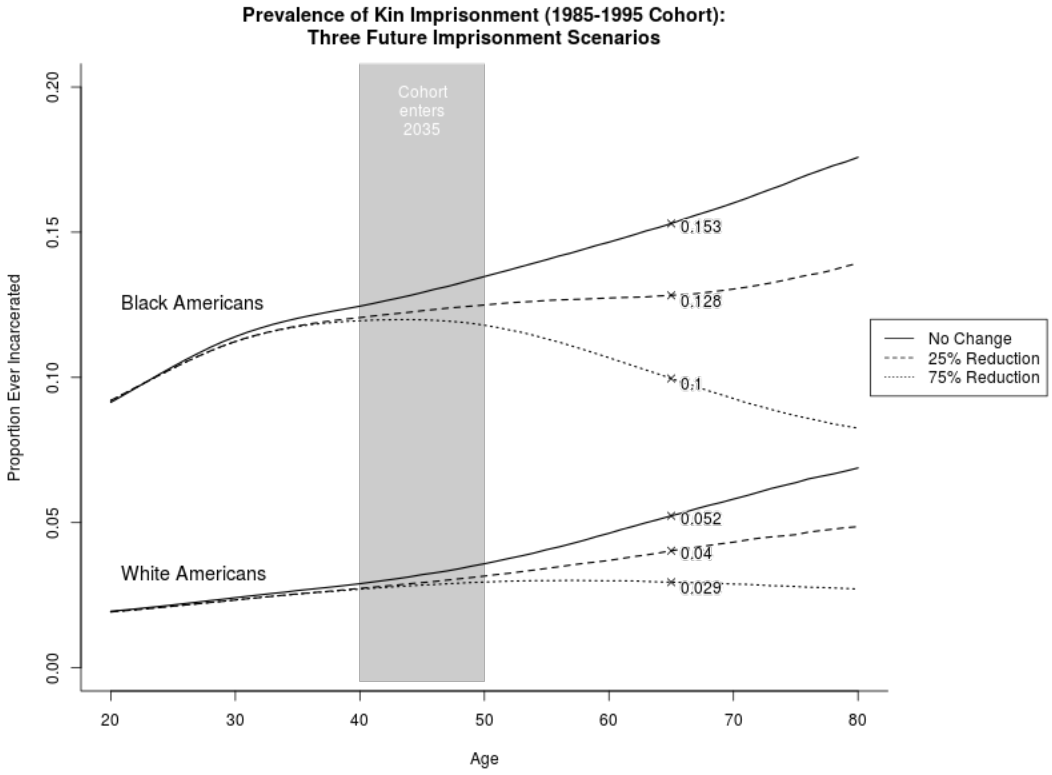

Figure 5. Prevalence of imprisonment within kinship networks over age for the 1985-1995 cohort under three future imprisonment rate scenarios (stratified by race). Dashed and dotted lines are results from simulations where future imprisonment rates are reduced by 25% and 75%, respectively, by the year 2035. Points marked by x's indicate the proportion of kin ever imprisoned when ego is age 65.

As expected, we see that the greater the reduction in future rates of prison admission, the lower the lifetime prevalence of ever imprisoned kin within family networks. This holds true for both black and white simulated populations. Overall, a 25% reduction in prison admission rates by the year 2035 leads to a 16-23% reduction in the proportion of family members ever incarcerated by age 65; and a 75% reduction in prison admission rates leads to a 35-44% reduction in the proportion of family members ever incarcerated by that same age. Though the relative drop in the proportion ever incarcerated is roughly similar across race groups, the absolute drop in these numbers is much more dramatic for blacks than for whites: 15% of black family members are expected to have ever been imprisoned by the time

ego reaches retirement age under the "No Change" scenario versus 10% under the "75% Reduction" scenario. For the white population, the equivalent drop in kin imprisonment prevalence is from 5% to 3%. The net result of these reductions is a meaningful narrowing of the race disparity in lifetime kin imprisonment prevalence from around 10% to 7%. That said, it is remarkable that even a 75% reduction in future imprisonment rates for the black population would still not be enough to bring them to parity with a white population whose imprisonment rates did not change at all.

Two additional features of these results are worth pointing out. First, the "25% Reduction" scenario sees a net reduction in kin imprisonment prevalence over all ages (compared to the "No Change" scenario), but the prevalence of kin imprisonment still increases monotonically over ages such that the older one gets, the more of one's living relatives are likely to have ever been imprisoned. Under the "75% Reduction" scenario, however, the age trend in kin imprisonment hits an inflection point and begins to decline in mid-to-late adulthood. In other words, there appears to be a particular imprisonment rate "threshold" beyond which the life course experience of kin imprisonment takes on a qualitatively different character: one eventually reaches a point in life when the older one gets, the *fewer* of one's living relatives are likely to have ever been imprisoned.

