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# Employment Trajectories among Individuals with Opioid Use Disorder: Can Evidence-Based Treatment Improve Outcomes?

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**Abstract:**

Using administrative records of Medicaid enrollees in Rhode Island that link their health-care information with their payroll employment records, this paper produces new stylized facts concerning the association between opioid use disorder (OUD) and employment and inquires as to whether treatment with FDA-approved medications might boost the job-finding rates of OUD patients. We find that individuals diagnosed with OUD are less likely to be employed compared with other Medicaid enrollees, that their employment tends to be more intermittent, and that they face increased job-separation risk following their initial diagnosis. In addition, commencing treatment with buprenorphine is associated with an increased job-finding rate among nonemployed OUD patients, while commencing methadone treatment is not associated with any significant change in job-finding rates. The job-separation rate and job-finding rate results are based on Cox proportional hazard regressions that control for numerous potential confounding factors. The paper discusses a variety of causal and noncausal explanations for these results in addition to their potential policy implications.

**JEL Classifications:** J21, J24, I18, I12

**Keywords:** Opioid use disorder, employment, job-finding rate, buprenorphine, methadone, Medicaid, Rhode Island

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## 1. Motivation

The nation's long-standing crisis of opioid abuse intensified during the COVID-19 pandemic, with opioid-related deaths rising to nearly 81,000 in 2021, an increase of more than 60 percent from just two years earlier (see Figure 1).[1] Also during the pandemic, the labor force participation rate in the United States fell precipitously, and as of September 2022 it remained depressed by more than a full percentage point relative to its February 2020 level despite record numbers of job openings in 2021 and 2022.[2] Citing labor shortages, a growing number of companies have recently eliminated workplace drug testing.[3] The unfortunate confluence of labor scarcity and record-setting opioid mortality highlights the need to better understand the relationship between opioid use and employment and prompts the question of whether effective medications for opioid use disorder (OUD), which have been shown to save lives, might also help to bolster the employment prospects of OUD patients and reduce the economic burden of OUD on society.

If increased rates of OUD are, in fact, holding back growth in labor force participation and/or employment,[4] the consequences could include added fiscal burdens at both the state and federal levels in the form of lower payroll taxes and increased reliance on public assistance programs.[5]

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[1] The 2021 figure for opioid-related deaths is a provisional estimate from the Centers for Disease Control and Prevention (CDC). See National Center for Health Statistics (2022) and Kaiser Family Foundation (2022).

[2] See "Job Openings and Quits Reach Record Highs in 2021, Layoffs and Discharges Fall to Record Lows," Bureau of Labor Statistics *Monthly Labor Review*, June 2022, https://www.bls.gov/opub/mlr/2022/article/job-openings-and-quits-reach-record-highs-in-2021.htm; and "Employment Situation Summary: The Employment Situation–September 2022," Bureau of Labor Statistics Economic News Release. October 7, 2022, https://www.bls.gov/news.release/empsit.nr0.htm.

[3] See Megan McCluskey, "Amid a Labor Shortage, Companies Are Eliminating Drug Tests. It's a Trend that Could Create More Equitable Workplaces" *Time*, October 20, 2021, https://time.com/6103798/workplace-drug-testing/.

[4] The economic evidence on this question is not conclusive to date. Both Krueger (2017) and Greenwood, Guner, and Kopecky (2022) find that labor force participation has been negatively associated with opioid use, but the association was not necessarily causal in either case. Currie et al. (2018) find that opioid prescribing exhibited a positive (if small) association with the employment rate for women and had no significant association among men.

[5] One estimate, which uses assumptions about the impact of OUD on labor force participation from Krueger (2017), finds that from 2000 to 2016, such adverse labor market outcomes cost state governments $11.8 billion and the

Lost productivity from OUD is a related concern.[6] The Centers for Disease Control and Prevention (CDC) estimated the total economic cost of the U.S. opioid epidemic in 2017 at $1.02 trillion, of which productivity costs represented one of the largest three components (Luo, Li, and Florence 2021).

Using administrative records of Medicaid enrollees in Rhode Island that link their health-care information with their payroll employment records and other individual data sources, this paper produces new stylized facts concerning the association between OUD and employment and inquires as to whether treatment with FDA-approved medications boosts the job-finding rates of OUD patients. We find that individuals diagnosed with OUD are less likely to be employed compared with other Medicaid enrollees and that their employment tends to be more intermittent. Among those observed both before and after receiving an OUD diagnosis, the chance of being employed is significantly lower in the period after the first diagnosis date, and among the employed, the risk of job separation is significantly higher after diagnosis. These results suggest that disordered opioid use may itself lower the chances of staying employed, as the analysis controls for fixed confounding factors. However, it could also happen that an individual experiences an adverse event—such as a major physical injury, the death of a loved one, or a divorce—which leads to their becoming both dependent on opioids and unable to hold down a job.

federal government $26.0 billion. Separately, Sullivan (2018) describes the substantial fiscal costs to New England states associated with OUD.

[6] Henke et al. (2020) find that employees with OUD exhibited lower productivity on the job and imposed higher health-care costs on their employers compared with workers without OUD. The same study finds that employees taking medications to treat OUD imposed less of an economic burden on their employers compared with employees with OUD who were not receiving medications.

Our analysis also reveals that OUD patients who received medications for their condition (either buprenorphine or methadone) are more likely to have been employed (as of 2018) and had higher earnings on average (in 2018) than OUD patients who never received such medications. In addition to that cross-sectional evidence, longitudinal analysis shows that commencing treatment with buprenorphine is associated with an increased job-finding rate among nonemployed OUD sufferers. However, the potential benefits of buprenorphine for job-finding rates appear to be concentrated in the period shortly after someone first starts taking the medication, suggesting at least two possibilities. First, the improvement in functioning that follows the initial phase of treatment may be more dramatic than the marginal benefit of merely continuing medication at later dates, as a patient's health condition may reach a low point just before commencing treatment and subsequently stabilize as treatment continues. Alternatively, unobserved confounding factors may also peak during the initial phase of treatment, such as an individual's motivation to return to work and/or the extent of extra support they receive in the form of vocational training and other referrals.

The associations between methadone and job-finding rates are more nuanced. On average, among all eventual methadone recipients, starting methadone treatment is not associated with any significant increase in the job-finding rate. However, when we restrict the analysis to the group that eventually received both medications, a positive (although not statistically significant) association emerges between starting methadone and becoming reemployed. The contrasting results for buprenorphine versus methadone in relation to job-finding rates suggest that there may be underlying differences between buprenorphine recipients and methadone recipients in their capacity to experience employment-related benefits from taking medications for opioid use disorder (MOUD). On average, patients treated with methadone tend to have more severe

disorders than those treated with buprenorphine and may also face other employment barriers. In addition, some past research suggests that entering into methadone treatment may be less compatible with employment than buprenorphine treatment, as in most cases methadone must be administered in person on a daily basis at a specialty treatment facility (Richardson et al. 2012).

Finally, a preliminary analysis of earnings data shows that the earnings of OUD patients increased more for those who initiated either methadone or buprenorphine and then became reemployed as compared with those who resumed employment before having initiated either medication. These results suggest that taking medications for OUD may help boost earnings, but more work needs to be done to rule out other explanations.

