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ABSTRACT

Labor Market Returns to a Prison GED*

Educational and skill-building programs are commonplace in prisons and have been the focus of recent prominent policy initiatives. These educational programs are expected to increase prisoners' post-release employability, with the hope that these lead to both private and public benefits. One of the most popular programs prepares prisoners to pass the GED exam, which is an academic certification for those without a high-school diploma. We analyze the labor market returns to a GED earned in prison using new administrative data on all released prisoners in the state of Missouri over nearly 25 years, and a matched comparison group difference-in-differences design with individual fixed effects. We find that the GED can lead to higher short-term quarterly earnings and employment, with the largest benefits experienced soon after release. These effects are strongest for those who did not have strong work histories prior to entering prison and for those who had access to post-release support. We also find that the effect of the GED is of a similar magnitude for White and Black formerly incarcerated individuals.

JEL Classification: I26, J24, J31, J38

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1. Introduction

While the formerly incarcerated face numerous challenges post-release, finding a job can be particularly difficult (e.g., Grogger, 1995; Holzer, Raphael, & Stoll, 2006; Pager, 2003; Waldfogel, 1994; Western, Kling, & Weiman, 2001). Programs and policy initiatives that attempt to enhance post-prison release labor market prospects are becoming increasingly popular, since gainful employment is expected to facilitate re-connection to communities, increase the opportunity cost of future crime, improve welfare, and reduce public social support expenditures in the long run. Among the most prominent avenues to improve labor market outcomes are within-prison educational and skill programs, with recent surges in federal, state, and privately funded education programs aimed at investing in and expanding prisoner participation in postsecondary education and vocational training.¹ Nearly 90% of state and federal prisons have educational programs and over half of prisoners participated in an educational or training program while incarcerated (Harlow, 2003).

One of the most popular programs prepares prisoners to pass the General Educational Development (GED) exam, which is an academic certification for those without high-school diplomas. One reason for its importance is the low level of educational attainment of the adult incarcerated population; about two-thirds of state prisoners do not have a high school diploma and assessed numeracy and literacy is substantively lower among the prison population as compared to US households more broadly (Harlow, 2003; Rampey et al., 2016). Over 10% of the GED credentials issued each year are from correctional institutions and nearly 30% of the formerly incarcerated have a GED credential as their highest education attainment, which is about five times

¹ See, for example, the U.S. Department of Education's Second Chance Pell program; the federal Workforce Innovation and Opportunity Act of 2014; or the Pathways from Prison to Postsecondary Education Project in Michigan, New Jersey, and North Carolina.

the rate in the general population (Harlow, Jenkins, & Steurer, 2010; Heckman & LaFontaine, 2010). Despite its popularity, there is limited research that successfully addresses problems of selection bias and provides credible evidence on whether the GED affects the post-release labor market outcomes of the formerly incarcerated.

To contribute to this literature, we analyze the labor market returns to a GED earned in prison using new administrative data on all released prisoners in the state of Missouri over nearly 25 years. Descriptively, those with a GED credential earned in prison experienced higher earnings and employment rates in the five years after being released, relative to the two years before entering prison. To identify the causal effect of the prison GED on labor market outcomes, we use a matched comparison group difference-in-differences design and individual fixed effects to compare the post-release versus pre-entry labor market outcomes of those who passed the GED with those who did not obtain GED certification. We find that the GED leads to short-term higher quarterly earnings and employment rate increases of as much as 25%-30%, with the effect of the GED of a similar magnitude for White and Black individuals. The largest benefits are experienced soon after release and are strongest for those who did not have strong work histories prior to entering prison and for those who had access to post-release support.

This study contributes to the thin literature that attempts to estimate causal labor market returns to the GED in prison (e.g., Tyler & Kling, 2007). This study also situates itself in the broader literatures on returns to the GED and returns to skill-building programs in prisons more generally. Research indicates that the labor market returns to the GED credential are not promising (e.g., Heckman, Humphries, & Mader, 2010; Jepsen, Mueser, & Troske, 2016). However, the GED is likely to have greater benefit for those with lower initial academic endowments, which may be particularly relevant for the incarcerated population given that educational attainment among the

incarcerated is relatively low (e.g., Murnane, Willett, & Tyler, 2000; Rampey et al., 2016; Tyler, Murnane, & Willett, 2000; Tyler, Murnane, & Willett; 2003). There is a general belief that prison skill-building programs more generally can generate positive returns, though causal inference from many of these studies is limited (see the meta-analyses in Bozick et al., 2018 and Davis et al., 2013). This is because of the well-articulated selection bias problem, where unobserved characteristics (e.g., motivation, latent ability) could instigate educational program participation and also lead to positive labor market outcomes. In a meta-analysis of the papers using “the highest caliber research designs,” Bozick et al. (2018) found that those who participated in correctional education programs had the same post-release employment outcomes as those that did not receive correctional education.

These findings are important in the context of the staggering costs of the corrections system and the increasing policy focus on educational programs that attempt to enhance returning individuals’ ability to find well-paying stable jobs. Federal, state, and local governments spend about \$80 billion a year on corrections, and the recent federal budgets allocated nearly \$800 million for reentry projects, not counting the vast expenditures by states on reentry (Kearney et al., 2014; Office of Management and Budget, 2019). In eleven states, correctional expenditures exceed higher education expenditures (Mitchell & Leachman, 2014).

2. Background

Researchers consistently find that a criminal record makes it more difficult for individuals returning from prison to obtain employment and experience wage growth, as compared to those who were not incarcerated (e.g., Western, 2002; Western, Kling, & Weiman, 2001). Agan and Starr (2018) and Pager (2003) found less interest from employers for applicants with prison records but similar observable measures of productivity, corresponding to research indicating that a

criminal record is commonly viewed as a negative signal about trustworthiness (Waldfogel, 1994). Research also finds differential experiences by race; most studies find that a criminal record presents a relatively large barrier to employment for Black workers (e.g., Agan & Starr, 2018; Holzer, Raphael, & Stoll, 2006; Pager, 2003).²

A criminal record may also hinder employment because of real or perceived human capital erosion, reduced social networks through which job seekers commonly find jobs, and restrictions related to certain types of jobs such as those in the public-sector (e.g., Bushway & Sweeten, 2007; Grogger, 1995; Hagan, 1993; Waldfogel, 1994). However, comparisons of prisoners' pre- and post-labor market prospects in prior literature are not consistent. Mueller-Smith (2015) observed worse labor market outcomes after incarceration using data from Harris County, Texas, and Grogger (1995) found lower employment and earnings in the short term after an arrest using California data. On the other hand, several studies observe higher earnings for prisoners post-release as compared to before prison entry. Using national IRS data on the entire incarcerated population in the US, Looney and Turner (2018) showed that prisoners have higher average employment and earnings after incarceration than they did before. Kling (2006) found that longer prison sentences correspond to better short-term labor market outcomes and negligible medium-term effects using administrative data from California and Florida. Tyler and Kling (2007) also observed increases in post-prison earnings relative to earnings prior to incarceration in their analysis of released prisoners in Florida. Nagin and Waldfogel (1995) found higher levels of youths' earnings after convictions as compared to prior to entry but found the reverse relationship for older individuals.

² This negative stigma spills over to law-abiding Black job applicants (Pager, 2003). An explanation for this effect is statistical discrimination, which explains why policies to "ban the box" and remove criminal records from job applications end up harming Black job applicants (e.g., Agan & Starr, 2018; Doleac & Hansen, 2016).

There are several possible mechanisms for these positive post-prison workforce outcomes, including positive effects of skill-building programs in prison and the role that incarceration may play distancing prisoners from prior damaging criminal networks. Observed short-term increases in employment and earnings may also not result in persistent labor market gains. Nagin and Waldfogel (1995) argue that a criminal record hinders workers' ability to obtain stable jobs with low initial wages but rising wage profiles, and, as a result, they are likely to work in spot market jobs that are relatively higher paying but unstable and temporary. Alternatively, higher employment may reflect employment requirements that some must meet as conditions of their post-release supervision, or be a product of support services that some can access while they are on probation or parole.

The challenges returning individuals face when seeking employment are important because researchers often consider criminal behavior to be a part of a decision-making process where an individual weighs the expected benefits of the crime against the probability of being apprehended and the expected penalty (e.g., Becker, 1968; Ehrlich, 1973; Lochner, 2004). Therefore, when the opportunity cost of crime increases – for example because the individual has a well-paying job – the incentive to commit crime should decline. There is considerable evidence that economic hardship contributes to crime and that economically motivated crime decreases when individuals have better economic prospects (Grogger, 1998; Gould, Weinberg, & Mustard, 2002; Krivo & Peterson, 1996; Raphael & Winter-Ebmer, 2001; Schnepel, 2018; Yang, 2017).

Employment can also provide structure and enhance community bonds (Wilson, 1996). At a community level, research indicates incarceration in a community begets not only more incarceration, but also weakens communities, producing a repeating cycle of economic and social hardship (Clear, 2007; Pattillo, Weiman, & Western, 2004; Western, 2006). A large literature also

studies neighborhood effects by looking at the relationships between community disadvantage and criminal activity (e.g. Glaeser, Sacerdote, & Scheinkman, 1996; Sampson, Raudenbush, & Earls, 1997).

For these reasons, and because education in the US is viewed as one of the primary mechanisms through which individuals can develop skills and improve their employment prospects, skill-building programs are commonplace in prisons and increasing in popularity. One of the most popular programs prepares prisoners to pass the GED exam. Over 10% of the GED test-takers in the US were in correctional centers; this proportion jumps to 22% for Black males (American Council on Education, 2011; Heckman & LaFontaine, 2010). The GED program could improve post-release outcomes by increasing the human capital of those who study for the exam or by serving as a positive signal to employers.

Whether the GED leads to better labor market outcomes depends on how employers value the credential. Though commonly presented as equivalent to a high school degree, completion of a GED does not provide the same benefits in the labor market as a high school diploma (Cameron & Heckman, 1993). In fact, research indicates that the GED has little to no effect on average labor market outcomes among the general population (see Heckman, Humphries, & Mader, 2010 for a review, and Jepsen, Mueser and Troske, 2016).³ However, research also indicates that the GED may have differential returns across groups. Incarcerated adults have relatively low educational attainment and lower performance on literacy and numeracy assessments (Harlow, 2003; Rampey et al., 2016), and the GED is likely to have greater benefit for those with lower initial academic endowments (e.g., Murnane, Willett, & Tyler, 2000; Tyler, Murnane, & Willett, 2000; Tyler,

³ Heckman, Humphries, and Mader (2010) also describe ways that the GED can actually harm recipients because it can induce students to drop out of high school, but this concern is less likely to be relevant to the adult prisoner population taking the GED.

Murnane, & Willett; 2003). Tyler, Murnane, and Willett (2000) provide evidence of higher returns to the GED among White recipients as compared to non-White recipients at the lower academic endowment margins. There is limited evidence, however, that returns to the GED differ by gender or nativity (Clark & Jaeger, 2006; Heckman & LaFontaine, 2006; Tyler, Murnane, & Willett; 2003). Though college-going rates are generally low for GED recipients, Jepsen, Mueser, and Troske (2017) found that GED certification increases postsecondary participation, but not educational attainment.

Research on the labor market returns to a GED among the formerly incarcerated is limited.⁴ Using administrative data from Florida on prisoners released in the late 1990s, Tyler and Kling (2007) found that non-White individuals who participated in a GED program in prison had higher short-term earnings and employment than those who had similar levels of education pre-prison but did not study for the GED exam; they found no corollary positive labor market effects for White individuals or when comparing GED recipients to those who participated in the program but did not pass the exam. Our own analytic approach is similar to that of Tyler and Kling, though we have a much more expansive sample of both treatment and control group individuals over a longer time period, including from the more recent decades where prison education programs have intensified. Like them, we use a fixed-effects model to control for unmeasured stable characteristics that have consistent effects on earnings over time. We also consider two comparison groups, one group of individuals who fail the exam, and another group who do not take it. Our methods differ from theirs in that rather than using a linear regression structure to control for

⁴ Research generally finds a positive relationship between education programs more broadly defined and employment, although causal inference is appropriate in only limited cases (see Davis et al., 2013). Zgoba, Haugebrook, and Jenkins (2008) show that the GED is associated with lower recidivism among 403 formerly incarcerated individuals from New Jersey, but they do not predict the number of post-release arrests. Cho and Tyler (2010) find that adult education targeted to those reading below a ninth-grade level is associated with higher earnings and employment following release.

observed individual characteristics that may be associated with earnings gains, we use detailed exact matching to adjust for differences in characteristics between those receiving the GED and our comparison groups and also match explicitly on pre-incarceration labor market trends. This approach assures that model specification problems do not affect results and allows us to match to a more plausibly comparable control group. Moreover, although our sample is limited to a single state, Missouri, its industrial structure and demographic makeup corresponds quite closely to that of the US as a whole, so our results are likely to be generalizable to other states.