The second point worth noting is that future reductions in the rate of imprisonment are likely to have a much delayed impact on the families of those whose lives have already been touched by the prison boom. For our post-boom (1985-1995) cohort, for example, even a dramatic 75% drop in prison rates over a relatively brief 20-year period doesn't seem to visibly effect the prevalence of kin imprisonment until around middle adulthood. By this

time, most individuals will have already completed school, started a career, and have finished having children. Thus, much of the potential gains to familial support are muted for these individuals. Instead, those who stand to gain the most from a reduction in future imprisonment rates are the next generations of Americans for whom the prison boom would then be an object of historical, rather than personal, memory.

Discussion

The prison boom of the 1980s and the 1990s has left an indelible mark on the American family. As we have shown, both the likelihood of experiencing the imprisonment of a relative, as well as the overall prevalence of relatives with the prison label has expanded tremendously over time. Furthermore, this expansion has overwhelmingly affected black families.

Research on the collateral consequences of imprisonment seek to characterize the effects that serving time has on the wider networks of family and friends within which prisoners are embedded. Collateral consequences are those that accrue to those *left behind*. The focal egos in these investigations are typically prisoners' children, partners, and parents. One of the key findings of this study is that these immediate kin members make up a minority of imprisoned kin. Across race and cohorts, more than half of all imprisoned relatives are extended kin.

As we argued above, the imprisonment of extended kin matters because (1) extended family members bear some portion of the material and symbolic costs of kin imprisonment and (2) former prisoners are less able to contribute to future kin support. These two factors can interact in ways that undermine norms of reciprocity and trust and ultimately weaken

kin networks. These networks have been shown to be particularly strong within and important for black families.

We find that those born at the height of the prison boom (1985-1995) are at higher risk of experiencing the first imprisonment event of a same- or older- generation relative during childhood and adolescence than those born 25 years prior. This translates into experiences of kin imprisonment at much earlier ages (up to 15 years earlier) and higher lifetime prevalences of ever imprisoned relatives within kinship networks when comparing across birth cohorts. These trends signal an alarming growth in the collateral consequences falling on the American family due to the growing carceral state over the past several decades.

Within cohorts, race differences in the experience of kin imprisonment are the most compelling story. White Americans alive at the height of the prison boom are likely to have had very few occasions to deal with the strain, stigma, or trauma of imprisonment. Black Americans over the same period, by contrast, were substantially more likely to have to shoulder that burden for either themselves or their kin, often during their most vulnerable ages. At every age, black individuals (relative to white individuals) are at substantially higher risk of experiencing the first imprisonment event of a relative, are likely to experience that event at much earlier ages, and have proportionately more relatives who have ever been imprisoned. At age 6, the moment of widest racial disparity in kin imprisonment risk for the 1985-1995 cohort, the average black individual loses 1 of every 10 relatives to imprisonment, while the average white individual loses 1 of every 100.

By age 21, 9.4% of black relatives have acquired a prison record versus 2.0% of white relatives. This represents a nearly five-fold higher probability of black individuals having

currently or formerly imprisoned relatives within their kinship networks at the moment they first enter their adult years. By age 65, the normative age of retirement, the race difference is even wider: 15.3% of black relatives versus 5.2% of white relatives with a prison record. Over the course of life, this translates to 83.3 person-years of potential support from working-age relatives lost to imprisonment for black Americans, and 19.1 person-years lost for white Americans. By all these measures, the collateral consequences of the growing carceral state appear to be disproportionately borne by black families.

But what about the future? With increasing agreement among researchers, activists, and policymakers that the current carceral system is in need of reform, we are likely to see efforts to reduce the national rate of imprisonment.[13] The results of our analysis suggest that the consequences of such efforts are likely to be profound (especially for black families), but also delayed. For those who lived through the prison boom, the "damage," in some sense, has already been done. The prevalence of imprisonment within their families will not change even if dramatic cuts to imprisonment rates are implemented quite soon.

However, this does not indicate that efforts to reduce imprisonment are wasted. On the contrary, the importance of such initiatives to the future family lives of our most recent generations is likely to be quite pronounced. What's more, our analysis suggests that there may a clear benefit to reducing national imprisonment rates as much as possible: below some "threshold" imprisonment rate, the age trend in the prevalence of imprisonment within kinship networks stops increasing monotonically and instead takes on an inverted-U shape. The implications of such a qualitative shift, from a life course perspective, are enormous. By

[13] The #cut50 initiative, for example, hopes to reduce the incarcerated population by 50% over the next 10 years (see: https://www.thedreamcorps.org/2015report).

achieving an imprisonment rate low enough to trigger a mid-life decline in familial imprisonment burden, we enable Americans, for the first time in several decades, to see the reach of the carceral state into their families recede rather than increase over their own lifetimes.

Future Directions

This paper estimates, in broad strokes, how mass imprisonment differentially affects the composition of black and white kin networks. This is in many ways a preliminary analysis. We suggest three major avenues for future research building on these findings.