Individuals with OUD often face multiple hurdles to becoming employed (see, for example, Morgenstern et al. 2003, Ware et al. 2021), and our results indicate that receiving medications alone may be insufficient to guarantee employment. Past research suggests that intensive case management may be an important complement to medication-assisted treatment for OUD among patients seeking to obtain (or maintain) employment (see, for example, Siegal et al. 1996). Given resource constraints, policies and programs seeking to help OUD patients find and/or retain jobs should be targeted to those who are most likely to benefit from such policies. In addition, more work could be done to help employers facilitate treatment and support patients in recovery, as workplace interventions have been shown to be effective toward those goals (Holtyn et al. 2021). The Americans with Disabilities Act (ADA) requires that employers provide reasonable accommodation for individuals with OUD, such as offering work schedules that don't conflict with treatment schedules. Adherence to such guidelines is likely to be incomplete, even though employers stand to lower their health-care bills and minimize productivity losses (Henke et al.

2020) by helping patients to stay on their medications.[7] Employees may be reluctant to discuss such accommodations with employers owing to the ongoing stigma against people with OUD and against receiving medications for OUD (National Academies of Sciences, Engineering, and Medicine 2019). More optimistically, recent policy innovations give states the option to expand permissions for take-home doses of methadone and to deploy mobile OUD treatment vans, options that should reduce the potential incompatibility between receiving treatment for OUD and becoming or staying employed.[8]

Rhode Island represents an appropriate context within which to study the relationships between opioid use, employment, and treatment. In 2020 the state's age-adjusted opioid-related mortality rate was the 10th highest in the United States, according to data from the Centers for Disease Control and Prevention (CDC).[9] Like the United States as a whole, the state saw a resurgence in opioid-related mortality in 2020 after experiencing a brief period of relatively stable death rates (see Figure 1). Rhode Island has been a pioneer in tackling the opioid crisis, instituting a variety of policies aimed at expanding access to medications and complementary therapies for OUD. For example, the state was the first to offer streamlined authorization for medical students to

[7] The US Equal Employment Opportunity Commission (EEOC) in 2020 released technical assistance documents on how employers might help retain workers with histories of opioid abuse. The documents act as a guide for types of reasonable accommodations guaranteed by the Americans with Disabilities Act (ADA) for employees with OUD. The documents similarly provide information to medical professionals on how best to advocate for reasonable accommodations for their patients. See US Equal Employment Opportunity Commission, "EEOC Releases Technical Assistance Documents on Opioid Addiction and Employment" August 5, 2020. https://www.eeoc.gov/newsroom/eeoc-releases-technical-assistance-documents-opioid-addiction-and-employment

[8] See Fred Trapassi, "Suboxone Not the Only Answer, Methadone Still a Needed Option," *Providence Journal*, August 27, 2022. https://www.providencejournal.com/story/opinion/columns/2022/08/27/suboxone-methadone-both-tools-answer-opioid-epidemic-harm-reduction/10318057002/

[9] When this report was written, the 2021 state-level numbers for the country were not available, but the national rate and the Rhode Island rate, which were available, had climbed to record highs.

prescribe buprenorphine and recently became first in the nation to deploy a mobile methadone van to serve neighborhoods lacking a specialty treatment facility.

The Rhode Island Data Ecosystem employed in our analysis is the only administrative data set we are aware of that links employment records with information from medical claims. Ours is accordingly the first study to use individual panel data to study the relationships of interest. Although the linked records are available only for Medicaid enrollees, the state's Medicaid population in 2018 accounted for nearly 62 percent of its total opioid-related deaths (See Table 1). Because the data capture a population with elevated rates of OUD along with below-average employment rates, the population represents a suitable group for identifying potential opportunities to improve health and economic outcomes alike.

The remainder of the paper is organized as follows. Section 2 discusses the related literature on the relationships between OUD, its treatment, and employment-related outcomes. Section 3 discusses relevant federal and state policies adjacent to these issues. Section 4 provides scientific background information related to OUD and the medications used to treat it. Section 5 describes the data and methods employed in the quantitative analysis. Section 6 describes results, including a descriptive analysis of employment patterns in relation to OUD status, descriptive analysis of employment outcomes (including earnings trajectories) in relation to receiving medications for OUD, and multivariate regression analysis of job-separation rates and job-finding rates among OUD patients in relation to the timing of diagnosis, medication status, and other factors. Section 7 offers a discussion of the results and their potential policy implications.

## 2. Related literature

The health benefits of treating OUD with either methadone or buprenorphine have been documented extensively in scientific research publications, as discussed in Section 3 below.[10] In contrast, relatively little is known about the relationship between OUD, its treatment, and employment. Given the widely documented adverse effects of disordered opioid use on the user's physical and mental health, it seems plausible or even likely that disordered use would impair job performance, resulting in job loss and/or an inability to find work once unemployed. Indeed, a study by Henke et al. (2020) finds that employees with OUD have exhibited increased rates of health-related absences and lower productivity on the job. Such workers also have imposed higher health-care costs on their employers compared with workers without OUD.

Concerning the implications of OUD for aggregate labor market outcomes, two recent papers estimate county-level associations between opioid prescribing—found to be a key driver of increased incidence of OUD in recent decades—and employment indicators, but their findings somewhat disagree with each other. Krueger (2017) finds that labor force participation has declined more in geographic areas that had relatively large increases in prescribing opioid pain medications, inferring that increased opioid dependence could have accounted for as much as 20 percent of the observed decline in male labor force participation from the 1999– 2001 period to the 2014–2016 period. On the other hand, Currie et al. (2018) find that opioid prescribing has exhibited a positive (if small) association with the employment rate for women, perhaps because better pain management allowed some women to work who otherwise would have left the labor

[10] See, for example, Connery (2015) for a review of existing research. In addition to its benefits for individual OUD patients, medications for OUD have been found to offer broader benefits to public health, such as reductions in HIV- and hepatitis C–risk behaviors as well as reductions in criminal behavior (Evans et al. 2019). Observational studies from Massachusetts (Larochelle et al. 2018) and Vermont (Mohlman et al. 2016) find, respectively, that treatment including medications is associated with lower risk of fatal opioid overdose and lower health-care expenditures.

force. The same paper observes no association between county-level opioid prescribing rates and employment rates among men. In related research, Greenwood, Guner, and Kopecky (2022) find that the labor force participation rate was 13 percentage points lower (for the 2015–2018 period) among prime-age individuals with a diagnosed substance use disorder (not limited to OUD) compared with similar-aged people without such a diagnosis; based on that association, the authors estimate that increased substance abuse during the first 16 months of the pandemic could have explained 9 to 26 percent of the decline in prime-age labor force participation over that time period.

However, a negative association between OUD and employment status might reflect factors other than the direct adverse effects of disordered opioid use. The populations that exhibit elevated rates of substance use disorders also tend to face a variety of other barriers to stable employment, including higher rates of housing instability, domestic violence, lower education levels, past or present criminal activity, and decreased access to reliable transportation (Morgenstern et al. 2003, Ware et al. 2021). Despite legal protections from employer discrimination against individuals with substance use disorders, stigmatization of individuals with OUD may, in practice, restrain the hiring and/or retention of such individuals, as evidenced by lawsuits against employers for violations of the relevant ADA rules.[11]

A variety of studies find that completing treatment for substance use disorders—treatment programs that may or may not have included medications for OUD—has been associated with higher rates of employment, although many of those studies focus exclusively on women

[11] The EEOC sued Volvo for rescinding an employment offer after having learned the job candidate was taking medically supervised Suboxone (a combination of buprenorphine and naloxone) to treat OUD. Volvo paid damages of $70,000 in 2018 as a result of this lawsuit. See https://rehabs.com/blog/volvo-refuses-to-hire-worker-legally-taking-suboxone/.

receiving public assistance.[12] Furthermore, longer stays in treatment and more comprehensive case management have been associated with greater increases in employment (Zarkin et al. 2002, Siegal et al. 1996). One small study shows that a randomized intervention involving access to an employment specialist improved the chances of finding a job among OUD patients undergoing treatment (Holtyn et al. 2021). These studies varied widely in terms of their sample sizes and methods, and not all included control groups.