3. Data and Context

We examine the labor market returns to the GED for prisoners released after serving in Missouri. In recent years in Missouri, state prisons cost over \$650 million per year, with a per prisoner cost of about \$20,870 annually; the state spends about \$8 million annually on educational programs in prisons (Missouri Department of Corrections, 2012). We use administrative micro data provided by two state agencies. We begin with a census of all individuals released from a Missouri prison from 1990 to 2013 based on records from the Missouri Department of Corrections (DOC).⁵ The DOC data are structured at the prisoner-stint level, where “stint” is defined as a time in prison with a recorded entry and exit date; 59% of the individuals in our data sample served multiple prison stints.

We merge the prisoner-stint data with quarterly earnings data from the first quarter of 1990 to the second quarter of 2014 based on administrative records maintained by Missouri’s Department of Labor and Industrial Relations. If a prisoner had positive earnings in at least one of the quarters for which we have earnings data, then we considered earnings in other quarters where

⁵ Because our sample includes only released prisoners we cannot analyze how educational programs undertaken in prison relate to release or time served. Our measures do not include time in a local jail, and so omits time spent prior to conviction as well as time served for some lesser crimes.

no earnings were reported to be a quarter of nonemployment with earnings equal to zero.⁶ For each released prisoner, our analysis uses up to 8 quarters of earnings prior to incarceration and up to 20 quarters after release. Our administrative earnings data are from covered jobs as reported by employers in Missouri to the state's Unemployment Insurance program. Therefore, ex-prisoners who do not work, who work only out of state, or who work in jobs not subject to UI reporting requirements in every quarter during the analysis period are not included in our sample. Earnings quarters outside our data window are counted as missing, and they do not contribute to our analysis (units of analysis are prisoner-stint-quarter).⁷ Of the 171,312 prisoners released from prison from 1990-2013 in the state, we have earnings data for 133,058 individuals, and we further restrict our analytic sample to those who entered prison without a high school diploma.⁸ This results in an analytic sample of 108,029 individuals and 147,144 individual-stints. We provide further detail on the sample construction in Appendix A.

Education is one of the prominent rehabilitative services offered by the DOC. Prisoners' educational backgrounds are assessed upon entry, and the DOC mandates that individuals who enter prison without a high school diploma make a "good faith effort" to prepare for the GED exam while incarcerated.⁹ However, while participation in the GED study program is required, actually taking the exam is not. About a third of our sample, or 29,742 prisoners, took the GED exam while in prison, of whom almost 92% ultimately passed. This high passage rate reflects the

⁶ We consider earnings greater than \$50,000 in any quarter to be an error and assign them to be a missing value. Individuals with such values in the window of our analysis are omitted. Fewer than 0.01% of quarterly earnings exceed this threshold.

⁷ Results from a sample including just those who have been released for at least five years are qualitatively similar to the results presented here.

⁸ Our analytic sample excludes 163 individuals who were under the age of 18 or over the age of 65 for our entire observation period (8 quarters prior to entry and 20 quarters after exit).

⁹ Those aged 65 and older, and those who are sentenced to life in prison without parole or sentenced to capital punishment are exempt from this requirement. This requirement was put into place in 1996, which is after the start of our sample period. As a sensitivity check, we analyze a subsample of individuals released in 1997 or later and find qualitatively similar results.

internal practice whereby only those likely to pass the exam were encouraged to take it (typically because they passed a practice exam). As we discuss later, this screen by the DOC results in a sample of arguably similar test-takers, at least related to latent GED test passing ability. Prisoners could retake the GED exam if they failed, though in our records prisoners who took the GED exam multiple times did so during just one stint. Approximately 45% of those in our sample who failed the exam the first time took it again and nearly 90% of those who re-took the exam ultimately passed it.

We report sample summary statistics in Table 1. Compared to the sample of those who did not pass the GED exam (“failers” in column 2), those who earned a GED (column 1) are more likely to be White, less likely to have a prior incarceration, and have higher pre-entry earnings and employment rates; other differences are generally minor. When comparing GED earners to the full sample in column (3), other differences are evident. As might be expected, among the most substantial is that those who did not take the GED are likely to have spent less time in prison.

Figure 1 displays earnings and employment trends for returning individuals who earned the GED while in prison (line with “+” markers) and for all others (line with triangle markers). In Panels A and B, we see generally declining earnings leading up to prison, with the rate of decline increasing about two quarters prior to prison entry. This is mirrored in the employment trends in Panel C. This dip is consistent with the theory that economic hardship leads to increased crime. More generally, since informal or illegal employment are not captured by the state earnings data, it is not surprising that lower formal earnings may indicate or facilitate greater involvement in criminal activities. Finally, for most individuals, there will be a time gap between apprehension for a crime and the beginning of the prison sentence, where factors such as employer responses to arrests, timing related to posting bail, time in a local jail, and legal hearings lead to decreased

employment (Grogger, 1995). Because these two quarters can reflect labor market experiences that are related to incarceration itself, we estimate our main results while dropping the two quarters prior to prison entry.¹⁰ After prison, earnings are generally higher across groups and the trends are mildly downward sloping. We see that earnings for those employed are increasing over time after being incarcerated, whereas employment immediately after release is substantially higher than prior to prison entry but then declines over time to at or below pre-prison levels within a few years. We show corollary graphs for White and Black individuals in Appendix Figure B1, with Black individuals having lower earnings and employment as compared to White individuals, though generally following a similar trend.

We estimate descriptive regressions of labor market outcomes (earnings, natural log of earnings, and employment), Y_{it} , in year-quarter t for each individual i who obtained the GED while in prison as:

$$Y_{it} = \alpha + \gamma Post_{it} + d_i + d_a + d_t + \varepsilon_{it}. \quad (1)$$

$Post$ is equal to zero in the time periods prior to entering prison; this variable switches to one in all time periods after the prisoner is released. The individual-stint fixed effect is d_i . We include quarter/year fixed effects, d_t , to account for macroeconomic variation and other variation over time that is common across all individuals in the sample. Age fixed effects in each time period, d_a , account for common labor market differences across the life cycle. From this equation, γ is the average difference between post- and pre-release earnings for each person who obtained a GED in prison, conditional on covariates.¹¹

¹⁰ Estimates including the two pre-prison quarters lead to similar inference as our base models (available upon request).

¹¹ We use ordinary least squares for all outcomes, including the binary employment outcome. Estimates using logistic models for employment produce similar results (available upon request). Earnings include quarters with no earnings coded as zero. Log Earnings omit quarters with no earnings. Employment is coded one in any quarter in which earnings are positive, zero otherwise. As noted above, any individual with no recorded earnings during our analysis window is

The coefficient γ includes any effect of obtaining the GED, but it is likely biased by other factors associated with time in prison that also have a net effect on outcomes. Insofar as employers use prison record in their hiring, or if skill degradation (declining social or other skills) occurs in prison, the coefficient will be downwardly biased. If, on the other hand, other kinds of services, such as mental health counseling or other rehabilitative services, aid prisoners, the effect may be upwardly biased. In addition, if parole or probation requirements push individuals into the labor market after release, this would also cause an upward bias.

We present results from these estimates in Table 2 to provide descriptive magnitudes to the average earnings of released prisoners post-prison. In the first five years after release quarterly earnings are on average \$403 higher over earnings in the prior two years, a 38% increase over average pre-prison earnings, while the log model implies that earnings (conditional on employment) are 18% higher and employment rates are 10 percentage points higher (about a 27% increase over average pre-prison employment). These positive post-prison trends are consistent with some prior research (Looney & Turner, 2018; Kling, 2006; Nagin & Waldfogel, 1995 [for younger individuals], Tyler & Kling, 2007). If we undertake separate analyses for Black and White individuals (panels B and C), we find that both groups experience post-release increases, but the magnitude of these increases, relative to pre-prison averages, are larger for Black individuals than for White individuals.

4. Empirical Approach

Our main empirical strategy is to estimate a matched comparison group difference-in-differences design with individual fixed effects to compare the within-person post-release labor market outcomes of those who passed the GED with those who did not obtain GED certification.

omitted. Age effects are captured by single year dummies, but because of fewer observations among older workers, we aggregate age fixed effects for those aged 50-55 and >56.

Unlike some recent studies that use exam scores to study the GED exam or other test score-based educational credentials, our context does not support using GED exam scores as a running variable in a regression discontinuity framework (e.g., Clark & Martorell, 2014; Jepsen, Mueser, & Troske, 2016; Jepsen, Mueser, & Troske, 2017). We discuss this issue in Appendix C.

We address the potential bias due to non-GED-related changes experienced in prison by estimating the following model for each individual i in year-quarter t :

$$Y_{it\tau} = \alpha + \sum_{j=-8}^{-4} \delta_1^\tau (GED_i \times \mathbf{1}[\tau = j]) + \sum_{j=1}^{20} \delta_2^\tau (GED_i \times \mathbf{1}[\tau = j]) + d_i + d_a + d_t + d_\tau + \varepsilon_{it\tau}. \quad (2)$$

The analysis includes those who passed the GED and a matched comparison group as described below. GED is equal to one for individuals who obtained GED certification while in prison and zero for those who did not. $\mathbf{1}[\tau = j]$ indicates the period j quarters before or after incarceration.¹² We examine labor market outcomes in the 20 quarters (5 years) after release. We set the omitted base quarter to be $\tau = -3$ (recall that we drop the two quarters immediately preceding prison entry since they may reflect labor market experiences affected by the incarceration). We include fixed effects for individual-stints d_i , calendar quarter and year d_t , age d_a , and quarter relative to incarceration d_τ .¹³ We cluster errors by prisoner-stint.

¹² In addition to our primary analysis that uses an event study framework, we also estimate a two-period (pre- and post-release) difference-in-differences specification of the following form:

$$Y_{it\tau} = \alpha + \delta(Post_{it} \times GED_i) + d_i + d_a + d_t + d_\tau + \varepsilon_{it\tau}.$$

Here, $Post$ is equal to zero in the time periods prior to entering prison; this variable switches to one in all time periods once the prisoner is released. Therefore, the coefficient on the interaction between $Post$ and GED , δ , measures the effect of GED passage on within-person post-release outcomes relative to pre-prison outcomes, as compared to the post-pre within-person outcome differences of the matched comparison group. We present results from the two-period difference-in-differences specification in Appendix E.

¹³ In alternate estimates, we find similar results by analyzing only those who are serving their first prison stint (available upon request).

We test for differences in effects by race, following prior research that finds differential experiences (e.g., Holzer, Raphael, & Stoll, 2006; Pager, 2003; Tyler & Kling, 2007) and differential returns to the GED (Tyler, Murnane, & Willett, 2000). There are only two races with large numbers in our sample, Black and White – other races make up about 1% of the released population in our context (another 1% are identified as a Hispanic or Latino ethnicity). Approximately 90% of the prisoners in the sample are males; we find similar results when examining a sample limited to male prisoners.

These estimates allow us to examine time-varying effects of the GED on earnings and employment, where the elements of the δ_2^t -vector measure the effect of GED passage on within-person post-release outcomes relative to pre-prison outcomes, as compared to the post-pre within-person outcome differences of the matched comparison group. We begin with a comparison group that draws from prisoners who took but did not pass the GED exam. As described earlier, about 92% of individuals who took the GED ultimately passed. This high pass rate is by design, as prisoners are not encouraged to take the exam unless deemed ready by DOC officials. This aids in the comparability of the two groups, with the intuition being that all GED test takers had skill levels observed to be above the bar to pass the GED, implying that actual performance was not likely to be strongly associated with observable characteristics. Under this interpretation, our results based on this comparison group are more likely to reflect signaling effects of the GED rather than human capital accumulation acquired through preparation programs.

While these groups' pre-prison labor market trends appear generally parallel (see Appendix Figure B2), we further match to enhance the comparability of the control group. We exactly match on race, gender, marital status at entry, type of offense (violent/sex offense, or other), incarceration type (shock incarceration, or other), and coarsened categories of sentence length, age at entry, and

average earnings and employment rate 3-4, 5-6, and 7-8 quarters prior to prison entry.¹⁴ We describe the matching procedure in detail in Appendix D. We weight observations by the probability of treatment within the group (p), with treatment observations having a weight of one and control observations having a weight of $p/(1 - p)$.¹⁵ We exclude any prisoner-stints that did not have at least one treatment and one control observation within their group, and further remove observations from cells where the probability of treatment is below the 1st percentile and greater than the 99th percentile. We follow the same procedure for our second comparison group. Here we match those who earned the GED in prison with the full sample of individuals who entered prison without a high school credential (high school diploma or GED) and did not earn the GED credential in prison.

Our approach assumes that the pattern of employment and earnings observed after release for those who do not receive GED certification provides an appropriate counterfactual for those who receive certification, after removing individual fixed effects, controlling for differences in earnings growth by measured characteristics, and controlling for calendar quarter. Bias occurs if the outcomes would have been systematically different, even in the absence of the GED certification. Because we account for time-invariant individual characteristics, match based on observables, provide strong evidence that we satisfy the parallel trends assumptions, and control for common macroeconomic conditions, working age, and time since release, the primary threat in our context are systematic dynamic changes that relate to GED passage but are not caused by the GED and are unaccounted for in our rich data.