First, given adequate data, the simulations carried out here could be extended in a number of ways. In an online appendix, we provide a first example of how this might be done by incorporating known variations by education in lifetime risk of imprisonment (Pettit & Western, 2004). Given race-specific measures of assortative mating, cross-generational educational transmission, and repeated cross-sections of family educational composition, those estimates could be substantially improved. Wildeman and Wakefield's (2014) recent work suggests that the concentration of imprisonment within families also bears further investigation. Our simulations do not – but with sufficient data potentially could – account for any intergenerational transmission or clustering of imprisonment risk within family networks. Full simulations are plausible but require increasingly sophisticated procedures to ensure the reliability and accuracy of simulated estimates. Confirmation of resulting estimates would also likely require collection of new sorts of network data.

Second, results from these simulations should lead to reassessment of previous findings on the collateral consequences of imprisonment. We agree wholeheartedly with Wildeman

and Wakefield in their assessment that, "the massive literature considering the effects of parental imprisonment on children may have been picking up not solely a direct effect of parental imprisonment, but a combined effect of parental imprisonment and broader family member imprisonment" [Wildeman & Wakefield (2014); p.389]. Much the same could be said about research on the effects of imprisonment on romantic partners and mothers of prisoners. If others in the ego's kin network are also imprisoned and straining either ego's or the network's resources, then the direct effect of proximate kin's imprisonment may be over-estimated.

Finally, third, we believe there is more to be gleaned from analyzing the extended family as a meso-level institution. For example, the results presented here have implications for reintegration of former prisoners. Families are the primary social institutions to which the formerly-imprisoned return (Braman, 2004; Harding et al., 2014; N. G. La Vigne et al., 2005). Our study draws attention to the changing composition of these families across race and over time. Different types of kin networks may be more or less supportive of the reintegration process. Does having higher proportions of relatives in their prime working ages mean that more material support is available to re-entrants? Is this effect tempered if that group has a large percentage of ex-prisoners?

As another example, black-white differences in kin imprisonment may have a direct effect on the racial wealth gap (Braman, 2004). Research suggests that ties to poor and less-educated kin serve as an obstacle to individual financial well-being and wealth accumulation; differentials in incidence of such ties serve to explain a portion of the racial wealth gap (Chiteji & Hamilton, 1998; Goldstein & Warren, 2000; Heflin & Pattillo, 2002, 2006; O'brien,

2012). The effects of ties to prisoners and ex-prisoners – alters who make significant, unreciprocated demands on ego's resources – may be even more severe. Turney and Schneider (2016) provide initial support for this claim, demonstrating that imprisonment lowers odds of romantic partner's asset ownership. Such spillover effects, when evaluated at the network level and across the racial divide, may prove significant.

Strengths & Limitations

The results presented here are based on data constructed using a microsimulation strategy. Consequently, we conduct our analyses with data that is demographically complete and longitudinal for all individuals in our (simulated) populations of interest. This allows for the exact measurement of genealogical relatedness and the ability to track those genealogical linkages over both individual and historical time. We are able to explore the kinship configurations of the imprisoned population with an unprecedented level of detail. These data take into account female imprisonment and – via our exploratory analyses with education rates – class variation in imprisonment rates.

This study also suffers from a number of limitations. Some of these are inherent in the nature of simulated data. The kinship networks that we develop and describe above are not "real" (in the sense that they are not derived from measurements of real people). In other words, we observe only the structures, not the cultural patterns that underlie or result from them. And the consequences of these structures are largely hypothetical. We attempt to justify the hypotheses, but these data do not allow us to test them directly.

Other problems are related to data availability and our choices in the configuration of SOCSIM, our microsimulator. In an effort to streamline our process, we have omitted several

factors that may be of importance. First, we do not account for the significant geographic variation in imprisonment rates (Greenberg & West, 2001; Wakefield & Uggen, 2010). imprisonment rates we use are nation-wide averages; lived experiences will be shaped depending on whether an individual (and her kin network) reside in a more or less punitive state. We also do not account for intra-familial correlations in risk of imprisonment, except via the education simulation. Our simulations also rely on an assumption of strict racial homogamy. Such an assumption is fairly well warranted given historical American marital patterns, but may be less tenable moving forward.

In addition, there is a large class of felons who are never imprisoned who do not factor into our analysis. Uggen, Manza, and Thompson estimate that as of 2004 there were 6.3 million individuals in the U.S. that were currently or had been imprisoned. The total number of current or former felons, however, is much larger: 16.1 million (Uggen et al., 2006). These individuals face many of the same problems of stigma, mistrust, and income loss discussed above, and their families may experience some of the same burdens. By omitting these individuals from our simulations we understate the true reach of the criminal justice system.