Only a few papers address the contribution of medications specifically in delivering employment advantages for OUD sufferers. The Henke et al. (2020) study mentioned above finds that employees taking medications to treat OUD imposed less of a burden on their employers (in terms of productivity losses and health-care costs) compared with employees with OUD who were not receiving medications. Most notably, Richardson et al. (2012) find that OUD patients in Vancouver treated with methadone were less likely to enter employment (after starting treatment) relative to patients undergoing treatment that did not include methadone or other medications for OUD, considering either formal or informal jobs. Richardson et al. (2012) attribute the negative association between methadone treatment (compared with other treatment modes not including medication) and entering employment to several possibilities, including the presence of additional employment barriers among the types of individuals assigned to methadone treatment—consistent with findings in Ware et al. (2021)—and the potential incompatibility of methadone treatment with job search and employment.

The previous research offers at least suggestive evidence of a negative association between OUD and employment on the one hand and of a positive association between treatment (but not

[12] Meara (2006) offers a review of several studies that look at transitions into employment among women (with and without substance use disorders) receiving Temporary Assistance to Needy Families (TANF) following the welfare reform of 1996.

necessarily medications) and employment on the other. However, ours is the first study that uses individual panel data of administrative health and employment records to study these associations and is among the first to study the relationship between receipt of medications for OUD (rather than any treatment in general) and the job-finding rate. The ability to observe individual employment trajectories combined with rich information on health outcomes permit a higher level of rigor in analyzing how OUD influences employment outcomes and whether treatment with medications might offset any negative association between OUD and employment.

## 3. State and Federal Policies Aimed at Protecting and Promoting Employment among OUD Patients

At the federal level, workers suffering from substance use disorders, including OUD, are protected from employment discrimination under the Americans with Disabilities Act (ADA). Primarily, workers can't be refused employment or have their jobs terminated simply by virtue of having been diagnosed with a substance use disorder in the past, provided illegal drug use is not ongoing. During the interview phase, some questions about current and/or past drug use may be permitted, but not if they would reveal the presence of a past substance use disorder from which an individual is recovering. However, the regulations do not prohibit discrimination against workers found to have recently engaged in illicit drug use or whose job performance is deemed inadequate owing to drug use (Aoun and Appelbaum 2019).

The ADA also prohibits employer discrimination against individuals on the basis of their receiving medications to treat OUD, unless they cannot do the job safely and effectively when using such medications. For example, regulations from the US Department of Transportation

disallow certain types of vehicles to be operated by an individual using methadone or buprenorphine.

For decades, Rhode Island state law has offered additional protections for workers in relation to drug use. For example, one Rhode Island law permits pre-employment drug screenings only after a conditional job offer has been made. The same regulation also allows employers to request drug tests for current employees provided there is reason to believe that substance use is impairing job performance. Employees who test positive must be given the chance to rebut the results and to be retested. If a positive test is confirmed, workers cannot be terminated immediately and must be allowed to enter a treatment facility. An employee whose testing indicates continued use of controlled substances after treatment may then be terminated. In addition, methadone patients are prohibited from working in some jobs, such as those that involve operating some types of vehicles and/or heavy equipment.

As noted above, previous research finds that comprehensive case management involving wrap-around services has been associated with improved employment outcomes at some OUD treatment facilities. Rhode Island is home to more than a dozen "Center of Excellence" facilities, which are recognized nationwide as providing a high standard of care for OUD that includes access to medications (including methadone, buprenorphine, and/or naltrexone), behavioral counselling, and tight coordination with other state programs offering housing assistance, education assistance, and vocational training.[13] In late 2021 Rhode Island's Employment and

[13] For details, see Rhode Island Department of Behavioral Healthcare, Developmental Disabilities, and Hospitals "Centers of Excellence for Opioid Use Disorders" https://bhddh.ri.gov/substance-useaddiction/individual-and-family-information/help-opioid-dependence/centers-excellence.

Training Administration was awarded a third installment of federal grant funding to provide workforce training for an estimated 670 Rhode Island residents with OUD.[14]

## 4. Scientific Background: Opioid Use Disorder and Medications Used to Treat the Condition

Opioid use disorder (OUD) is defined by the *Diagnostic and Statistical Manual* (*DSM-5*) as a problematic pattern of opioid use that leads to significant impairment or distress (American Psychiatric Association 2013). Medications for opioid use disorder (MOUD) refer to any of three medications approved by the FDA to treat the condition: methadone, buprenorphine, or naltrexone. Both methadone and buprenorphine suppress cravings for opioids by occupying the same receptors in the brain that opioid drugs would otherwise occupy, but without producing a euphoric high when used as directed. Naltrexone suppresses cravings for opioid drugs by blocking, rather than occupying, the brain's opioid receptors and also does not produce a euphoric high.[15] A common formulation (typically marketed under the brand name Suboxone) combines buprenorphine and naltrexone in order to deter abuse of buprenorphine.

The World Health Organization and the US Department of Health and Human Services strongly endorse the use of opioid agonist treatment (OAT) specifically, which involves the daily use of either methadone or buprenorphine after an initial period of detoxification from other opioids (World Health Organization 2009, Krantz and Mehler 2004). [16] The decision of whether to

[14] For details, see "US Department of Labor Awards $1.3M in Funding to Continue Employment, Training Services to Combat Rhode Island's Opioid Crisis," https://www.dol.gov/newsroom/releases/eta/eta20211101.
[15] The injectable form of naltrexone (brand name Vivitrol) has been found to reduce illicit drug use, while the pill form of naltrexone has not been found to consistently improve patient outcomes. See, for example, Lee et al. (2018) and National Institute on Drug Abuse (2020).
[16] The medical literature supporting the use of medications for OUD is vast—see, for example, Connery (2015) for a review of existing research. In addition to its benefits for individual OUD patients, MOUD has been found to offer broader benefits to public health, such as reductions in HIV- and hepatitis C–risk behaviors as well as reductions in criminal behavior (Evans et al. 2019). Within the New England region, observational studies from Massachusetts

prescribe methadone, buprenorphine, or naltrexone is specific to each patient and takes into account the risks of side effects and interactions with other medications (McCance-Katz, Sullivan, and Nallani 2010). This report's analysis does not consider naltrexone treatments owing to a variety of data limitations.[17] Despite the strong endorsement of medications for OUD by public health officials and the medical community, it is estimated that the vast majority of people with an OUD are not treated with such medications. Nationwide in 2019, an estimated 35 percent of patients received any form of treatment for OUD and a smaller but unknown fraction received medications as part of treatment (Jones and McCance-Katz 2019).

Individuals prescribed methadone are required to simultaneously enter into individual and/or group counselling, and the combination of medications and behavioral therapy is called medication-assisted treatment (MAT). Many specialized opioid treatment programs (OTPs) that dispense methadone also offer a variety of complementary support services, such as job training and/or intensive case management.[18] Individuals prescribed buprenorphine or naltrexone by an office-based provider are not required to undergo counselling (unless mandated by the criminal justice system), but many such people engage in behavioral therapy nonetheless.

A limitation of the analysis is that we can't observe the non-medical details of treatment programs, such as whether people are receiving job training or case management. However, methadone users are much more likely to have access to such services based on receiving

(Larochelle et al. 2018) and Vermont (Mohlman et al. 2016) find, respectively, that medication-assisted treatment (MAT) is associated with lower risk of fatal opioid overdose and lower health-care expenditures.