¹⁴ We do not have local labor market information, which Heckman, LaLonde and Smith (1999) argue is important in evaluating the effects of training. This is not likely to be a problem in our context, however, since fixed effects capture factors that have the same effects on earnings before and after the stint, and the sample is of those in a single state's prison system. Mueser, Troske and Gorislavsky (2007) show that controls for labor market differences within the state of Missouri do not affect estimates of JTPA training.

¹⁵ This approach weights the comparison group to have the same covariate distribution as the treated group, so that, subject to specified assumptions, our model provides estimates of the effect of the treatment on the treated.

We display descriptive statistics for our matched samples in Table 3. When comparing the matched samples in column 1 to column 2 and column 3 to column 4, the groups are nearly identical based on pre-entry observable characteristics. The match comes at a cost to sample size, as we match about a third of GED passers when matching to the GED failer group, and about two-thirds of GED passers when matching with the broader sample. Relative to the unmatched samples, both matched samples are less likely to be married and less likely to have committed a violent or sex offense. We also note that the matched samples also had low levels of pre-entry employment and earnings relative to the unmatched sample.

While the similarity of observable pre-entry characteristics provides some confidence in the comparability of treatment and control groups, we can also explicitly test whether earnings and employment trends prior to incarceration are different for treatment and control groups by examining parameters in the δ_1^T -vector from equation (2), as discussed in more detail below. As a preview, our tests confirm that our matched treatment and control groups follow nearly identical pre-entry labor market trends. Pre-entry coefficients are close to zero in magnitude and statistically indistinguishable from zero. This confirms that our matching on pre-entry labor market measures is effective, i.e., evidence that our matched groups satisfy parallel trend assumptions.

We examine pre-prison trends graphically in Figure 2 for the two matched groups.¹⁶ Compared to the full sample, pre-incarceration employment and earnings levels are relatively low in the matched samples. Therefore, results from our analysis are most directly relevant to those who had relatively poor labor market experiences prior to prison entry, though we later examine heterogeneity by pre-entry earnings. For both comparison groups, pre-incarceration earnings and employment trends among the treatment and control groups are visually indistinguishable.

¹⁶ Parallel trend graphs for the full sample of (unmatched) GED test takers are available in Appendix Figure B2.

Analogous graphical depictions of earnings and employment trends for White and Black individuals presented in Appendix Figures B3 and B4 show similar trends. In sum, graphical observation and explicit tests of the parallel trends assumption provide strong support for the use of the matched comparison group difference-in-differences research design to yield estimates of the causal effect of the GED on post-prison labor market outcomes.

5. Results

5.1. Estimates of Labor Market Outcomes

We present our main results in Figure 3. We plot coefficients (δ_1^τ and δ_2^τ from equation 2) using circle markers, with the coefficient for the third quarter prior to incarceration set to zero. The dotted lines denote the 95% confidence level for each point estimate. In the analysis that uses the matched GED test taker group (figures in the left column), there is a positive effect of the GED on overall earnings and employment for the first two quarters after release (the magnitude of the increase in the first two quarters is nearly 25% and 19% of the post-release comparison group earnings and employment means, respectively), after which point estimates decline and point estimates are not statistically significantly different from zero for the following 18 quarters. Log earnings effects for the matched GED test taker group (contingent on employment) are essentially zero in all quarters, suggesting that improved overall earnings (as in panel A) are largely driven by increased employment and not higher wages for those employed. For the analysis that uses the more broadly matched group (right column), the point estimates, while declining over time, are positive for nearly the full five years for earnings and employment (panels D and E) and for about two years for log earnings contingent on employment. Relative to the comparison group post-release mean, earnings gains range from a magnitude of 24-29% in the first year after release to about 10% five years after release. Relative to the comparison group post-release employment rate

mean, employment gains range from a magnitude of 15-24% in the first year after release to about 5% five years after release.¹⁷

In summary, across outcomes and samples, we consistently observe positive effects of the GED soon after release that fade over time. One explanation for this declining trend corresponds to research which indicates that the labor market learns about worker productivity over time, so signals of educational credentials are the most valuable soon after receipt (Altonji & Pierret, 2001; Lange, 2007). We would not expect the decline we observe, however, if the GED were an accurate signal of long-run productivity relative to the control group. If employers are not making mistakes, then this suggests that initial productivity benefits dissipate over time. Given that the GED does not appear to improve earnings or employment outcomes for the general population (Heckman, Humphries, & Mader, 2010; Jepsen, Mueser, & Troske, 2016), it may be that temporary gains are specific to the prison setting.

5.2. Robustness to the Inclusion of GED Test Score

It is possible that GED exam score is a measure of unobserved ability and therefore may predict post-release earnings and employment, especially for those with little or no pre-prison labor market history. To test this, we add the term $Post_{it} \times GED_i \times TS_i$ to equation (2), which is an interaction for being post-prison release, passing the GED, and the first score on the GED exam.¹⁸

¹⁷ We present results in Appendix E from a two-period difference-in-differences specification that estimates post-period average effects. As a summary, we do not see a positive earnings effect of obtaining the GED when accounting for the trends of a matched group of GED test failers, as point estimates for earnings, natural log of earnings, and employment are not significantly different than zero. Using the broader matched sample, we see stronger evidence of an effect of the GED on post-release labor market outcomes: quarterly earnings are about 17% higher for GED earners, which is a function of both higher earnings for those employed (8%) and greater employment (effect size of about 10%). Our results by race indicate a positive effect of the GED on labor market outcomes of similar magnitude for White and Black individuals.

¹⁸ We use the first score on the exam since this arguably less subject to gaming, but use of last score yields qualitatively similar results.

To improve power, we constrain the interaction effect to be the same for all quarters. We standardize test score to have a mean of zero and a standard deviation of one.

We present results in Appendix Table B1. Higher test scores predict better labor market outcomes post-prison (about \$134 in earnings and 1.6% in employment). However, when controlling for test scores, the coefficients on the post-release periods are very similar and are statistically indistinguishable from our main results. Therefore, we do not include this term in our primary estimates to preserve our ability to estimate similar specifications across matched comparison groups (we cannot include this control for the sample matched with the broader comparison group since most of these individuals did not take the test), but we do not believe its exclusion substantially biases our results.

5.3. Heterogeneity by Race

We display results for White and Black individuals in Figures 4 and 5. Results are largely consistent with the pooled results. Pre-incarceration trends are similarly small in magnitude and statistically insignificant, indicating that pre-prison labor market trends are unlikely to be biasing our results. Moreover, for members of both races, we generally see the most beneficial effects of the GED soon after release, after which effects decline over time. When matched to the GED failers comparison group, earnings and employment estimates for both Black and White individuals are largest, and generally only statistically different than zero during the first one or two quarters after release.

Nonetheless, the post-release trends for Black returning individuals differ somewhat from those of the White returning individuals. The effect of the GED on earnings fades out more quickly for Black individuals than for White individuals. When matched with the broader group, White individuals' earnings effects are generally positive for five years after release, whereas the earnings

effects for Black individuals are small and generally not statistically different than zero by the end of the second to third year. However, average earnings and employment for Black individuals are lower than for White individuals both prior to and after prison (see Appendix Figure B1). Therefore, even though the effects fade out more quickly, the magnitude of effects in early periods is greater for Black individuals compared to White individuals when considering the average earnings and employment of the groups. Relative to the comparison group post-release mean, the magnitudes of earnings effects for White individuals for the first two time periods (where coefficients are statistically significant) in the sample matched with GED failers are 20-23%, and 11-29% in the sample matched with those who did not take the test. The comparable figures for earnings of Black individuals in the sample matched with GED failers are 27%, and 18-38% for the sample matched with those who did not earn the GED. Employment comparisons show similar patterns.

Our results differ in some important ways from those of Tyler and Kling (2007), whose results imply that a GED earned in prison has labor market benefits for non-White individuals but not for White individuals. Our results suggest that the GED has positive effects for both racial groups, and that there are few statistically consistent differences. The difference in results may reflect various differences in specification—in particular, our use of a modern matching method rather than regression adjustment—or it may result from differences in state contexts or because we have a more expansive sample over a longer time period. In any event, our results are generally not consistent with their general finding of substantial racial differences in the returns to the GED in this context.

5.4. Heterogeneity by Pre-entry Earnings

We next split our sample into two groups based on pre-entry earnings and employment: the first group did not work and thus had earnings equal to zero, while the second group had positive earnings during at least one quarter. We present graphs identifying the effects on earnings by quarter for the two groups in Figure 6 for the sample matched with those not earning the GED (figures for the sample matched with GED failers are available in Appendix Figure B5). Pre-period trends continue to demonstrate evidence that trends were the same prior to prison. The panels (A vs. C and B vs. D) show relatively similar trends for the two groups, but with slightly higher earnings and employment effects that take longer to fade out among those not attached to the labor force prior to entry. The higher or equivalent earnings and employment gains for those with no employment is notable as these results suggest that the GED is particularly helpful for individuals who had poor labor market experiences prior to entering prison.

5.5. Heterogeneity by Release Type

We next explore the possibility that post-release supports affect post-release labor market outcomes. There are two main ways incarcerated adults can be released: a discharge, which comes at the end of the full term served by the prisoner, and parole, which is a release from prison prior to the full sentence term being served. Over 80% of our analytic sample are released on parole, with about 10% released on a full discharge.¹⁹ A notable feature of parole is that released prisoners are typically subject to conditions, which can include requirements for regular meetings with officers or counselors, and may require that they seek employment. Moreover, in the Missouri context, prisoners who are released on parole can also take advantage of publicly funded reentry

¹⁹ The remaining released prisoners are released on other programs, including probation. The latter can occur either due to so-called “split sentences,” where the original sentence includes both a term in prison and a probationary period, or a “shock treatment,” where an individual is first sentenced to probation without incarceration, but then serves some prison time due to a probation violation and is subsequently released back to probation.

services, including job assistance (e.g., resume and interview preparation), counseling, housing supports, and other community resources. Those who are discharged cannot access these state funded supports. While we do not have data on the length of parole in our sample, parole is typically up to two years in our context.

To explore differentials in outcomes among those with different post-release supports, we restrict our sample to those either discharged or released on and parole (together over 90% of our sample) and estimate the following:

$$\begin{aligned}
Y_{it\tau} = & \alpha + \sum_{j=-8}^{-4} \theta_1^\tau (GED_i \times \mathbf{1}[\tau = j]) + \sum_{j=1}^{20} \theta_2^\tau (GED_i \times \mathbf{1}[\tau = j]) \\
& + \sum_{j=-8}^{-4} \gamma_1^\tau (GED_i \times \mathbf{1}[\tau = j] \times Parole) + \sum_{j=1}^{20} \gamma_2^\tau (GED_i \times \mathbf{1}[\tau = j] \times Parole) \\
& + \sum_{j=-8}^{-4} \Gamma_1^\tau (\mathbf{1}[\tau = j] \times Parole) + \sum_{j=1}^{20} \Gamma_2^\tau (\mathbf{1}[\tau = j] \times Parole) \\
& + d_i + d_a + d_t + d_\tau + \varepsilon_{it\tau}. \tag{3}
\end{aligned}$$

Here, *Parole* is an indicator equal to one if the prisoner was released on parole and zero if discharged. In this specification, the θ_2^τ -vector includes estimates of the GED effect for discharged individuals. Elements in the γ_2^τ -vector measure the marginal difference in the pre-post within-person effect of GED passage among those released on parole (compared to the matched group of those *released on parole but who did not obtain a GED*), relative to the pre-post within-person effect of GED passage among those discharged (compared to the matched group of those *discharged but who did not obtain a GED*).²⁰ In this way, we mitigate bias that might arise from potential unobserved differences that relate to being released on parole versus being discharged,

²⁰ The “total” effect of the GED among parolees would be the sum of elements in the θ_2^τ and γ_2^τ vectors.

since we compare GED passers who were paroled to matched paroled individuals and GED passers who were discharged to matched discharged individuals, and then compare the relative effects. The remainder of the specification is the same as described for equation (2).

We display results for the marginal difference in the per-period post-release effect of the GED on those who were paroled versus discharged in Figure 7 for the sample matched with those who did not earn the GED (figures for the sample matched with GED failers are available in Appendix Figure B6). Earnings effects are substantively greater for those on parole (panel A) throughout the period, suggesting that the interaction of the GED and post-release supports can have a persistent positive effect on labor market outcomes.²¹ This earnings differential appears to be largely driven by higher employment rather than higher earnings among those who are working (panels B and C), though these effects are not always precisely estimated.

6. Discussion

This study situates itself in a policy context where educational programs have become one of the more popular approaches to help prisoners develop skills and improve their future employment and economic prospects. These personal improvements are expected to facilitate reconnection to communities and reduce reliance on public social supports. Comments by two former U.S. Secretaries of Education illustrate this policy emphasis. Former Secretary John King (2016) stated, “Providing [prisoners] with opportunity, advancement, and rehabilitation is not only the right thing to do, it also positions our country to remain economically competitive in a global economy...High-quality correctional education has become one of the most effective crime-prevention tools at our disposal.” Similarly, former Secretary Arne Duncan (as quoted in Berman, 2015) remarked on the hundreds of thousands of prisoners released “like a tidal wave” back into

²¹ Results also indicate that earnings are higher among parolees who do not earn a GED, as compared to discharged individuals who did not earn a GED. This is captured in the vector Γ_2^T .

society every year: “And they’re either going to be released and go back to the streets and go back to a life of crime and go back to being a menace to society, or they’re going to be released with some real skills...Do we really want to arm them with skills and a chance to be productive citizens who are going to be taxpayers, or do we just want to perpetuate a system where the costs are mind-blowing?”