Conclusion

Understanding the collateral consequences of mass imprisonment and their effects on racial inequalities and stratification processes requires us to fully account for the affected. Meeting this requirement, we argue, is not simply a matter of getting the qualitative story right. Good existing research has already established that the consequences of mass imprisonment spill over into the lives of friends and relatives of the imprisoned, and that these collateral consequences fall unevenly by race and class. What we need, in addition, is a careful

identification of the scale at which we assess our outcomes. Cast the net too narrowly and we are liable to mis-characterize the consequences of the modern carceral system by underestimating the likely exposure of individuals to those consequences. To wit, existing research has suggested the ways in which imprisonment affects the life chances of prisoners' most immediate family members: the children, partners, and, on occasion, parents of the imprisoned. However, our present work suggests that we may be missing over half the story of familial imprisonment if we fail to account for the connectedness of extended kin.

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Appendix

A1. Rate Inputs

Table A1-1. Years of admission and release data known and interpolated for each year of simulation.

Simulation Years	Year of Admission Data	Year of Release Data
1960-1963	1960; 1961-1963*	1978
1964-1969	1964; 1965-1969*	1978
1970-1973	1970; 1971-1873*	1978
1974-1978	1974-1978	1978
1979-2013	1979-2013	1979-2013
2014+	2014	2014

*Interpolated

The earliest year for which we could locate release data is 1978, and so we hold the known 1978 release rates constant for earlier years. We do not expect this methodological choice to effect this study's findings in any appreciable way for two reasons: 1) historically, imprisonment rates held steady over the period 1960-1980 – this suggests that the 1978 release rates are not an unreasonable approximation for the rates of earlier years; and 2) our study's outcomes of interest are all based on measures of *first*, rather than *current*, imprisonment status – a slight mis-specification of release rates is not likely to affect these outcomes since when and whether current prisoners are released has no bearing on when and whether any other individual in the simulation is imprisoned for the first time.

Table A1-2. Year of known and interpolated race-, sex-, and age- distributions assumed for each year of admission and release data.

Admission

Year of Data	Year of Race Distribution	Year of Sex Distribution	Year of Age Distribution
1960-1963	1960; 1961-1963*	1964	1974
1964-1973	1964; 1965-1973*	1964-1973*	1974
1974-1978	1974-1978	1974; 1975-1978*	1974; 1973-1978*
1979-2013	1979-2013	1979-2013	1979-2013
2014+	2014	2014	2014

*Interpolated

Release

Year of Data	Year of Race Distribution	Year of Sex Distribution	Year of Age Distribution
1960-1973	1974	1991	1991
1974-1990	1974; 1975-1990*	1991	1991

1991-2013	1991-2013	1991-2013	1991-2013
2014+	2014	2014	2014

*Interpolated

For years with missing race-, sex-, and age- distribution information where there is no observed data to serve as the "lower bound" for the interpolation procedure, we apply the earliest known race-, sex-, and age- distribution. Also, for years where prisoners' race information is not further disaggregated into Hispanic and non-Hispanic categories, we downwardly adjust the given proportion of black and white prisoners according to the most contemporaneously reported proportion of Hispanic prisoners (United States Bureau of Justice Statistics, 2016b, 2016b, 2016a) such that we end up with plausible approximations for the proportion of total prisoners who are non-Hispanic black and non-Hispanic white.

A2. Calibration of SOCSIM via Maximum Likelihood Estimation

In order to recover results that are consistent with observed data, we calibrate our input rates against the known distribution of family sizes and life expectancies (TFR and e_0) at each ten-year interval from 1910 to 2009. This calibration is done via two scaling factors – θ_m and θ_f – that multiplicatively adjust the levels of the age-specific mortality and fertility inputs, respectively. What is thus assumed is confidence in the general shape of the age-specific mortality and fertility curves, but uncertainty regarding their magnitudes (Figure 1).

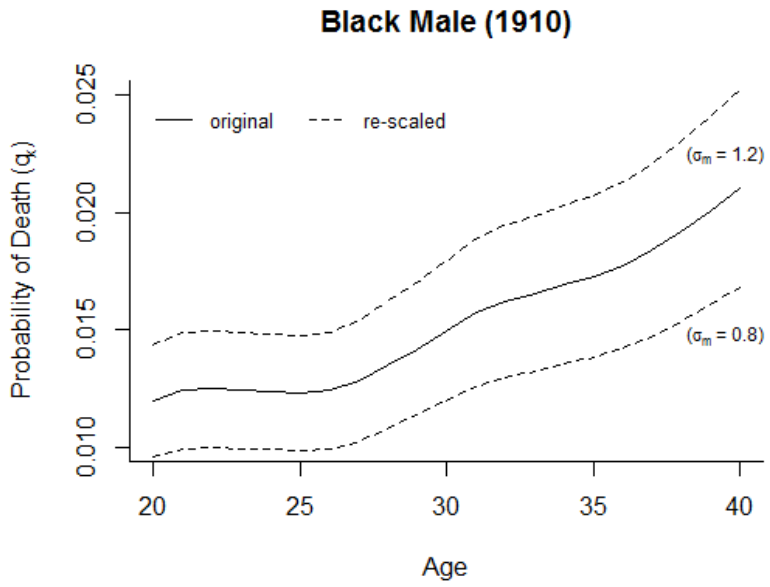

Figure A2-1. Example of re-scaled age-specific mortality curves. The area between the dashed lines demarcates the range of possible re-scaled values.