[17] In the medical claims data, it is hard to separate whether naltrexone represents treatment for OUD as opposed to treatment for alcohol use disorder (AUD), as many patients suffer from both conditions simultaneously. According to official Rhode Island data, only about 2 percent as many patients in the state receive naltrexone for OUD as receive either methadone or buprenorphine. Although our analysis is limited to employment-related benefits from the latter two medications only, the importance of naltrexone in boosting employment rates among OUD patients is likely to be relatively small in light of its more limited application.

[18] The use of methadone or buprenorphine (not naltrexone) is sometimes called opioid agonist therapy (OAT).

methadone at or via an OTP, especially in Rhode Island, as compared with those receiving buprenorphine through a primary care physician or other office-based provider. To address this limitation, we examine the association between medication and employment separately for methadone and buprenorphine.

## 5. Data and Methods

The Rhode Island Ecosystem is a data resource managed by the Rhode Island Executive Office of Health and Human Services (EOHHS) that links person- and family-level data across multiple state agencies.[19] The research team at the Federal Reserve Bank of Boston's New England Public Policy Center (NEPPC) gained use of selective Ecosystem data for research purposes via a data user agreement (DUA) with EOHHS. All data have been anonymized to protect confidentiality. The analysis described in this working paper (and in the associated research report) makes use of Rhode Island Medicaid claims and enrollment records, payroll earnings records from the Rhode Island Department of Labor and Training (DLT), death records from the Rhode Island Department of Health's vital records office, and public assistance program eligibility information from Rhode Island's Department of Human Services.

Payroll employment data and death records are available for the entire state population, whereas information on medical diagnoses and treatments is limited to Rhode Island's Medicaid population. Therefore, the analysis relating treatments for OUD with employment outcomes is restricted to the Medicaid population. Nonetheless, the state's Medicaid population is substantial and includes a disproportionate share of individuals diagnosed with OUD, as discussed below.[20]

[19] The stated goal of the Ecosystem is to "drive holistic improvements in human well-being." For more information, visit https://eohhs.ri.gov/initiatives/data-ecosystem.
[20] The available sample sizes of Medicaid enrollees, even subject to additional restrictions on age and other factors, are large enough to detect relationships between the outcomes of interest.

Furthermore, individuals on Medicaid have below-average incomes and below-average levels of labor force participation compared with people not enrolled in Medicaid but who are otherwise similar in age and gender. Therefore, the Medicaid population may stand to benefit disproportionately from policies aimed at improving access to medications for OUD and/or raising the employment prospects of individuals with OUD.

The payroll-earnings records are observed at a quarterly frequency from 2010Q1 through 2020Q3. Each record pertains to a specific employee-employer pair and reports the total wages or salary paid to the individual by the given employer in the given quarter and reports the employer's industry code at the three-digit North American Industry Classification System (NAICS) or subsector level. As the employment records are not limited to the records of Medicaid enrollees, in some cases we observe employment records of Medicaid sample members in periods when they were not enrolled in Medicaid. (The employment data span a longer time period than the Medicaid data, and some individuals were enrolled in Medicaid only intermittently.) These employment records in off-Medicaid periods are useful for determining the true employment trajectories of Medicaid enrollees, regardless of their Medicaid status in a given quarter.

Medicaid enrollment status is observed at a monthly frequency from July 2013 through October 2020. The Medicaid pharmacy claims are observed as of specific dates ranging from early July 2013 through late October 2020. The Medicaid medical claims are known to span the same time period as other Medicaid data, but the individual claims are not dated. However, separate records indicate the earliest date of receiving methadone among those ever receiving that treatment for OUD, as well as the earliest date of having an OUD diagnosis. The earliest possible date in our sample for any buprenorphine receipt, methadone initiation, or first OUD diagnosis is July 2013,

and the latest date for any of these outcomes is October 2020.[21] The death records (used only in descriptive statistics tables), which report the month of death and as many as five causes of death, span January 2013 through December 2020. Figure 2 illustrates the respective time ranges covered by the various data sources as just described.

Given these data sets, we can observe Medicaid enrollees' payroll employment records and health-care-related activity for an overlapping time period that extends from 2013Q3 through 2020Q3, and we make use of records as far back as 2010Q1 in determining employment status prior to an individual's Medicaid activity. To align the Medicaid data with the quarterly employment records, we aggregate Medicaid outcomes to the quarterly frequency. An individual was "enrolled in Medicaid" in a quarter if they were enrolled in one month or more within the quarter, and "received buprenorphine" in a given quarter if they had at least one pharmacy claim involving buprenorphine that was dated within that quarter. The individual "started methadone" as of a given quarter if their first date receiving methadone fell within or before that quarter and was "diagnosed with OUD" as of a given quarter if their first OUD diagnosis fell within or before that quarter. For other health outcomes based on undated claims, such as having a hepatitis C diagnosis, we construct indicators of "ever" having had such a diagnosis in at least one observed medical claim, and these indicators do not vary across quarters. An individual was "employed" in a quarter if they had at least one payroll employment record dated in that quarter involving nonzero wages. Here, "employed" is shorthand for "had a nonzero wage record from a payroll job located in Rhode Island."

[21] There are large clusters of individuals who first received buprenorphine, methadone, or an OUD diagnosis in July 2013. It is likely that many such individuals actually received their first treatment or diagnosis prior to July 2013. Such left-censoring is controlled for in the regression analysis, described below. The left-censoring of an OUD diagnosis is a separate issue from the presence of undiagnosed OUD, which we do not control for.

In periods when an individual was off Medicaid, their buprenorphine status is unknown. To use the off-Medicaid observations in the analysis, we impute buprenorphine status in these periods as follows: Someone is said to have been on buprenorphine in the non-Medicaid interim only if they received buprenorphine prescriptions in both of the nearest abutting observations—just before the non-Medicaid period and immediately after.[22] For methadone treatment, once an individual has commenced methadone (while on Medicaid), the indicator of having started methadone is set equal to 1 (with no uncertainty) in all subsequent periods regardless of whether the individual remained on Medicaid continuously, and similarly for the indicator of having been diagnosed with OUD as of a given date. Indicators of ever receiving various diagnoses, such as for alcohol use disorder, are also imputed to off-Medicaid periods without uncertainty.

A limitation of the employment record is that the earnings of Rhode Island residents working for out-of-state employers are not observed, nor are the earnings of self-employed individuals living in Rhode Island. These data therefore offer incomplete evidence of employment status as of a given quarter. Someone with one or more records in a given quarter—multiple records would indicate working for more than one employer—can rightfully be considered as having been employed in that quarter. However, someone with no earnings record in a given quarter was either not employed in the quarter, self-employed in the quarter, or working for an out-of-state employer in the quarter. Having a payroll job in Rhode Island is likely to offer advantages over either self-employment or out-of-state employment for the population in question. Research suggests that self-employment among the low-income population tends to be characterized by marginal work for low pay and no benefits (see, for example, Edin et al. 2019). Although many

[22] The imputation assigns a value of 1 for receiving buprenorphine in a given quarter in only a very small number of cases, and results are robust to assuming buprenorphine was never received in an off-Medicaid period.

parts of Rhode Island are within a reasonable commuting distance to employment centers such as the Greater Boston area, in-state employment is likely to involve shorter commutes on average and so could be preferred for that reason. In sum, the limitations of the employment data do not unduly alter the policy implications of our findings.

Employment counts based on the Ecosystem's payroll records that are not restricted to Medicaid enrollees represent, on average, about 90 percent of the employed individuals in the state in a given quarter as observed in the Current Population Survey. Results are shown in Figure A1 of the appendix.[23] The shortfall is consistent with the fact that we do not observe individuals who were either self-employed or working out of state. Considering just the Medicaid enrollees in our sample (aged 18 to 64), we estimate that the observed employment rate represents somewhere between 72 and 91 percent of the true employment rate for this group, depending on the year.[24] See Table A1 of the appendix for details.