Over 20% of incarcerated adults participate in a formal degree or certificate program and 70% signal interest in partaking in educational opportunities (King, 2016).²² Because of the relatively low level of educational attainment among prisoners, a key emphasis is secondary education, which in recent history typically meant training incarcerated individuals to pass the GED exam.²³ This focus on the GED conflicts with the broader literature that finds generally no or modest effects of the GED on labor market outcomes (e.g., Heckman, Humphries, & Mader, 2010; Jepsen, Mueser, & Troske, 2016).

We use large-scale systematically recorded data that has not been previously commonly available and find that the prison GED can have positive short-term benefits to formerly incarcerated individuals as they return to the labor market for both earnings and employment, which is consistent with evidence that the GED has more promise for those with lower academic endowments, as is true for the prison population (e.g., Murnane, Willett, & Tyler, 2000; Tyler, Murnane, & Willett, 2000). In the correctional context, it may be that the GED presents a positive signal of accomplishment and rehabilitation, as opposed to a negative signal of high school drop out in the broader population.

²² Back of the envelope calculations suggest that this means that each year about 300,000—500,000 incarcerated adults participate in a prison education program, which is about equivalent to the annual number of college students in states like Wisconsin, Missouri, or Massachusetts.

²³ In recent years, some states have moved emphasis away from the GED to other tests measuring high school equivalency, like the HiSET or TASC.

Positive effects are greatest soon after prison release and decrease over time. This may reflect the value of educational credentials being highest before employers are able to learn about the productivity of workers, or it could reflect a temporary increment to productivity. The benefits are largely similar for White and Black individuals, though the results for returning Black workers fade out more quickly. Our results also indicate that the GED is particularly helpful for those who had poor labor market experiences prior to entering prison and for those who had access to post-release support and structure. These promising but modest effects need to be weighed against the cost of implementing these programs. To comprehensively compare the costs and benefits of prison education, however, more research is needed to understand educational program effects on future crime and recidivism, and on other benefits to a GED program that are not captured in labor market outcomes, for example, regulation of behavior in prison or improvements in cognitive development.

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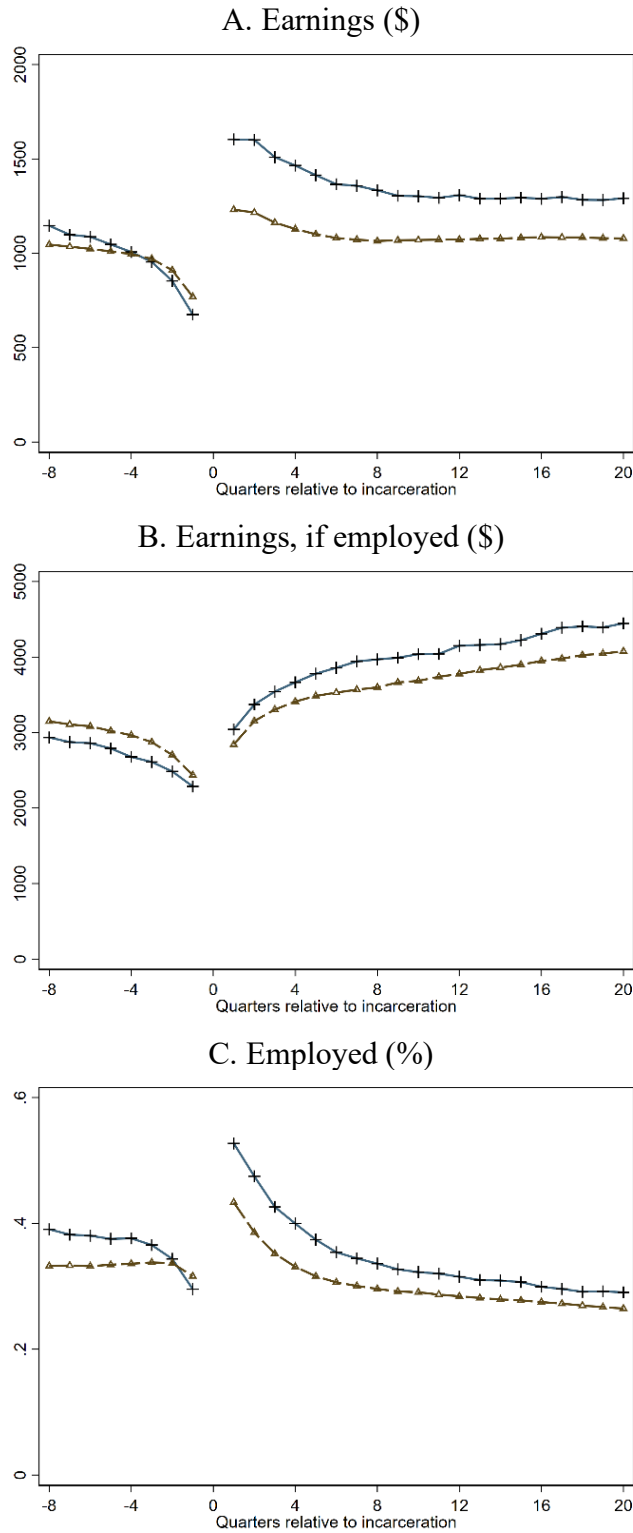
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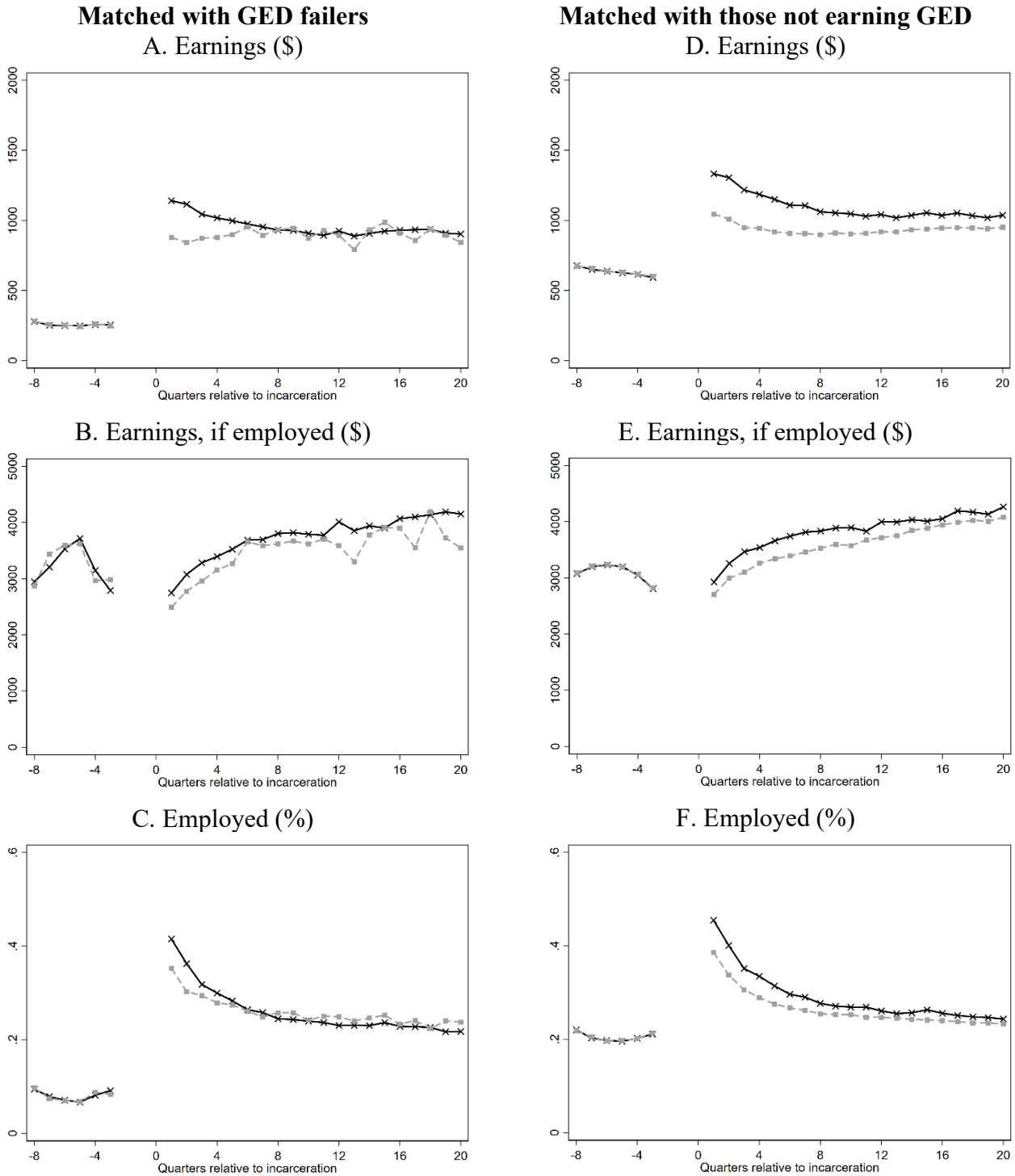
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Figure 1: Quarterly Earnings and Employment Trends



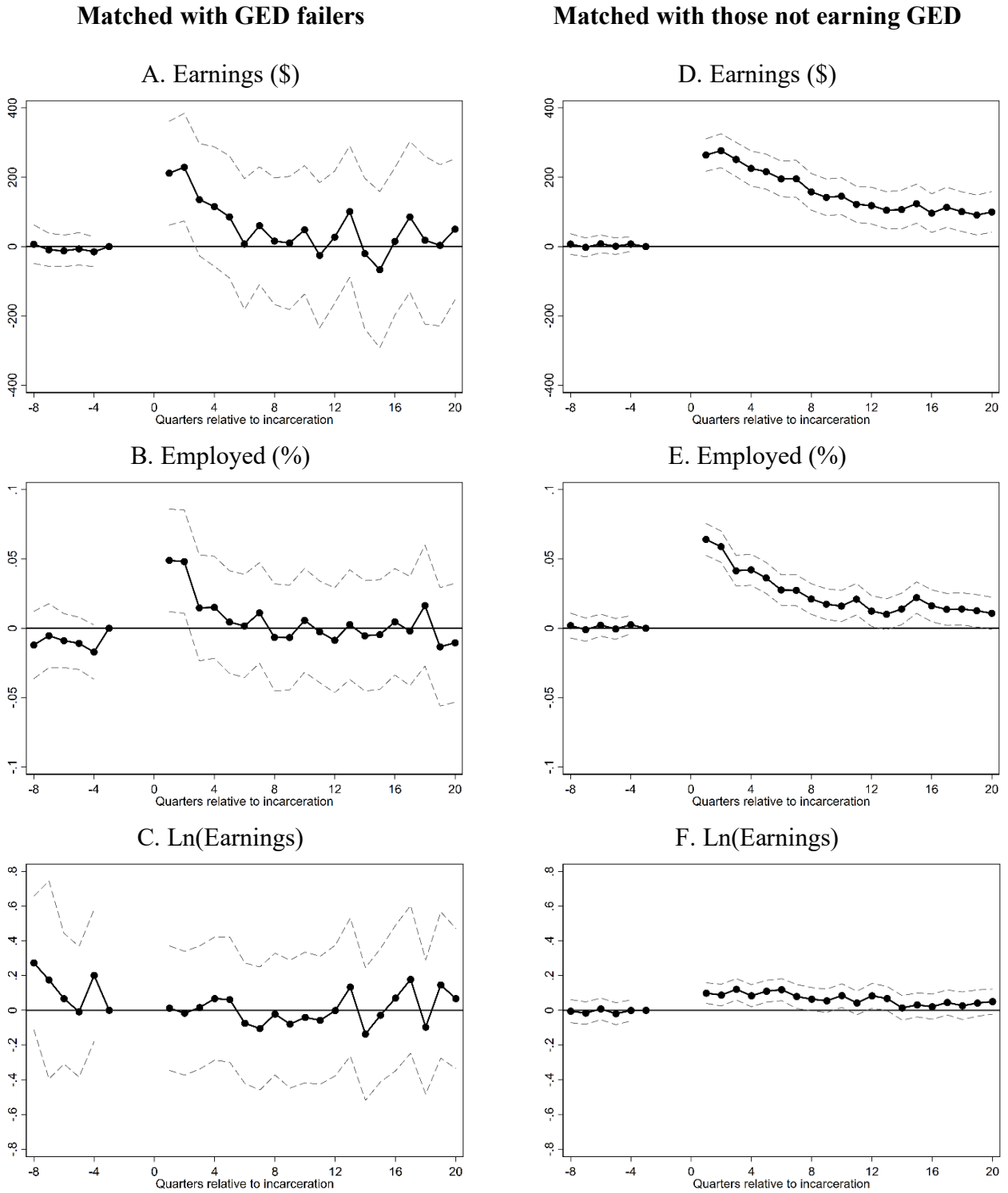
Source: Administrative data from Missouri. Notes: The line with plus (+) markers is the trend of those who earned a GED in prison and the line with triangle markers is the trend of those who did not earn a GED in prison. All earnings in constant 2014 dollars. Sample is limited to those without a high school credential on entry.