Procedurally, twenty candidate values are chosen (at even intervals) between the range 0.80 to 1.20 for each θ_m and θ_f parameter. This results in 400 possible (θ_m, θ_f) pairs. Each of these pairs are applied to the simulation's 11 sets of mortality and fertility inputs, and the

simulation is then run to completion 25 times (for each pair of scaling factors) producing 25 unique values of TFR and e0. The variation and average of these outcomes over the 25 runs is used to compute a likelihood estimate of observing the true values of the outcomes assuming that the simulated outcomes are normally distributed. In sum, what is produced is an estimated likelihood surface that varies by θ_m and θ_f for each of the 11 input rates used in the simulation (Figure 2). The (θ_m , θ_f) pair that generate the highest likelihood value is then chosen as the final re-scaling parameter set.

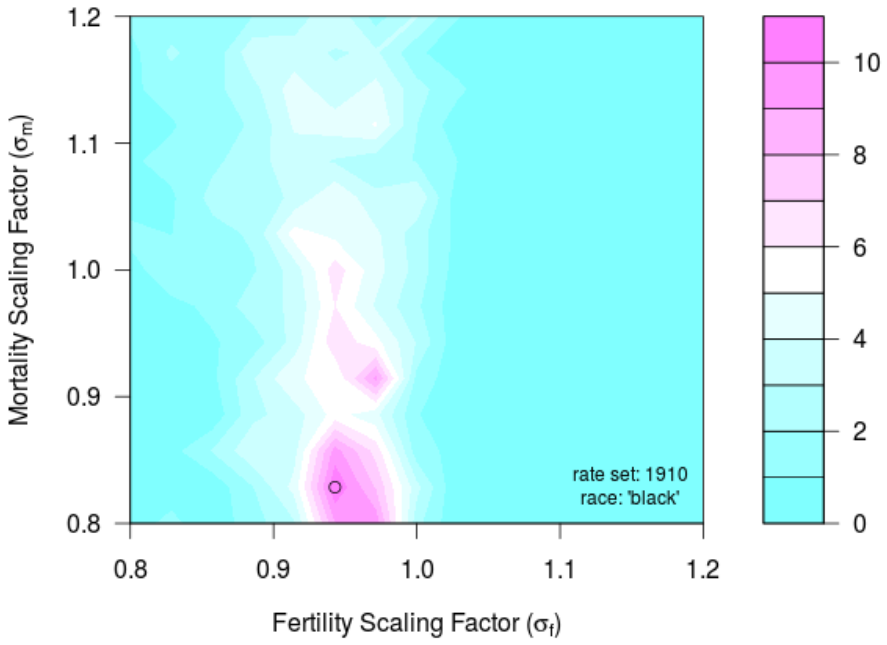

Figure A2-2. Example of estimated likelihood surface generated by the calibration procedure. The point marked by the hollow dot represents the (θ_m , θ_f) pair associated with the maximum likelihood value.

Thus in sum: (11 simulation input rate sets) x (400 re-scaling pairs) x (25 random simulations) = 110,000 calibration simulations are conducted to arrive at a final set of 11 re-scaling parameters. In concert, these 11 re-scaling parameters applied to our simulation's fertility and mortality inputs do a competent job of reproducing the expected TFR and e_0 values (Figure 3).

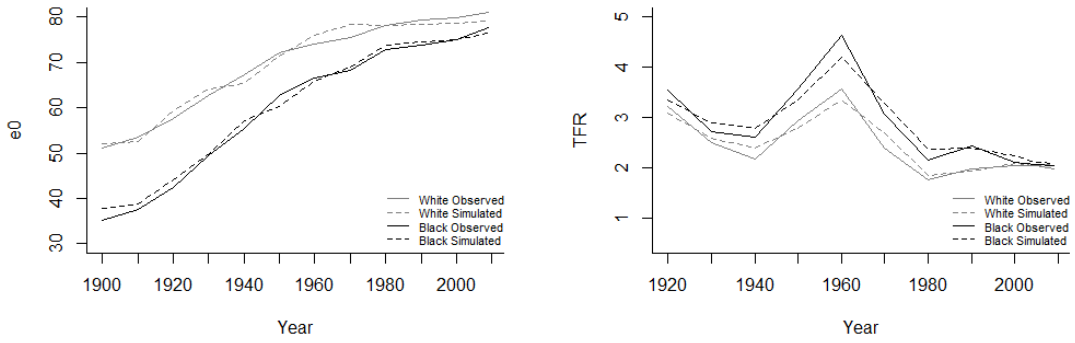

Figure A2-3. Period female life expectancy (e0) and total fertility rate (TFR): observed and simulated values.