We employ Cox proportional hazards models to estimate (1) the job-separation rate from a state of employment and (2) the job-finding rate from a state of nonemployment. In the discussion below we refer to job-finding rates. The same descriptions apply to the model of the job-separation rate, with the exception that job separations are analyzed starting from a state of employment rather than nonemployment. The instantaneous job-finding rate can be written as follows:

$$h_i(q|\boldsymbol{X_i}) = h_0(q)exp\{\boldsymbol{X_i'\beta}\}. \qquad (1)$$

[23] The estimates are not fully comparable in light of data limitations. See Figure A1 notes for details.
[24] The estimates are not fully comparable in light of data limitations in the comparison data source, which was the Rhode Island Health Information Survey, accessed September 28 at https://healthsourceri.com/surveys-and-reports/. See Table A1 for details.

In the above equation $h_i(q|X_i)$ denotes the expected rate of finding a job (between period $q$ and $q+1$ for individual $i$,[25] who is not employed as of time $q$ and has the vector of (fixed) individual characteristics $\boldsymbol{X_i}$. The hazard function includes a baseline component, denoted $h_0(q)$, that depends only on the number of quarters ($q$) since the start of someone's first nonemployment spell. The function also includes an individual-specific component that depends (via the natural exponential function or *exp*) on $\boldsymbol{X_i}$ and the parameter vector $\boldsymbol{\beta}$, which is estimated in the regression. [26]

For each included factor in the vector $\boldsymbol{X_i}$, the model estimates the ratio by which that factor multiplies the baseline rate of job finding.[27] A hazard ratio on a given factor that is significantly greater than 1 means that individuals with that characteristic, holding all else equal, have a systematically higher job-finding rate (by a constant multiplier) after any given duration of nonemployment.

The model is readily extended to allow for explanatory factors that vary over time for an individual (see Cleves, Gould, and Marchenko 2016). In the model of job separations, the main explanatory variable of interest is a (time-varying) binary indicator of whether the individual was first diagnosed with OUD in the preceding quarter. (We also include an indicator of having been diagnosed two quarters ago or more.) In the job-finding rate model in relation to buprenorphine, the main explanatory variable of interest is a binary indicator of whether an individual received

[25] The expression represents a rate rather than an instantaneous probability because it is estimated over a discrete unit of time.
[26] The coefficient vector, $\boldsymbol{\beta}$, is estimated via a partial likelihood estimation that does not require estimation of the baseline hazard function. Cumulative survival-rate estimates (shown in Figure 4 and Table 4) are based on Kaplan-Meier estimates of the baseline instantaneous hazard for specified characteristics.
[27] For all Cox models estimated in this paper, the proportional hazard assumption is tested for all explanatory factors. If any factor fails the test, the model is stratified on that factor (or on combinations of factors) to allow for nonproportionality. In addition, all models are tested for interactions between the stratification variables and the other explanatory factors. Results reflect models that are consistent with the required stratification and interactions in each case.

buprenorphine to treat OUD in the preceding quarter. [28] Having been diagnosed with OUD is also included in the latter model, along with several control variables described below. In a separate job-finding model the main variable of interest is an indicator of having started taking methadone in any previous quarter. Recall that for methadone we don't observe the date of each individual treatment event, only the date of the first treatment. Once the "started methadone" indicator turns on, it remains on in all later periods.

In all models we use lagged indicators (of OUD diagnosis, receiving buprenorphine, or starting methadone) in order to ensure that the relevant event occurred strictly prior to a job separation or job-finding event, where the employment outcomes are observed only up to the quarter rather than the day. For, say, a buprenorphine prescription received in the job-finding quarter itself, the employment might have started before the prescription was actually filled, ruling out the possibility that the treatment itself contributed to the job-finding event in a causal sense. For consistent estimation, there must be no variables omitted from the model that are simultaneously correlated with the explanatory factors and with the job-finding (job-separation) rate, and the explanatory factors must not themselves depend on the job-finding rate.

In the model of job separations, the sample is restricted to individuals who meet the following criteria: (1) were enrolled in Medicaid during at least one month from July 2013 through October 2020, (2) had at least one quarter (during the 2013Q3–2020Q3 period) with a payroll employment record (while enrolled in Medicaid) and was between the ages of 18 and 54 as of

[28] Specifically, the indicator equals 1 if the individual filled a prescription for the drug on any date within the preceding calendar quarter, or if they filled a buprenorphine prescription at some earlier date such that the supply was ongoing within the preceding quarter. We use information from the claim about the fill date and days' supply to determine whether supply was ongoing as of a given date. Results are robust if we restrict the indicator to strict prescription fills in the preceding quarter.

their earliest such employment period, (3) was enrolled in Medicaid for at least four quarters[29] after the start of their first employment spell, (4) was diagnosed with opioid use disorder and the first diagnosis occurred after the start of their first employment spell, and (5) received either buprenorphine or methadone to treat OUD while on Medicaid in the sample period. The resulting sample consists of 1,899 individuals and a total of 11,410 person-by-quarter observations.[30]

The sample used for the job-finding rate analysis in relation to buprenorphine receipt (methadone receipt) is similar, with the exceptions that (1) instead of requiring at least one employment spell, the individual must have had at least one quarter with *no* payroll employment record (while enrolled in Medicaid) and was between the ages of 18 and 54 as of their earliest such nonemployment period, and (2) the sample is restricted to those ever diagnosed with OUD and who received buprenorphine (methadone) to treat OUD while on Medicaid in the sample period; they may or may not have ever received methadone (buprenorphine). Finally, we eliminate individuals who first started receiving buprenorphine (methadone) strictly prior to the start of their first nonemployment spell. The buprenorphine sample consists of over 5,300 individuals and a total of over 66,000 person-quarter observations; the methadone sample makes use of over 53,000 person-quarter observations among more than 4,200 unique individuals.

The motivation for the last sample restriction just described is that we want to identify any effects of starting treatment with buprenorphine (methadone) on the job-finding rate based on medication status changes for the same individual over time during the course of their

[29] Enrolled in Medicaid in a quarter means enrolled in at least one month in that quarter, not necessarily continuously enrolled within the quarter.

[30] The total number of person-quarter observations refers to the total number of "observations at risk." For a given individual, the "at-risk" observations consist of those immediately after the first employment quarter and through either the first quarter without employment (the job-separation event) or, if no separation occurs, the last observed quarter for that individual. For models of job-finding rates, the at-risk observations consist of those immediately after the first nonemployment quarter and through either the first quarter of employment (the job-finding event) or, if no such event occurs, the last observed quarter for that individual.

nonemployment spell, and because treatment initiation may be an especially important moment to consider with respect to reemployment. The same reasoning applies to the restriction in the job-separation model that an individual's first OUD diagnosis must not have occurred prior to the start of their first employment spell. The sample requirement of having not started treatment before the first nonemployment spell is especially important in the case of methadone treatment. Among those who started methadone treatment well before their first nonemployment spell, there is both a lower chance that we would observe a positive effect of methadone treatment on job finding should such an effect exist (because the person may no longer be taking the medication) and a higher chance that any observed positive association is spurious for the same reason.