Figure 2: Quarterly Earnings and Employment Trends, GED Recipients and Comparison Groups



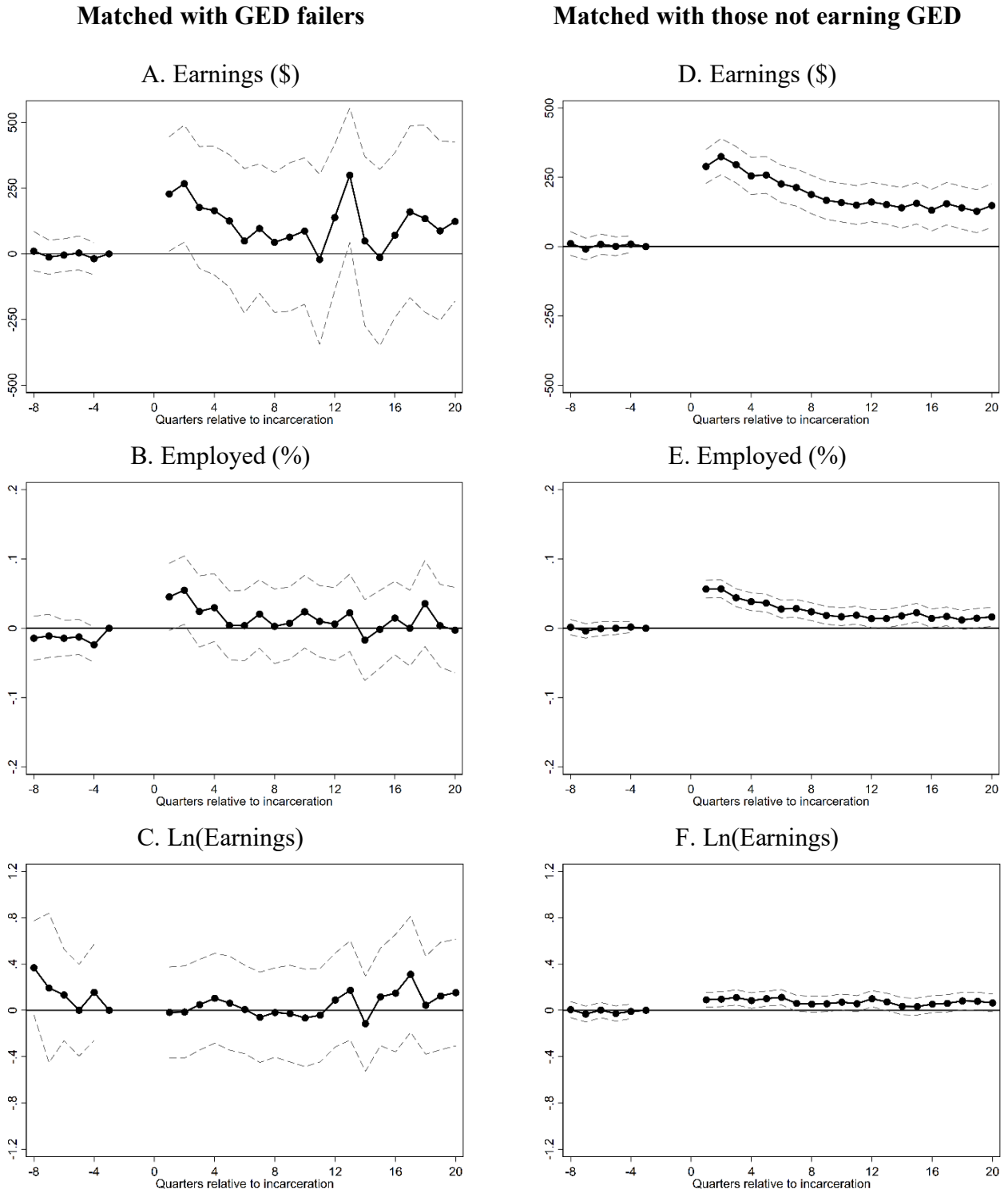
Source: Administrative data from Missouri. Notes: Solid line with X markers report the mean for individuals who earned a GED in prison, while the dashed line with square markers report the mean for matched persons who took the GED exam in prison but did not pass, or the mean for matched persons from the sample of the formerly incarcerated who entered prison without a high school credential and did not earn the GED in prison. All earnings in constant 2014 dollars.

Figure 3: Effect of GED on Quarterly Earnings and Employment



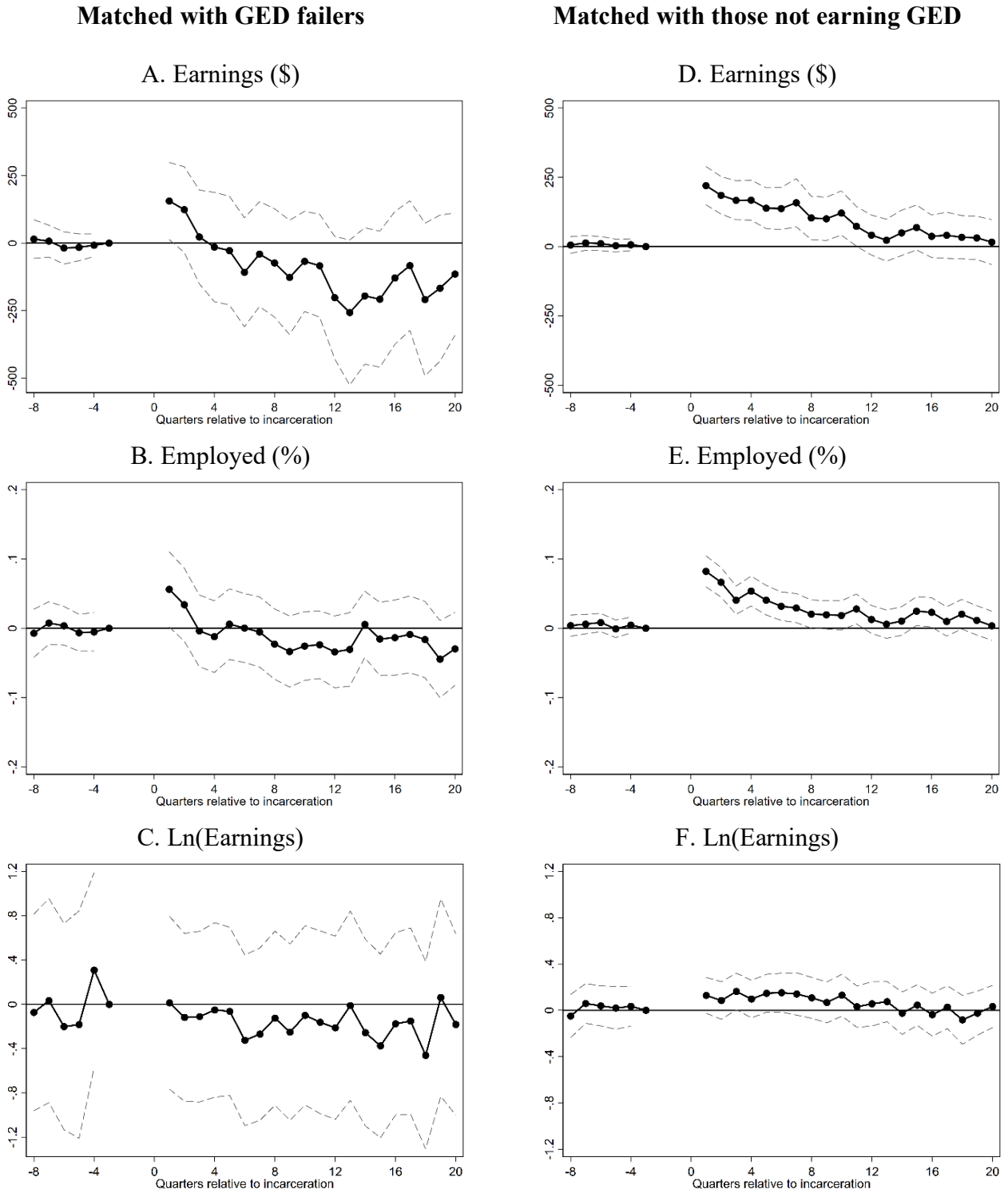
Source: Administrative data from Missouri. Notes: Marker reports the point estimate for the effect of passing the GED exam for each quarter, grey dashed lines are the 95% confidence interval.

Figure 4: Effect of GED on Quarterly Earnings and Employment, White Individuals



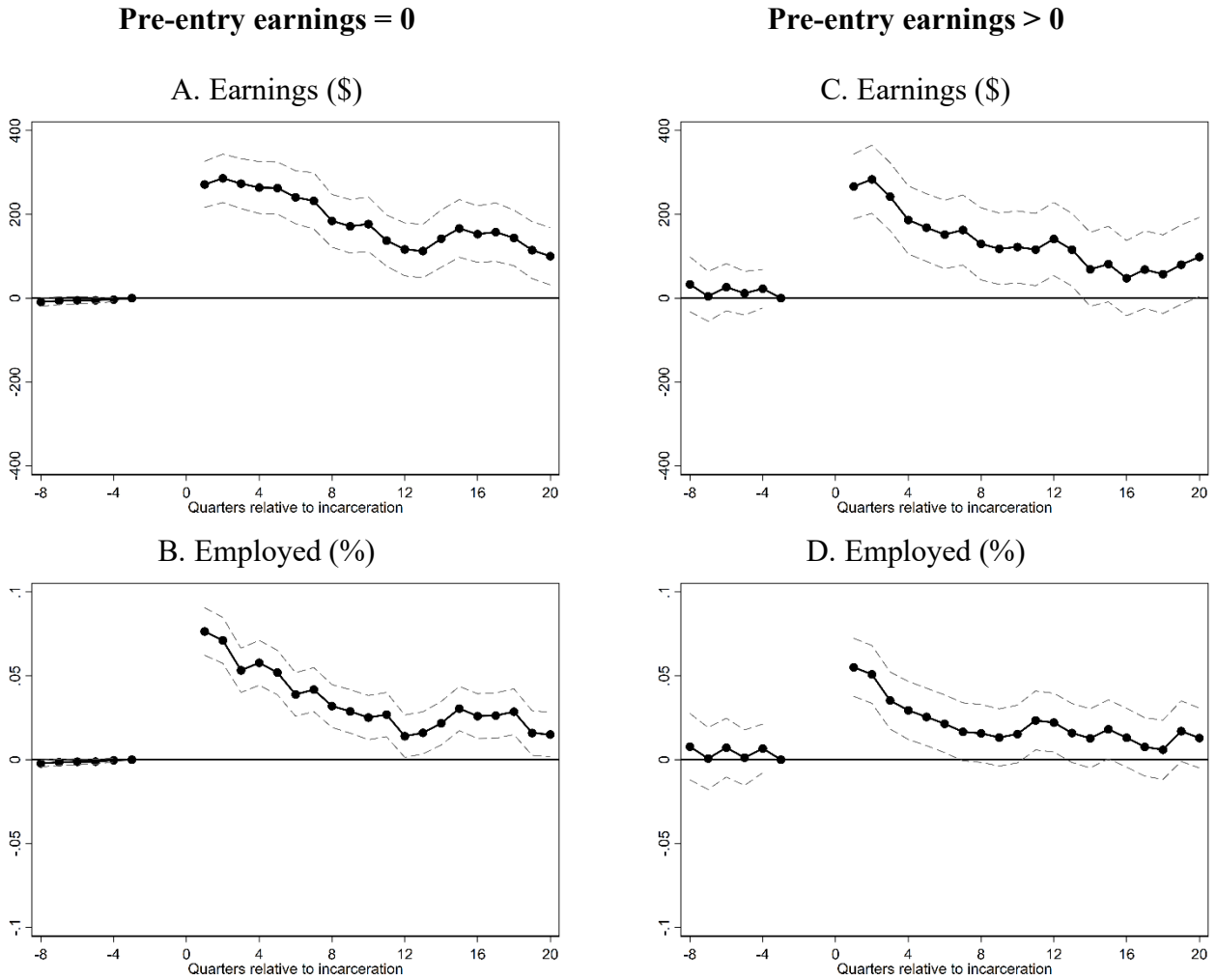
Source: Administrative data from Missouri. Notes: Marker reports the point estimate for the effect of passing the GED exam for each quarter, grey dashed lines are the 95% confidence interval.