An identical strategy is employed to calibrate the race-specific rates of prison admission and prison release to reliably re-produce observed population rates of first admission to prison (Carson & Golinelli, 2013) in simulation (Figure 4).

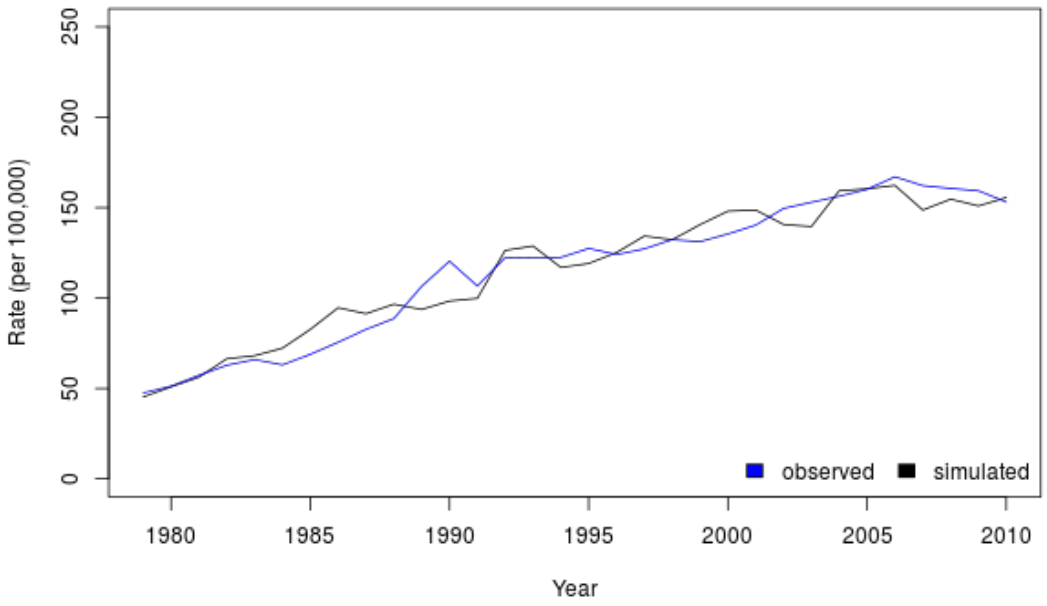

Figure A2-4. Period male first imprisonment rate (per 100,000): observed and simulated values. Race-specific rates are aggregated to allow comparison to observed rates (which are not reported separately by race).

Traditionally, calibration of this sort has been done via an informed trial-and-error methodology, but advances in computational power allow for more systematic optimization

procedures, such as the one presented here (for similar applications see: Ševčíková, Raftery, & Waddell (2007); Zagheni (2011)). That being said, the need for these calibration steps should alert the reader to the danger of placing too much confidence in the exact magnitudes of effect being reported here (or in any other microsimulation study). These concerns, however, should be much less pronounced when considering the relative differences between two identically-configured simulations that vary only in their initial inputs as is the case in the present study.

A3. Replication of Prior Findings

To check the overall credibility of our fully calibrated microsimulation model, we attempt to replicate measures of own and family imprisonment reported by three prominently cited studies:

1. Western & Wildeman (2009): The cumulative probability of imprisonment for black and white men by age 30-34 (for 5-year birth cohorts over the period 1960-1979[14]).
2. Wildeman (2009): The cumulative probability of imprisonment of parents (fathers and mothers) for black and white children by age 14 (born 1978 and 1990).
3. H. Lee et al. (2015): The proportion of black and white Americans in 2006 who have at least one family member in prison and the average number of imprisoned family members.

The following tables gives the results of our replication exercises:

Table A3-1. Cumulative probability of imprisonment for black and white men by age 30-34 (for 5-year birth cohorts over the period 1960-1979: original values and simulated values.

	Birth Cohort			
	1960-1964	1965-1969	1970-1974	1975-1979
Western & Wildeman (2009)				
1. Black	15.2%	20.3%	22.8%	20.7%
2. White	2.2%	2.8%	2.8%	3.3%
Simulation				
1. Black	14.6%	20.2%	23.9%	23.4%
2. White	1.8%	3.0%	3.3%	3.4%

Table A3-2. Cumulative probability of imprisonment of parents (mothers and fathers) for black and white children by age 14 (born 1978 and 1990): original values and simulated values.

	Birth Year	
	1978	1990

[14] Western & Wildeman (2009) reports cumulative probabilities for cohorts born as early as 1945, but our simulation starts in 1960 and so we compare results for only those cohorts for which we are able to generate estimates.