The model of job separations controls for gender, age at start of first employment spell (given as a range), ever having been not employed between 2010Q1 and their earliest quarter of employment, initial Medicaid enrollment date (either before or after the Medicaid expansion of January 2014),[31] indicators of alcohol use disorder (AUD), hepatitis C, disability, and blindness,[32] and indicators of ever having received buprenorphine (but not methadone), having received methadone (but not buprenorphine), and having received both buprenorphine and methadone.[33] The model also includes indicator variables for each calendar quarter in order to

[31] Starting in January 2014, Rhode Island expanded Medicaid eligibility to a wider selection of low-income adults, in accordance with the option provided under the federal Patient Protection and Affordable Care Act (ACA).
[32] Drawing on Medicaid eligibility records and Medicaid medical claims dated from July 2013 through October 2020, these variables indicate whether the individual was observed with the given condition in at least one month of the observation period. For example, the AUD variable equals 1 if the individual ever had a diagnosis of AUD within the Medicaid medical claims records. The disability indicator flags individuals who qualified for Medicaid on the basis of disability, not including blindness. Blindness is determined as having qualified for Medicaid on the basis of disability, but specifically blindness.
[33] Some of these factors are controlled for using stratification, which involves estimating separate baseline hazard functions for each level of the factor or combination of factors along which stratification is deemed appropriate. See the notes to Table 2 for details.

capture changes in macroeconomic conditions (at the state level of higher) that could influence the job-separation rate.

The models of job finding also control for gender, age, employment history, initial Medicaid enrollment date, calendar quarter, alcohol use disorder, hepatitis C, disability, and blindness.[34] However, age is measured as of the start of an individual's first *nonemployment* spell (given as a range), and past employment status indicates if the individual was ever *employed* between 2010Q1 and their first nonemployment quarter. Both job-finding models also control for OUD diagnosis status (whether the first diagnosis occurred strictly prior to the given quarter). In the model that associates buprenorphine receipt with the job-finding rate, we control for ever receiving methadone, and vice-versa for the model that associates methadone receipt with the job-finding rate. An indicator of having received Supplemental Nutritional Assistance Payments (SNAP) during the 2016–2020 period was included in alternative models of job-finding rates (results not shown) and was not found to add any explanatory power to either model or to influence other results. Similarly, models that include the industry code for any previous employment do not yield significantly different results.

## 6. Results

### *6a. Descriptive Analysis of Employment Patterns among Rhode Island Medicaid Enrollees in Relation to OUD Status*

We begin by describing a variety of demographic, health, and employment indicators among Rhode Island Medicaid enrollees in relation to whether individuals have been diagnosed with opioid use disorder (see Table 1). The baseline sample for the descriptive analysis (labeled "Full

[34] Again, some of these factors are controlled for using stratification. See the notes to Tables 5 and 7 for details.

Medicaid Sample" in the table) consists of individuals who were enrolled in Medicaid during one month or more in 2018 and who were between the ages of 18 and 64 as of 2018.[35] The table also describes outcomes separately for two distinct subgroups of the baseline sample: those receiving at least one OUD diagnosis within the sample's date range and those with no OUD diagnosis during the observation period.[36] The group with an OUD diagnosis consists of over 20,000 individuals, or slightly more than 9 percent of all enrollees in the full 2018 Medicaid sample.

As shown in Table 1, the OUD population is older on average than the average Medicaid enrollee (as of 2018) and much more likely to be male. Compared with those never diagnosed, OUD patients spent more time on Medicaid (from 2013 through 2020) and were less likely to have had a Rhode Island (RI) payroll job from 2010Q1 through 2020Q4—the date range of the employment records. Although the difference between the employment rates of those diagnosed with OUD and other Medicaid enrollees is relatively moderate, the OUD group appears to exhibit more intermittent employment. Among those ever employed in the relevant time period, OUD patients spent less time being employed (by more than four quarters on average) and had a greater number of distinct employment spells. Since individuals may have been either self-employed or working out of state during apparent periods of nonemployment, these patterns indicate that individuals with OUD either have relatively unstable employment patterns or, at the

[35] Our data set observes individuals aged 65 and over receiving Medicaid. These are omitted from analysis for two reasons: (1) Such individuals also qualify for Medicare, complicating the issue of observing their health-care activity, and (2) such individuals are less likely to be job-seeking compared with younger individuals.
[36] We observe the timing of the initial diagnosis only. Individuals may have subsequent diagnoses, but these are not dated. The earliest possible first diagnosis date in the sample is July 2013, based on how the data were collected. For the no-diagnosis group, we also remove suspected cases of OUD based on their having received methadone or buprenorphine or having had an opioid overdose diagnosis. Therefore, the combined number in the latter two groups does not sum to the total number in Full Medicaid Sample.

very least, exhibit more frequent transitions between self-employment and payroll employment or between out-of-state and in-state employment.[37]

Results in Table 1 suggest a negative association between having an OUD diagnosis and either obtaining or maintaining employment. However, it is uncertain whether having OUD itself causes a reduction in someone's chances of becoming employed or of maintaining stable employment. Instead, individuals suffering from OUD might simply be less likely to obtain/maintain employment than those without OUD for a variety of reasons not directly related to their condition. Also shown in Table 1, OUD patients are more likely to be employed in the leisure and hospitality supersector, which might be characterized by more transient or intermittent employment, and similarly the construction sector. In addition, nearly half of those diagnosed with OUD also had a diagnosis of alcohol use disorder (AUD) during the observation period, and nearly 35 percent were classified as disabled (not including blindness). The rates of AUD and disability are much lower in the non-OUD Medicaid population. The OUD population also exhibits a much higher incidence of hepatitis C compared with those without OUD and a modestly higher rate of blindness. In addition to these differences, previous research points to other barriers to employment faced by OUD patients, such as lower education and skill levels, unstable housing, and lack of access to transportation and/or childcare.

To delve further into whether OUD itself presents barriers to employment, we exploit the fact that many OUD patients in the sample are observed both before and after their initial OUD diagnosis date.[38] Figure 3 shows employment rates among OUD patients, measured on either

[37] Among those with Rhode Island (RI) payroll employment records continuously over time, there nonetheless may have been switching across specific RI payroll jobs over time.
[38] Even for those with an initial diagnosis date recorded as July 2013, employment status is observed as far back as January 2010.

side of diagnosis onset. The left bar indicates the percentage of RI Medicaid enrollees (eventually diagnosed with OUD) with at least one RI payroll employment record dated strictly before their first diagnosis date, and the right bar gives the percentage employed in or after the quarter of the first diagnosis. The underlying sample is the same for both bars. The share employed in the period after diagnosis onset is nearly 14 percentage points lower than the share employed before, and the difference is highly statistically significant. Although all sample members would have been older after their respective diagnoses, the median age at OUD onset, 37, is still well within the prime working age range. Therefore, the results are not likely to be driven primarily by retirements.

For a more rigorous assessment of whether OUD is incompatible with employment, we estimate a Cox proportional hazards model of job separation (quits are not distinguished from involuntary separations) from an initial state of employment, as described above. As shown in Table 2, the chances of leaving a job increase significantly after the onset of OUD. This association is strongest in the quarter immediately after the diagnosis and remains statistically significant, if somewhat weaker, in later quarters. Women face consistently lower risk of job separation than men (with high statistical significance), and higher separation risks are observed among those who are disabled, were ever diagnosed with hepatitis C or alcohol use disorder, and who were not employed previously. Blindness is also associated with a higher separation risk, but the effect is only marginally statistically significant.

All of these results suggest that having an OUD makes it harder to find and/or retain a payroll job, even if a separation is voluntary. This finding agrees with prior evidence that worker productivity is lower among individuals with substance use disorders (including OUD) and with the fact that disordered opioid use results in physical and psychological impairments to

performing a broad range of tasks, whether they involve manual labor or cognitive reasoning. However, it is also possible that individuals could experience an adverse shock, such as a major physical injury, that leads both to their becoming dependent on opioids and to their no longer being able to hold down a job, whether temporarily or permanently.[39] Alternatively, individuals may have been employed and using opioids for some time but without receiving any medical help or diagnosis, and then at a certain point they may have sought medical treatment (prompting a diagnosis) and subsequently quit their job in order to focus on their recovery. However, even an intentional separation to enter treatment implies some degree of incompatibility between having and/or receiving treatment for OUD and holding a job.