Figure 5: Effect of GED on Quarterly Earnings and Employment, Black Individuals



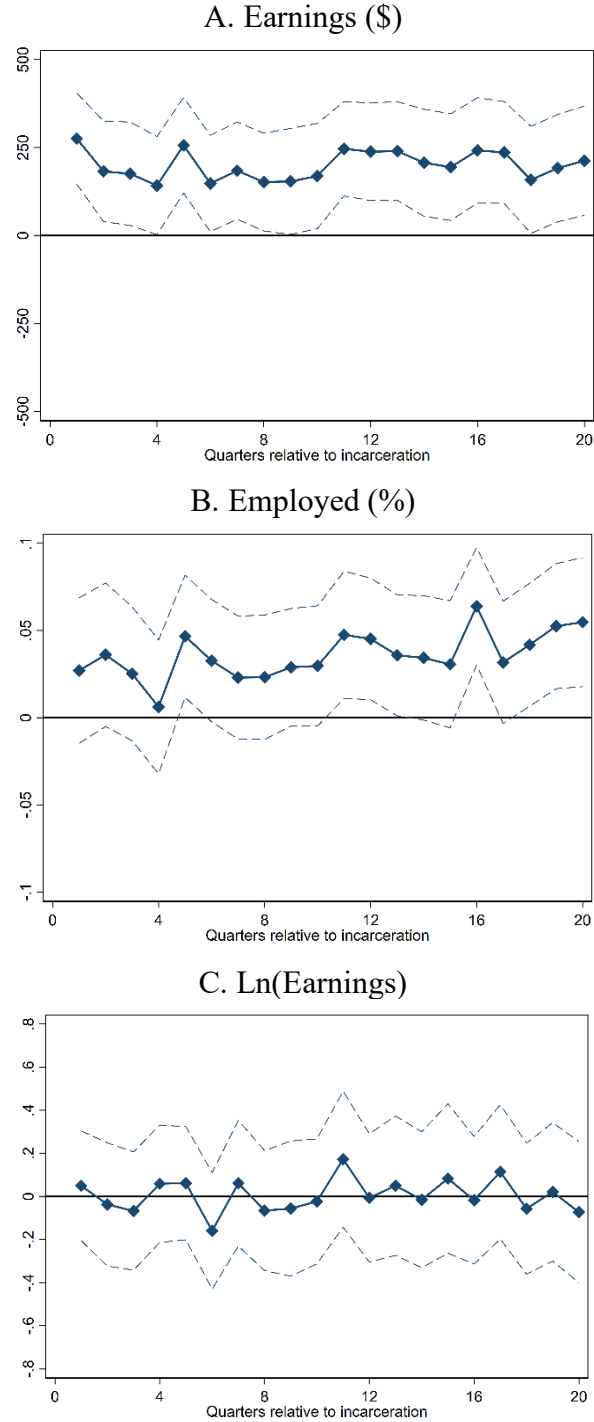
Source: Administrative data from Missouri. Notes: Marker reports the point estimate for the effect of passing the GED exam for each quarter, grey dashed lines are the 95% confidence interval.

Figure 6: Effect of GED on Quarterly Earnings and Employment, By Pre-entry Earnings



Source: Administrative data from Missouri. Notes: Matched sample is GED earners matched with those not earning the GED. Marker reports the point estimate for passing the GED exam for each quarter, grey dashed lines are the 95% confidence interval.

Figure 7: Differences Between Parole and Regular Discharges in Effects of GED on Quarterly Earnings and Employment, Matched with Those Not Earning GED



Source: Administrative data from Missouri. Notes: Matched sample is GED earners matched with those not earning the GED. Markers report differences in the GED policy effect per post-release period for those released on parole as compared to those released on a regular discharge. The 95% confidence interval are the dashed lines.

Table 1: Sample Summary Statistics

	Passed GED†	Failers: Did not pass GED††	Did not earn GED
	(1)	(2)	(3)
Age at entry	27.9 (8.2)	29.9 (8.7)	31.1 (9.2)
Age at exit	30.8 (8.6)	32.7 (9.1)	32.6 (9.5)
Race: White	0.71	0.48	0.59
Race: Black	0.28	0.51	0.40
Race: Other	0.01	0.01	0.01
Gender: Male	0.90	0.88	0.85
Married at entry	0.19	0.19	0.20
Prior incarceration	0.46	0.56	0.44
Offense type: Violent/Sex	0.30	0.28	0.19
Sentence length in years	6.2 (4.1)	6.3 (4.4)	5.0 (3.4)
Short-term shock incarceration	0.05	0.05	0.09
Earnings, pre-entry (\$)	960 (1868)	731 (1653)	900 (1912)
Employment rate, pre-entry	0.38	0.30	0.34
Prisoner-stints (unweighted)	27,348	2,394	117,402

Source: Administrative data from Missouri.

† Obtained GED certification during stint.

†† Took GED test but failed to obtain GED certification during stint.

Notes: Sample is restricted to prisoners who did not have a high school credential upon prison entry. Average pre-entry earnings and employment are for the six quarters from three to eight quarters prior to incarceration. Standard deviations for continuous variables are in parentheses. Observations are unweighted prisoner-stints.

Table 2: Estimates of Post-Release Changes in Quarterly Earnings and Employment, GED recipients

	Earnings	Ln(Earnings)	Employed
	(1)	(2)	(3)
A. All Races/Ethnicities			
Post-release	403**	0.181**	0.103**
	(12)	(0.011)	(0.002)
Pre-release mean	1054	1400	0.378
Observations	629,319	224,339	629,319
B. White Individuals			
Post-release	449**	0.183**	0.113**
	(15)	(0.013)	(0.003)
Pre-release mean	1205	1556	0.400
Observations	449,396	166,119	449,396
C. Black Individuals			
Post-release	340**	0.206**	0.121**
	(18)	(0.025)	(0.005)
Pre-release mean	637	968	0.317
Observations	176,012	56,848	176,012

Source: Administrative data from Missouri. Notes: Observations are prisoner-stint-quarters, limited to prisoners without a high school credential on entry. Each coefficient is from a separate regression. Standard errors are in parentheses. All earnings in constant 2014 dollars. All models control for year and quarter, age, and individual fixed effects. These estimates exclude earnings, log earnings, and employment rates for the two periods immediately prior to entering prison. The pre-release mean reported for natural log earnings are the anti-log of the average pre-release log earnings (i.e., the geometric mean).

** p < 0.01, * p < 0.05

Table 3: Matched Samples Summary Statistics

	GED passers matched with GED failers		GED Passers matched with all individuals not earning GED	
	Passed GED	Did not pass GED	Passed GED	Did not earn GED
	(1)	(2)	(3)	(4)
Age at entry	28.3 (8.6)	28.6 (9.1)	30.0 (8.9)	30.3 (9.3)
Age at exit	30.7 (8.8)	30.7 (9.3)	32.1 (9.2)	31.7 (9.5)
Race: White	0.67	0.67	0.65	0.65
Race: Black	0.33	0.33	0.35	0.35
Race: Other	0.00	0.00	0.00	0.00
Gender: Male	0.93	0.93	0.89	0.89
Married at entry	0.12	0.12	0.15	0.15
Prior incarceration	0.54	0.54	0.52	0.52
Violent/Sex offense type	0.21	0.21	0.16	0.16
Sentence length in years	5.6 (3.2)	5.5 (3.1)	5.2 (2.9)	4.9 (2.9)
Shock incarceration	0.02	0.02	0.05	0.05
Earnings, pre-entry (\$)	222 (1340)	223 (1323)	584 (1824)	588 (1831)
Employment, pre-entry	0.08	0.08	0.21	0.21
Prisoner-stints (unweighted)	8,681	1,220	18,496	64,619

Source: Administrative data from Missouri. Notes: Standard deviations for continuous variables include in parentheses. Observations are prisoner-stints. Sample is limited to stints where the prisoner did not have a high school credential on entry.

Appendix A: Sample Construction

Table A1 provides information on our analysis sample. A total of 171,312 individuals were released from Missouri prisons in 1990-2013. An individual could have served in prison multiple times, with each “stint” defined as a time in prison with a recorded entry and exit date. Of this population, 24,240 individuals did not have a unique identifier that allowed us to link the Missouri Department of Corrections data to earnings records from the Missouri Department of Labor and Industrial Relations. We further dropped 13,851 individuals who did not have a single earnings record in 1990-2014 and 163 individuals who were under the age of 18 or over the age of 65 for our entire observation period (8 quarters prior to entry and 20 quarters after exit). After restricting to prisoners who had a recorded educational assessment on entry and who did not have at least a high school credential (high school diploma or GED), the resultant analytical sample includes 108,029 individuals and 147,144 individual-stints. Of this sample, 29,742 individuals took the GED. Although we observe individuals taking the GED multiple times within the same stint, individuals in our data only take the GED during one stint; thus, the number of stints and individuals for whom we have GED scores both equal 29,742.

Table A1: Sample Construction

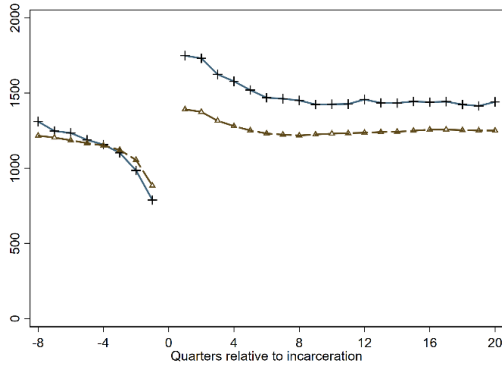
	Prisoners	Prisoner-Stints
	(1)	(2)
All prisoners released from 1990-2013 in MO	171,312	370,195
Records with SSN	147,072	344,375
Records that link to wage data	133,221	320,501
Records that meet age requirements	133,058	320,173
Prisoners without a HS credential upon entry	108,029	147,144
Took GED	29,742	29,742

Appendix B: Supplementary Tables Figures

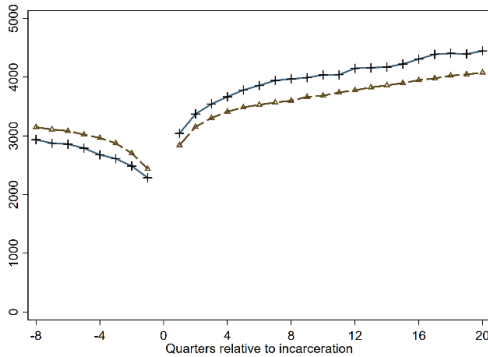
Appendix Figure B1: Quarterly Earnings and Employment Trends, By Race

White Individuals

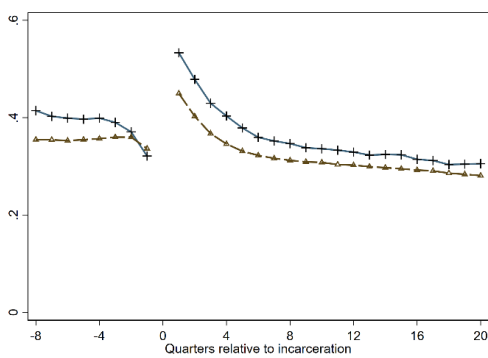
A. Earnings (\$)



B. Earnings, if employed (\$)

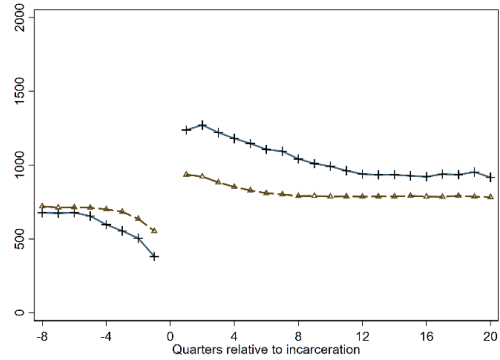


C. Employed (%)

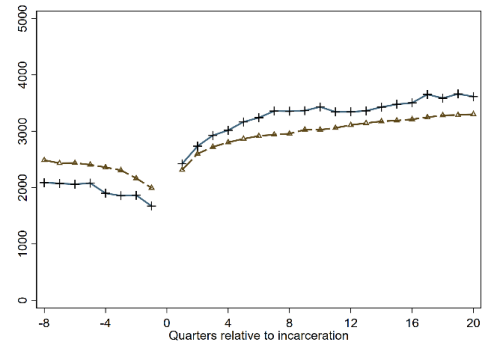


Black Individuals

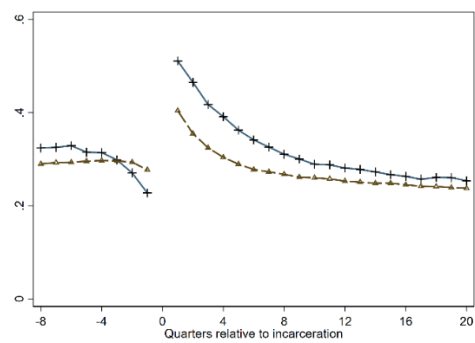
D. Earnings (\$)