	Mother	Father	Mother	Father
Wildeman (2009)				
1. Black	1.4%	13.4%	3.2%	24.5%
2. White	0.2%	2.1%	0.6%	3.6%
Simulation				
1. Black	2.1%	12.2%	6.5%	26.1%
2. White	1.8%	2.7%	1.6%	3.8%

Table A3-3. The proportion of black and white Americans 18-years or older in 2006 who have at least one family member in prison and the average number of imprisoned family members: original values and simulated values.

	Proportion w/1 or More Family Member in Prison	Average Number of Imprisoned Kin
Lee et al. (2015)		
1. Black Men	0.320	0.84 (1.80)
2. Black Women	0.438	1.63 (3.24)
3. White Men	0.056	0.08 (0.39)
4. White Women	0.116	0.14 (0.45)
Simulation		
1. Black Men	0.348	0.65
2. Black Women	0.382	0.72
3. White Men	0.066	0.10
4. White Women	0.073	0.11

(**Note:** Values from H. Lee et al. (2015) reflect black and white Americans in 2006 who "know" at least one family member in prison. Numbers in parentheses are standard errors. Standard errors for the "Proportion" measure are not reported by H. Lee et al. (2015).)

Happily, our microsimulation returns values that are in close agreement with those reported by Western & Wildeman (2009) and Wildeman (2009). This is perhaps not surprising given that the life table methods that are used by these authors are closely related to the underlying mechanism that drives our microsimulator. Nevertheless, it is still encouraging to see agreement on these values of interest given that our estimates reflect the *joint* effect of fertility, mortality, and imprisonment input factors all operating in tandem. In sum, it seems fair to say that our microsimulation strategy performs no worse in its ability to estimate cohort-level kin imprisonment status than the estimation strategies used by Western and Wildeman.

As for the somewhat larger discrepancy between our estimates and the survey results of H. Lee et al. (2015), we can anticipate at least two factors that might account for these deviations. First, the General Social Survey (GSS) item that H. Lee et al. (2015) draw on for

their estimates rely on in-the-moment respondent recall – the item in question asks: "Next, we are going to ask questions about people in your family, including relatives and in-laws. How many are currently in state or federal prison?" Thus there exists a distinct possibility of mis-reporting due to imperfect recollection (especially for more extended kin relations). Second, our simulation models are calibrated to reliably reproduce ever-imprisonment status rather than current-imprisonment status, and so some disagreement in the exact moment-to-moment imprisonment status of individuals observed in the GSS population versus in our simulated population is to be expected. Fortunately, the reliability of our study's results do not depend on the accurate estimation of *current* imprisonment status (only *ever* imprisonment status). That being said, our simulated values are all still rather close to those reported by H. Lee et al. (2015). For example, our estimates of average number of imprisoned family members fall well within a single standard deviation of these authors' estimates.

A4. Exploratory Models of Kin Imprisonment by Educational Attainment

The patterns in kin imprisonment we have described are population averages. Previous research has documented a strong class differential in the effects of mass imprisonment; the least educated face higher risks than their more-educated counterparts of being incarcerated. The correlation of educational attainment within families leads us to suspect that this burden of kin imprisonment is not evenly borne across the population. That is, families who have a greater proportion of less-educated members likely have higher rates of kin imprisonment, while those with a higher proportion of more-educated members experience less kin imprisonment.

We present here exploratory results from a sensitivity analyses in which we employ education-varying imprisonment rates and make the strong assumption of total educational homogamy within families. That is, we model kin imprisonment for blacks and whites as though each was made up of three wholly separate populations: those without a high school diploma, those with a high school diploma or equivalent, and those with some college or more. Individuals from the first population – non-high school graduates – come from families where all members are non-graduates, partner with non-graduates, and give birth to future non-graduates. All members thus face the increased imprisonment risks that come with that status. The same holds for the other groups.

Within SOCSIM, our microsimulator, we build three separate models that are specified identically to the non-stratified models we've been using so far with the exception of multiplicatively adjusted prison admission rates. These adjustment factors are derived from Pettit & Western (2004) (table 4) and are exactly equivalent to the ratio of imprisonment risk at each educational strata to the average population risk. For example: in the period 1979, white men were incarcerated at an average rate of 0.4%; however white men who never completed high school were incarcerated at a rate of 1.0%. Thus, we scale prison admission rates up by a factor of 0.4/1.0 = 2.5 for our simulation of white Americans who never completed high school in order to reflect this observed class difference in imprisonment risk.

This represents an obviously unrealistic model of the world. Parents' education is correlated with children's education, but not perfectly. Some percentage of the children of high school drop-outs will go on to earn college degrees, just as a fraction of the offspring of college graduates will never make it through high school. Educational assortative mating,

likewise, is a well-documented and increasingly-common phenomenon, but it is hardly a universal practice (Greenwood, Guner, Kocharkov, & Santos, 2014; Schwartz & Mare, 2005). What this exercise helps us to establish, despite its implausibility, are the "outside bounds" of the range. The families with no high school graduates experience the worst that the system has to offer, while those in which all members have some college will be in the best position. Real-world families will fall somewhere in-between.