### *6b. Does Receiving Medication for Opioid Use Disorder Influence Job Prospects among OUD Patients?*

Next, we consider how receiving medication for OUD relates to health and employment outcomes using a snapshot of outcomes in 2018 for additional subgroups of enrollees, as shown in Table 3. All groups are pulled from the set of individuals aged 18 to 64 as of 2018 who received Medicaid benefits during at least one month in 2018. The first column refers to the full set described in Table 1. Each of the remaining columns refers to a subgroup of individuals diagnosed with OUD and differentiated by medication status: received buprenorphine ever, received methadone ever, or never received either medication.

Members of the full Medicaid sample, combined, accounted for nearly 62 percent of all opioid-related deaths in Rhode Island in 2018, despite representing just 20 percent of the larger Rhode Island population in the same age range as of 2018.[40] Perhaps surprisingly, the subsample

[39] Such injuries might be inferred from the medical claims data, but their timing would be unobserved.
[40] These estimates, taken from the American Community Survey, represent the share of the Rhode Island population aged 19 to 64 insured by Medicaid in 2018. Given the narrower age range, the 20 percent estimate is not exact for

diagnosed with OUD (combining the second, third, and fourth columns) accounted for just 40 percent of the state's opioid deaths in 2018,[41] which means that 22 percent of the state's opioid deaths occurred among Medicaid enrollees who did not have an observed OUD diagnosis during our sample period.[42]

For any subset of individuals with OUD, the employment rate in 2018 was well below the average rate observed in the full Medicaid sample. Among individuals with OUD, those who received buprenorphine (at least once during the observation period) had the highest chance of being employed in 2018, followed by methadone recipients and, lastly, those who did not receive any MOUD during the sample period. Median total earnings in 2018 (calculated only for those with nonzero wages for the year) follow a similar pattern. Earnings were below average among Medicaid enrollees with OUD compared with all Medicaid enrollees; for those with OUD, median earnings were highest among the buprenorphine recipients, followed closely by the methadone recipients, and lastly, by the non-MOUD recipients, who had significantly lower earnings.

In terms of health status, the all-cause mortality rate is elevated in each of the OUD subgroups compared with the general Medicaid population. Although all-cause mortality (for 2018) was highest among OUD patients who did not receive MOUD, opioid-related mortality in 2018 (per 1,000 sample members) was similar across all three subsets of OUD patients. In fact, opioid-

our sample age range. Visit https://www.census.gov/data/tables/time-series/demo/health-insurance/acs-hi.2018.html#list-tab-MHHR1OPN46IXBAFMZO, and see cell AE212 of Table HI-05.

[41] The 40 percent figure is less than the sum of the relevant values in the second, third, and fourth columns of Table 3, as there is significant overlap between the sets of individuals represented in the second and third columns.

[42] It was pointed out in conversation with a public health official in Rhode Island that dying of opioid-related overdose need not indicate an opioid use disorder, as individuals abusing other drugs might accidentally encounter substances laced with opioids, especially fentanyl, that prove fatal.

related mortality was slightly lower among non-MOUD types than it was among either of the other two OUD subgroups (buprenorphine recipients and methadone recipients, respectively).

The higher all-cause mortality among the non-MOUD recipients likely reflects their older age, whereas their lower opioid-related mortality suggests that they had less severe cases of OUD compared with those treated with either methadone or buprenorphine for their condition. Reinforcing the suggestion of selective uptake of MOUD based on illness severity, the opioid overdose rate (calculated as the share of group members with at least one nonfatal or fatal opioid overdose at any date in the observation period) is more than twice as high among OUD patients treated with either buprenorphine or (separately) methadone for OUD as it is among those not receiving either methadone or buprenorphine.[43] The implication is that those receiving MOUD have higher overdose rates than non-recipients despite receiving medications, not because of receiving them.[44] In fact, having a nonfatal overdose itself may precipitate the receipt of medications, as some hospitals have a policy of offering buprenorphine to opioid overdose patients treated in the emergency room and/or of referring the patient after discharge to treatment facilities that employ MOUD (Jaeger and Fuehrlein 2020).

Comparing buprenorphine recipients and methadone recipients (among whom the amount of overlap represents about 36 percent of the buprenorphine sample and 38 percent of the methadone sample), the table indicates that buprenorphine recipients have a slightly lower rate of opioid overdose (fatal or nonfatal) and a slightly lower opioid-related mortality rate per capita,

[43] As shown in Table 3, the opioid overdose rate among OUD patients treated with buprenorphine is roughly equal to the corresponding rate among OUD patients treated with methadone. There is an overlap of nearly 2,700 people between the groups in columns 2 and 3 of Table 3, as some individuals eventually receive both medications, although not at the same time.

[44] In fact, prior research shows that among individuals ever receiving MOUD, having received methadone or buprenorphine recently is associated with lower nonfatal overdose rates (Burke et al. 2021).

but the differences are not statistically significant. Other health differences between these two groups are significant, however, as methadone recipients have a higher incidence of hepatitis C and of disability than buprenorphine recipients and exhibited higher all-cause mortality despite having the same median age. The higher incidence of hepatitis C suggests that they are more likely to inject opioids than to take pills, as hepatitis C is often contracted by sharing needles with other users. The fact that methadone recipients are less likely to have been employed during the observation period (compared with buprenorphine recipients) may relate to these differences in health status and/or to the differences in underlying circumstances revealed by these health differences. For example, we do not observe housing status, but the elevated rate of hepatitis C among methadone users is consistent with their having a higher rate of homelessness (as suggested by Richardson et al. 2012).

It is perhaps surprising that employment rates and earnings are higher among MOUD recipients than among OUD patients not receiving MOUD, despite the evidence that MOUD recipients are likely to have more severe opioid use disorders and elevated rates of other health problems. Non-MOUD recipients are older, however, and have a much higher disability rate than MOUD recipients and exhibit greater all-cause mortality. In addition, MOUD recipients might embody other factors, such as higher education levels, which could contribute to both a tendency to seek medication-assisted treatment for OUD and a tendency to become employed. In light of the apparent heterogeneity between MOUD recipients and other OUD patients, we limit our analysis of the associations between MOUD and job-finding rates to the population that eventually receives MOUD. In this way, the estimated associations are based on contrasts in job-finding rates between people who have not yet started taking MOUD and those who have started medications. Furthermore, many individuals are observed both before and after they started

MOUD. Finally, we run separate analyses relating buprenorphine receipt to job-finding rates and methadone receipt to job-finding rates, based on the observed heterogeneity between recipients of those different medications and the different circumstances pertaining to receipt of those drugs.