E. Earnings, if employed (\$)

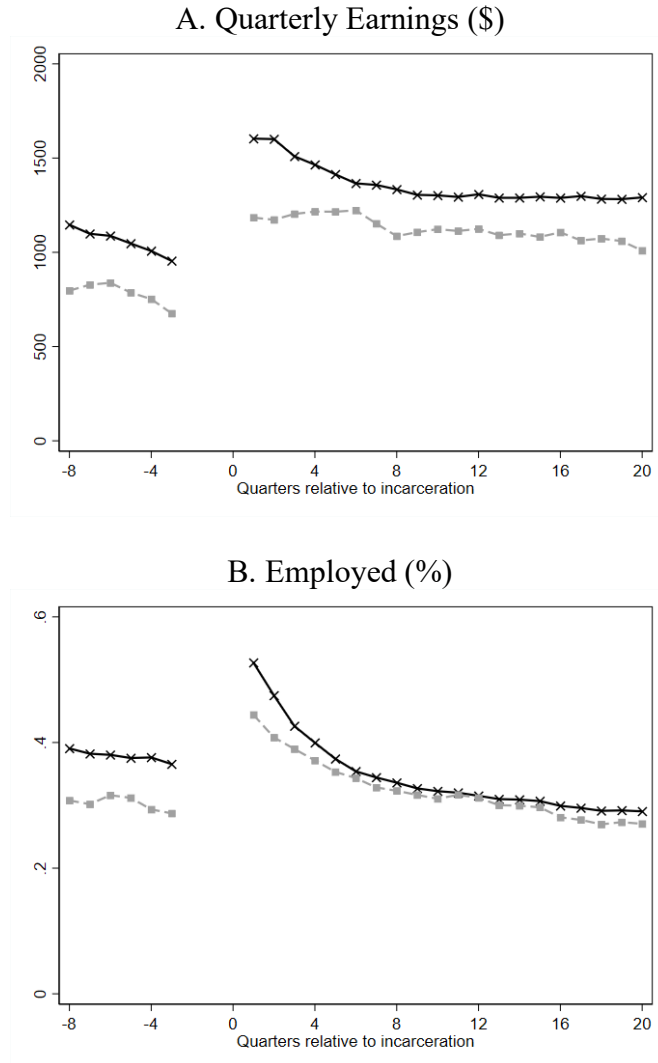


F. Employed (%)



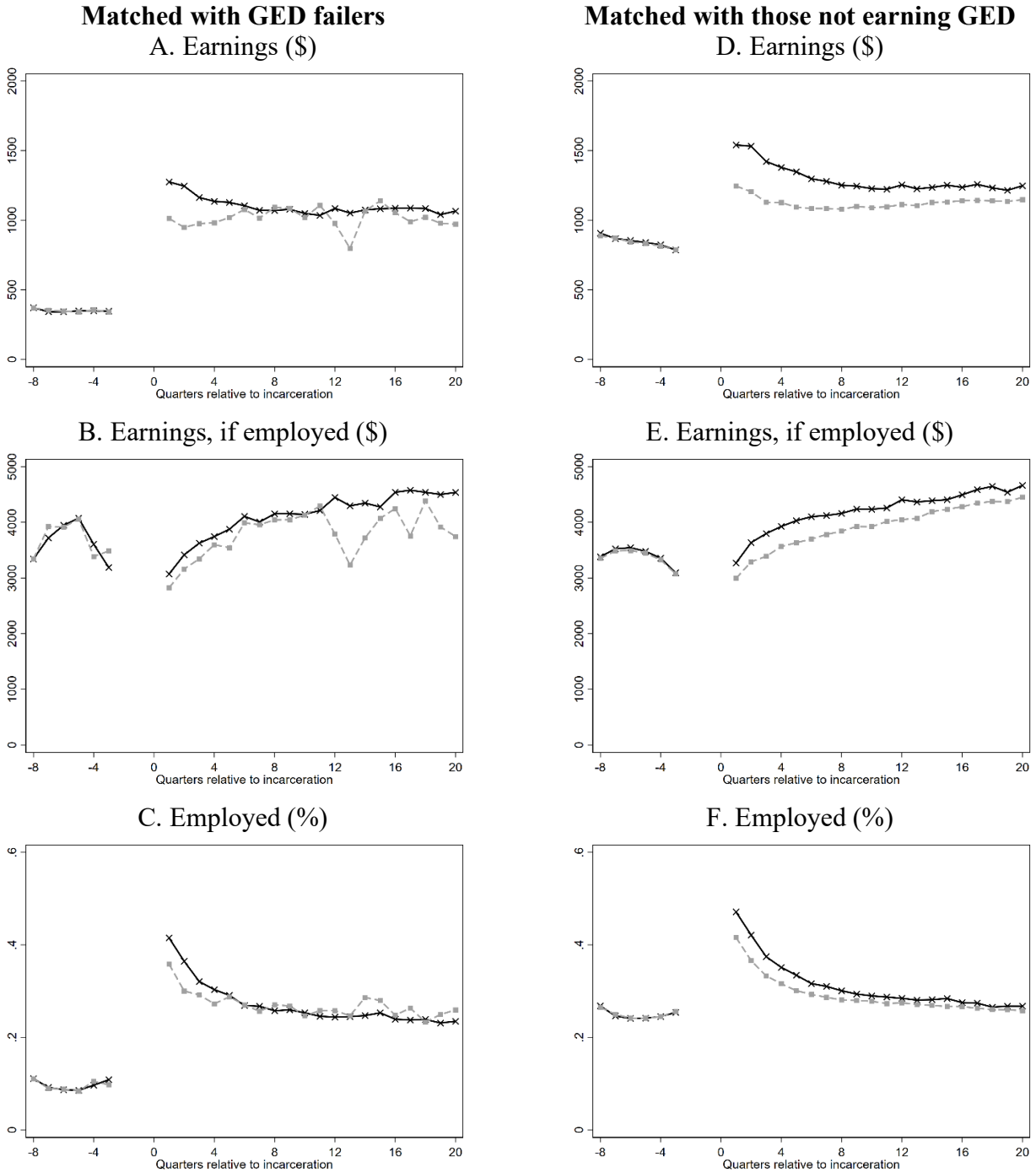
Source: Administrative data from Missouri. Notes: The line with plus (+) markers reports the mean for those who earned a GED in prison and the line with triangle markers reports the mean for those who did not earn a GED in prison. All earnings in constant 2014 dollars. Sample is limited to stints where the prisoner did not have a high school credential on entry.

Appendix Figure B2: Earnings and Employment Trends – GED Test Takers



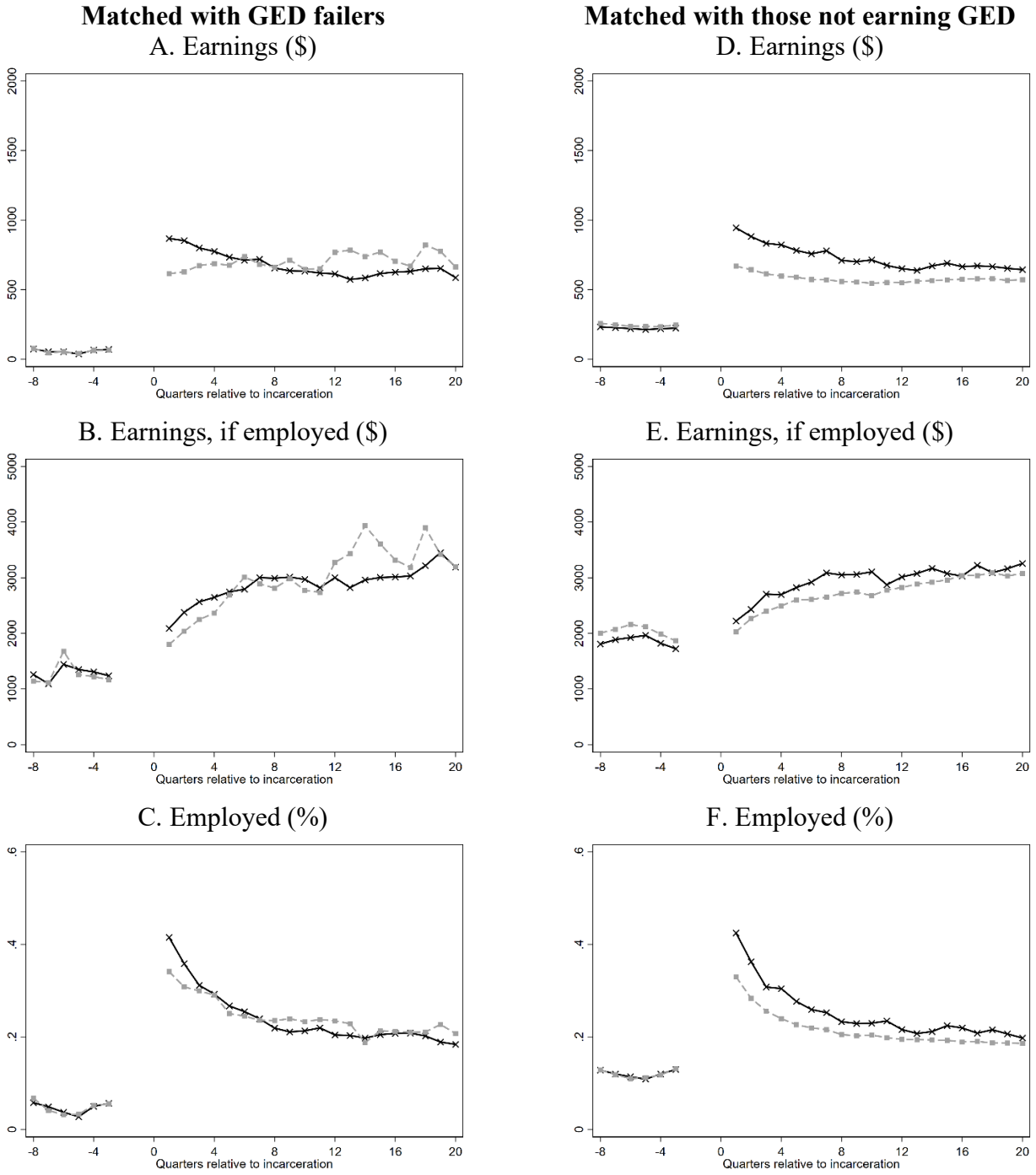
Source: Administrative data from Missouri. Notes: Solid line with X markers is the trend of individuals who earned the GED while in prison, while the dashed line with square markers is the trend of those who took the GED exam while in prison but did not pass. All earnings in constant 2014 dollars.

Appendix Figure B3: Quarterly Earnings and Employment Trends, GED recipients and Comparison Groups, White Individuals



Source: Administrative data from Missouri. Notes: Solid line with X markers is the trend of individuals who earned the GED in prison, while the dashed line with circle markers is the trend of matched persons who took the GED exam while in prison but did not pass or the trend of matched persons from the sample of those not earning the GED. All earnings in constant 2014 dollars.

Appendix Figure B4: Quarterly Earnings and Employment Trends, GED Recipients and Comparison Groups, Black Individuals



Source: Administrative data from Missouri. Notes: Solid line with X markers is the trend of individuals who earned the GED in prison, while the dashed line with circle markers is the trend of matched persons who took the GED exam while in prison but did not pass (panels A and B) or the trend of matched persons from the full sample of those who did not earn a GED. All earnings in constant 2014 dollars.

Appendix Figure B5: Effect of GED on Quarterly Earnings and Employment, By Pre-entry Earnings, Matched with GED Failers



Source: Administrative data from Missouri. Notes: Matched sample is GED earners matched with all GED failers. Marker is the point estimate for each quarter, grey dashed lines are the 95% confidence interval.

Appendix Figure B6: Differences Between Parole and Regular Discharges in Effects of GED on Quarterly Earnings and Employment, Matched with GED Failers



Source: Administrative data from Missouri. Notes: Matched sample is GED earners matched with GED failers. Markers are differences in the policy effect per post-release period for those released on parole as compared to those released on a regular discharge. The 95% confidence interval are the dashed lines.

Appendix Table B1: Test Score Adjusted Results

	Earnings				Employed			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Post X GED X Test Score			134**	32			0.016**	0.005
GED X P1	212**	76	190*	76	0.049**	0.019	0.046*	0.019
GED X P2	229**	79	207**	79	0.048*	0.019	0.046*	0.019
GED X P3	136	83	114	83	0.015	0.020	0.012	0.020
GED X P4	115	88	94	88	0.015	0.019	0.013	0.019
GED X P5	86	90	64	90	0.005	0.019	0.002	0.019
GED X P6	7	96	-15	96	0.002	0.019	-0.001	0.019
GED X P7	60	87	38	87	0.011	0.019	0.009	0.019
GED X P8	16	93	-6	93	-0.007	0.020	-0.009	0.020
GED X P9	10	98	-12	98	-0.007	0.019	-0.009	0.019
GED X P10	48	95	26	94	0.006	0.019	0.003	0.019
GED X P11	-25	107	-48	107	-0.003	0.019	-0.005	0.019
GED X P12	27	97	5	97	-0.009	0.019	-0.011	0.019
GED X P13	101	97	79	97	0.003	0.020	0.000	0.020
GED X P14	-20	111	-43	111	-0.005	0.020	-0.008	0.020
GED X P15	-67	115	-89	115	-0.005	0.020	-0.007	0.020
GED X P16	15	108	-8	108	0.005	0.020	0.002	0.020
GED X P17	86	111	63	111	-0.002	0.020	-0.005	0.020
GED X P18	18	124	-4	123	0.016	0.022	0.014	0.022
GED X P19	3	119	-19	119	-0.013	0.022	-0.016	0.022
GED X P20	50	104	27	104	-0.011	0.022	-0.013	0.022

Source: Administrative data from Missouri. Notes: Columns 1 and 5 are parameter estimates from equation (2) in the text, corresponding to Figure 3, with standard errors in the column to the right of each coefficient in columns 2 and 6. Columns 3-4 and 7-8 show parameter estimates and standard errors for estimates of equation (3) from the main text. GED = passed the GED exam, P1...P20 are indicators for post-release periods 1-20, Post = post-prison release, Test Score = first recorded score on the GED exam. All earnings in constant 2014 dollars. All models control for calendar year/quarter, period relative to incarceration, age, and individual-stint fixed effects. Parameter estimates for pre-prison entry periods interacted with GED passage are not shown.