To describe the range of experience we curtail our focus to just the boom cohort (those born 1960-1970) and just to measures of the prevalence of kin imprisonment among kin of working age. Figure A4-1 replicates the plots from Figure 4, split here by family education. The top panel presents results for white families and the bottom panel for black families. Moving left to right, the figures display kin availability in families made up entirely of non-high school graduates, families in which all members have a high school diploma or equivalent, and families in which all members have some college or more.

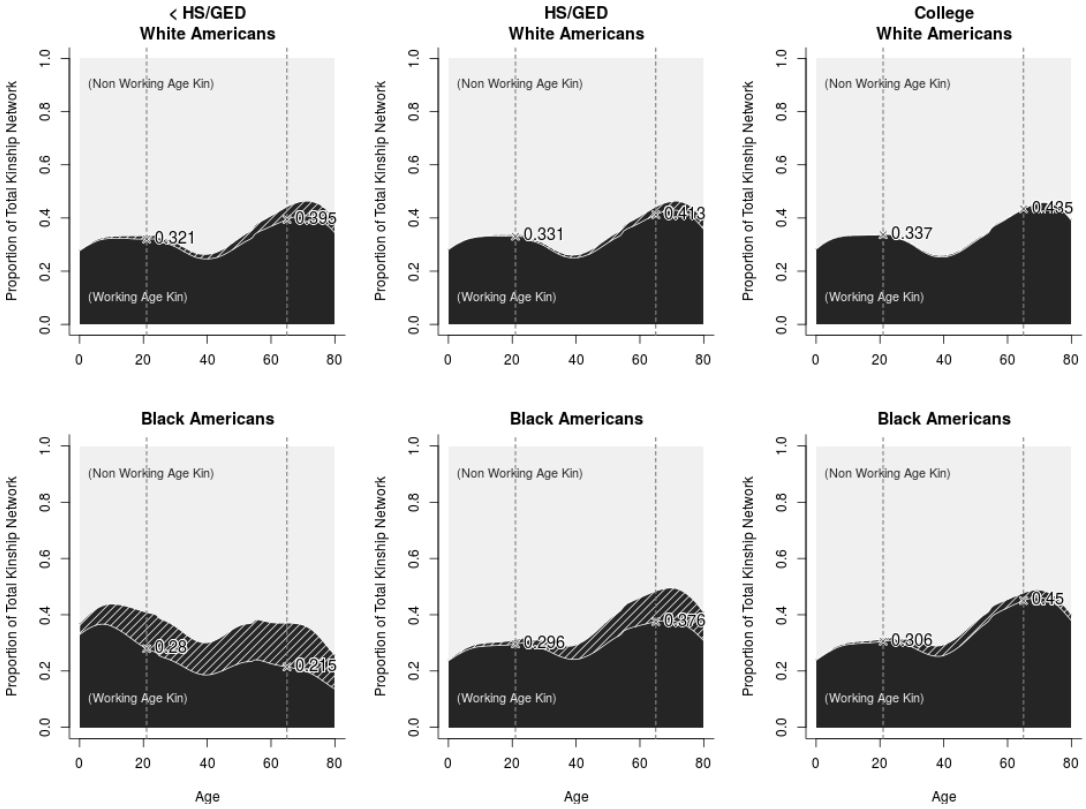

Figure A4-1. Education-specific availability of never-incarcerated, working-age (25-54 y.o.) kin in the "boom" (1960-1970) cohort. The top plots illustrate the proportions of working-age kin for white individuals; while the bottom plots illustrate the same for black individuals. The shaded regions indicate the share of working-age kin who have ever been incarcerated. Points marked by x's indicate the proportion of kin who are working age and have never been incarcerated when ego is age 21 and 65.

For both white and black populations, increasing education is associated with greater availability of never-incarcerated working-age kin. Over the course of life, white and black

Americans with less than a high school education lose 7.9% and 49.3%, respectively, of their working-age kin to imprisonment. This represents a loss of 35.8 person-years of potential kin support for white Americans, and a loss of 129.8 person-years for black Americans. In contrast, white college-educated Americans lose 1.0% and black college-educated Americans 6.7% of their working-age kin to imprisonment. This translates to 5.2 person-years of potential kin support lost for whites and 40.2 person-years for blacks. Note that it takes a black family composed entirely of college-educated individuals (the theoretical "best-case" scenario for black Americans) to reach a level of familial imprisonment similar to that of a white family composed entirely of individuals with less than a high school education (the theoretical "worst-case" scenario for white Americans).

Thus, while education seems to be an important mediator of an individual's exposure to family imprisonment, race remains the dominant determinant of an individual's overall experience of familial imprisonment. This finding reinforces what has been found within close friend and family networks by previous research using empirical data (Bobo & Thompson, 2010).