** p < 0.01, * p < 0.05

Appendix C: Regression Discontinuity

Conceptually, we could use the score on the GED exam as a forcing variable in a regression discontinuity (RD) framework. The identifying assumption is that those just over and just under the GED passage threshold are as good as randomly distributed, thereby allowing inference about local treatment effects akin to a randomized experiment. There is an important consideration in using an RD framework with GED test scores in this setting. Most test takers who fail the exam take it again. In our data, nearly half of those who failed the exam retake it, and this proportion rises as scores approach the threshold (see Appendix Table C1). Therefore, while test takers' "final" scores (i.e., the score that incorporates the most recent GED exam taken) most clearly identify those who obtain GED certification, the use of final score leads to a discontinuity in test scores density, implying manipulation of the final test score and possible violation of the assumptions of the RD design. To address this issue, we could follow Jepsen, Mueser, and Troske (2016, 2017) and instead use the score for the first GED test of each test taker.

Since those with scores below the cutoff on the first test may ultimately obtain GED certification, a fuzzy RD structure is more appropriate than the sharp RD in this context.²⁴ An impediment arises, however, with the use of the first test score. About 60-80% of test takers with GED scores just under the passing threshold ultimately pass the GED exam with subsequent retakes (see Appendix Figure C1). As a result, from the first stage of a fuzzy RD design, the coefficient on the indicator for having a first test score above the threshold is in the range of 0.2 and contains appreciable estimation error. Said another way, first test scores above the threshold

²⁴ Another consideration is that although an aggregate score of 2250 is necessary to pass the exam, test takers need to also pass each of five subtests with a minimum score of at least 410 (this threshold was 400 prior to 2002). Thus, there are some test takers with scores greater than 2250 who do not receive GED certification because they did not pass all subtests. In our sample, this happens relatively infrequently, accounting for about 5% of exam scores.

are not especially predictive of ultimately passing the exam. Empirically, this results in estimates in the second stage of the fuzzy RD being unreasonably large and unstable.

Perhaps equally important, our analyses suggest that basic assumptions required for an RD may be violated. Appendix Table C2 provides a simple regression predicting six predetermined measures as a function of the first test score listed on our file, allowing for a discontinuity at the GED passing threshold. Results show that all predetermined measures display a statistically significant discontinuity. For example, those just above the GED threshold were nearly half a year older than those just below the threshold.

This finding may be related to the fact that some prisoners may have taken GED tests prior to entering prison, so the first score on our file will not be the first test taken. Whatever the source of the observed discontinuities, it opens up the possibility that the RD estimates may be biased. Estimates based on the RD assume that there are no differences (other than the likelihood of GED certification) that change discontinuously across the threshold. Discontinuities in preexisting characteristics suggest that there may be factors that would bias estimates of the effects of the GED based on the RD. In summary, an RD design was not appropriate in this setting.

Appendix Table C1: Distribution of Test Scores

First Score Range	Count	Retake	Ever Passed Rate
1500-1649	82	49%	33%
1650-1799	119	52%	36%
1800-1949	279	44%	35%
1950-2099	814	60%	47%
2100-2249	2279	77%	71%
2250-2399	5206	14%	96%
2400-2549	6412	4%	98%
2550-2699	5409	1%	100%
2700-2849	3633	1%	100%
2850-2999	2252	0%	100%
>3000	2270	0%	100%

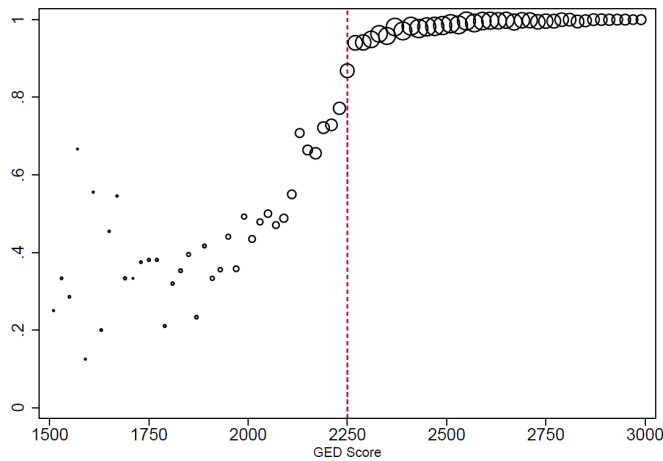
Source: Administrative data from Missouri.

Appendix Table C2: Discontinuity Estimate at GED Test Passing Threshold for Predetermined Measures

	Dependent Variable	Threshold Discontinuity	SE
(1)	African American	0.006**	(0.002)
(2)	Female	-0.005**	(0.001)
(3)	Age of entry	-0.506**	(0.036)
(4)	Age of exit	-0.625**	(0.038)
(5)	Sentence (years)	-1.815**	(0.288)
(6)	Average quarterly prior earnings	-18.360*	(8.176)

Source: Administrative data from Missouri. Notes: Estimates are on a sample of all those who took the GED. Dependent variable = $f(\text{first score} > 2250, \text{Distance from threshold}, \text{Distance from threshold} \times \text{first score} > 2250)$ Each coefficient is from a separate regression. Bandwidth is +/- 500 points. Sample drops those who are listed as being released on probation or other terms (less than 10% of the sample). ** $p < 0.01$, * $p < 0.05$

Appendix Figure C1: Passage by First Test Score



Notes: Bins are 30 points. Markers are the share of total test takers with first test scores in the bin that pass the GED exam. Marker size is proportional to the number of test takers in the bin. Source: Administrative data from Missouri.

Appendix D: Matching and Weighting Procedure

1. Matching

We perform exact matches on the following categories, with all factors measured at the time of prison entry. In other words, each individual who obtained a GED is matched to individuals who were in the same cell based on all the variables listed below.

Categorical variables

- Race; White, Black, Other/Unknown
- Gender: Male, Female
- Marital status at entry: Married, Not Married
- Had a prior stint in prison: Yes, No
- Offense type: Violent/Sex, Non-violent/Non-sex
- Incarceration type: Short-term shock treatment, Not short-term shock treatment

Continuous variables

We create mutually exclusive categories for each of the following.

- Age at entry: 18-20, 21-24, 25-39, 30-34, 35-39, ≥ 40
- Sentence length years (SL): $SL < 1$, $1 < SL \leq 5$, $5 < SL \leq 10$, $SL > 10$, SL missing

Pre-incarceration labor market experiences

We average the following variables in two quarter blocks (7-8 quarters prior to incarceration, 5-6 quarters prior, 3-4 quarters prior), and create mutually exclusive categories for each block.

- Employment rate (ER): $ER = 0.0$, $0.0 < ER \leq 0.5$, $0.5 < ER \leq 1.0$, ER missing
- Mean Earnings \$ (W): $\$ = 0$, $0 < W \leq 250$, $250 < W \leq 1000$, $1000 < W \leq 3000$, $3000 < W \leq 5000$, $W \geq 5000$, W missing

Employment rate and earnings are missing when the date of earnings is outside our observation window. Where no earnings record is observed within our window, employment and earnings are set to zero.

2. Cells

Within each cell j , we calculate the proportion of individuals who earned a GED in prison, p , as the number of individuals who earned the GED divided by the total number of individuals in the

$$\text{cell: } p_j = \frac{\#GED_j}{N_j}$$

3. Exclusions

We exclude individuals in the following cells:

- All members passed the GED
- No members passed the GED
- $p_j < 1\text{st percentile}$ or $p_j > 99^{\text{th}}$ percentile of the non-0, non-1 distribution of p_j

4. Weights

We assign the following weights:

- Treatment group (GED earnings): 1
- Control group (did not earn a GED): $p_i / (1 - p_i)$

Appendix E: Two-Period Difference-in-Differences Estimates of GED Effects on Quarterly Earnings and Employment

In addition to our primary analysis that uses an event study framework, we also fit a two-period difference-in-differences model of the following form:

$$Y_{it\tau} = \alpha + \delta(Post_{it} \times GED_i) + d_i + d_a + d_t + d_\tau + \varepsilon_{it\tau}.$$

Here, *Post* is equal to zero in the time periods prior to entering prison; this variable switches to one in all time periods after the prisoner is released. Therefore, the coefficient on the interaction between *Post* and *GED*, δ , measures the effect of GED passage on within-person post-release outcomes relative to pre-prison outcomes, as compared to the post-pre within-person outcome differences of the matched comparison group.

We present the main results from our difference-in-differences estimates using our two matched samples, corresponding to the specification above, in Appendix Table E1. Here we do not see a positive earnings effect of obtaining the GED when accounting for the trends of a matched group of GED test failers, as point estimates for earnings, natural log of earnings, and employment are not significantly different than zero (panel A). From Figure 2, we see that both GED exam passers and failers experience post-release increases in earnings and earnings, but the increase among GED exam passers is not different than the increase among GED exam failers.

In panel B we display results for the matched sample of those not earning the GED. Here we see stronger evidence of an effect of the GED on post-release labor market outcomes. Quarterly earnings are \$163 higher for GED earners (an effect of about 17% of the comparison group post-release mean), which is a function of both higher earnings for those employed (8.0%) and greater employment (2.6 percentage points, which equates to an effect size of about 10%).

We split the sample between Black and White individuals and display results in Appendix Table E2. Consistent with our main results, we do not see a precisely estimated difference in

earnings when using the sample of matched GED test takers. Results from the broader matched group in panel B indicate positive effects of the GED earned in prison for both White and Black individuals. Earnings, log earnings, and employment effects are \$198 (an effect size of 18%), nearly 9%, and 2.8 percentage points (effect size of 10%), respectively for White individuals and \$98 (effect size of 17%), close to 7% (not statistically significant), and 2.7 percentage points (effect size of 12%) for Black individuals. Taken together, these results confirm our main conclusions, that is, implying a positive effect of the GED on labor market outcomes, with generally similar magnitudes for White and Black individuals.

Appendix Table E1: Estimates of GED Effects on Quarterly Earnings and Employment

	Earnings	Ln Earnings	Employed
	(1)	(2)	(3)
A. Matched with GED failers			
GED*Post-Release	77	-0.119	0.018
	(73)	(0.112)	(0.012)
Comparison group post-release mean	895	1844	0.264
Observations	221,027	48,991	221,027
B. Matched with those not earning GED			
GED*Post-Release	163**	0.080**	0.026**
	(21)	(0.018)	(0.004)
Comparison group post-release mean	937	1942	0.266
Observations	1,981,766	508,099	1,981,766

Source: Administrative data from Missouri. Notes: Standard errors are in parentheses. All earnings in constant 2014 dollars. All models control for calendar year/quarter, period relative to incarceration, age, and individual-stint fixed effects. Observations are prisoner-stint-quarter. The comparison group post-release mean reported for natural log earnings are the anti-log of the average comparison group post-release log earnings (i.e., the geometric mean).

** p < 0.01, * p < 0.05

Appendix Table E2: Estimates of GED Effects on Quarterly Earnings and Employment, By Race

	White			Black		
	Earnings	Ln Earnings	Employed	Earnings	Ln Earnings	Employed
	(1)	(2)	(3)	(4)	(5)	(6)
A. Matched with GED failers						
GED*Post-Release	132	-0.106	0.031	-69	-0.144	-0.006
	(106)	(0.132)	(0.017)	(81)	(0.170)	(0.016)
Comparison group post-release mean	1015	2165	0.275	698	1376	0.247
Observations	146,976	34,113	146,976	73,973	14,859	73,973
B. Matched with those not earning GED						
GED*Post-Release	198**	0.088**	0.028**	98**	0.067	0.027**
	(28)	(0.019)	(0.004)	(28)	(0.044)	(0.007)
Comparison group post-release mean	1126	2231	0.293	580	1516	0.217
Observations	1,290,837	369,722	1,290,837	687,422	137,725	687,422

Source: Administrative data from Missouri. Notes: Standard errors are in parentheses. All earnings in constant 2014 dollars. All models control for calendar year/quarter, period relative to incarceration, age, and individual-stint fixed effects. Observations are prisoner-stint-quarter. The comparison group post-release mean reported for natural log earnings are the anti-log of the average comparison group post-release log earnings (i.e., the geometric mean).

** p < 0.01, * p < 0.05