### *6c. Job-Finding Rate Analysis: Does Treatment with Medications for OUD Increase the Chances of Finding a Job?*

The results so far indicate that individuals with OUD, compared with others on Medicaid, have more intermittent employment, but that those who received medications to treat OUD (at some point in our observation period) are more likely to have been employed in a given year and have higher earnings compared with the average individual with OUD who did not receive such medications. However, the results so far don't necessarily indicate a causal relationship between taking either methadone or buprenorphine for OUD and becoming or staying employed and earning higher wages. From a policy perspective, the hope is that individuals who are currently out of work and suffering from OUD, and who would like a job, might raise their chances of finding and maintaining employment, and possibly increasing their earnings, as a result of undergoing treatment with either buprenorphine or methadone.[45]

As described above, we use a Cox proportional hazard model to estimate the job-finding rate in association with receiving buprenorphine in the previous quarter (whether for the first time or as a continuing treatment), or in association with starting methadone treatment (either in the previous quarter or some number of quarters ago). Table 4 shows selected descriptive statistics for each of the two relevant regression samples described in Section 5 above. A total of 1,670

[45] Such treatment represents an extended process involving an initial detoxification period followed by an indefinite period of maintenance at a sustainable dose of either medication.

individuals appears in both regression samples. Comparing the two samples reveals some demographic differences between them—for example, the buprenorphine sample has a somewhat higher share of women, an older age distribution, and more members with AUD, but the employment measures of the two samples are not starkly different from each other.[46] In the buprenorphine sample, a somewhat higher share of members were employed before their first nonemployment spell, but only a slightly higher share became reemployed during the observation period compared with the methadone-sample members. Among those who did become reemployed, the average time until reemployment rounds to seven quarters for both groups and the average duration of the new employment rounds to three quarters for both groups.

The regression analysis reveals that there is a statistically significant positive association between having received buprenorphine in the preceding quarter and the chance of becoming reemployed in the current quarter, on the order of an 18 percent increase; selected coefficients are shown in column 1 of Table 5. Further exploring the association between buprenorphine receipt and job finding reveals that the effect is concentrated in the quarter immediately following the initiation of treatment with buprenorphine, as shown in column 2 of Table 5. Specifically, in the quarter immediately after an individual first starts taking buprenorphine, the estimated increase in the instantaneous job-finding rate (44 percent) is more than twice as great as the corresponding increase associated with receiving buprenorphine in any previous quarter in the original model. Also under this alternative model, receiving buprenorphine beyond the first quarter after initiation may not significantly boost the reemployment rate. (The hazard ratio is

[46] The characteristics of these two samples differ from those in Table 3 (columns 2 and 3) because the regression samples impose additional restrictions relative to the samples described in Table 3.

greater than 1 and no longer statistically significant.) Possible reasons for these results are discussed in Section 7 below.

Figure 4 illustrates the cumulative job-finding rates predicted by the model under three different treatment scenarios and for each of two selected demographic groups, within the first three years after the start of a nonemployment spell. The predicted cumulative job-finding rate for a given amount of elapsed time represents the expected share of people who will have entered employment within that number of quarters, regardless of whether they subsequently remain employed. In the baseline scenario (depicted by the red line), the individual never started taking buprenorphine. In the "early treatment" scenario (green line), the individual started receiving buprenorphine two quarters after their "origin" (first quarter of nonemployment) and stayed on the medication in all subsequent quarters. In the "late treatment" scenario, the individual started taking buprenorphine six quarters after their origin and then stayed on the medication indefinitely. The contrasts between the different curves illustrate the fact that an individual receives a discrete boost to their chances of finding a job in the quarter immediately after they start taking buprenorphine but does not receive any substantial *additional* job-finding benefits from continuing to take the drug. The figure also shows that starting treatment earlier yields greater benefits for job finding than does starting treatment later. These qualitative patterns apply to both of the groups represented in the figure, but among men aged 31 to 41 with no previous employment, the job-finding rates are lower across the board, and the absolute increases in job-finding rates associated with buprenorphine treatment are smaller. The predicted instantaneous job-finding rates for these same scenarios are illustrated in Figure A2 of the appendix.

To illustrate the results more precisely, Table 6 shows selected job-finding rates based on Figure 4. Three quarters after the initial nonemployment period, and among men aged 31 to 41 with past

employment records, an expected 46 percent of those under the early-treatment scenario will have found a job, as opposed to 43 percent for those under the alternative scenarios (which are identical as of three quarters after the origin). Under the late-treatment scenario, the job-finding benefit (over not starting treatment) emerges in quarter seven. Although the proportional increase in the job-finding rate is equivalent to that observed in the early-treatment scenario, the absolute gain is smaller because the baseline job-finding rate is lower after seven quarters of nonemployment as opposed to after just three quarters. The table also illustrates the fact (noted above) that the absolute gains from buprenorphine treatment (compared with no treatment) are slightly lower among men aged 31 to 41 with no past employment relative to the gains among those who were previously employed.

The relative benefits of taking buprenorphine apply in similar measure to all other combinations of age group, gender, and past employment status. However, demographic factors are associated with systematic differences in job-finding rates when we control for buprenorphine treatment status. For example, job-finding rates decline systematically with age, and women with no previous employment have lower job-finding rates compared with men (of the same age) with no previous employment. For any given group, the cumulative job-finding rate levels off as the duration of nonemployment increases, consistent with a wealth of previous economic research on job-finding rates (see, for example, Shimer 2008).

In models that test for an association between starting methadone treatment and finding a job, we find no significant association. See Table 7 (column 1) for selected regression coefficients. That is, in periods after a person starts treatment with methadone, their chances of becoming reemployed are not significantly different from what they would be in periods before starting treatment. Even if we single out the quarter immediately after initiation, no significant effect of

methadone is observed (see column 2 of Table 7). Table 8 shows the predicted cumulative job-finding rates based on model 1 of Table 7 for selected demographic groups, illustrating the result that the rates for those who have started methadone do not differ significantly from the rates among those who have not yet started the medication. Again, individuals with no past employment have consistently lower job-finding rates compared with people who have been employed. As discussed below, the results suggest that OUD patients treated with methadone face greater barriers to employment, on average, compared with those treated with buprenorphine, both before and after methadone has been initiated.[47]

When the sample is limited to those who eventually take both medications (not typically at the same time), buprenorphine treatment continues to predict a higher job-finding rate in the quarter immediately after initiation, although the coefficient estimate is somewhat smaller (closer to 1) and not as precisely estimated as it was in Table 5. See Table 9 for results. For methadone, we observe a positive association (hazard ratio greater than 1) between methadone and the job-finding rate for the first quarter after initiation, while in later periods, having started methadone is associated with, if anything, a lower job-finding rate, although neither of these latter estimates is statistically significant, as shown in Table 9. Since this latter analysis was restricted to people who eventually received both methadone and buprenorphine, any differences in employment potential across individuals based on the type of medication received for OUD should have been minimized. The results suggest that members of this more selected group could experience job-finding benefits from opioid agonist therapy (whether methadone or buprenorphine), but that such potential may be most readily realized under treatment with the more convenient option of

[47] Although there is significant overlap (1,670 individuals) between the regression sample of buprenorphine recipients and that of methadone recipients, more than 60 percent of methadone recipients in the sample did not also receive buprenorphine.

buprenorphine. Alternatively, health status—such as the severity of the opioid use disorder itself—might be changing over time among members of this group, such that at the time they start methadone, the potential for treatment to boost employment prospects is very limited. Indeed, methadone is often recommended for more severe cases of OUD (McCance-Katz, Sullivan, and Nallani 2010).

Finally, we consider some preliminary evidence on the association between MOUD and earnings. Table 10 shows median single-quarter earnings among regression sample members, both immediately before and immediately after the initial nonemployment spell, in relation to whether someone started receiving buprenorphine (or, alternatively, methadone) treatment before or after they became reemployed. (The calculations are limited to those who were employed on either side of their original nonemployment spell.) Median earnings were higher after the nonemployment spell than before in all cases, but the increase in earnings appears greater among those who initiated buprenorphine (or methadone) before starting their new job compared with those who first found a new job and only later began receiving buprenorphine (methadone) treatment. These findings suggest that starting MOUD treatment may help OUD patients achieve greater earnings increases over time than they would achieve otherwise because they worked more hours and/or earned a higher wage per hour, but these results are preliminary.

## 7. Discussion

The analysis above describes a variety of patterns and associations between an individual's OUD status and/or their treatment status (receiving either methadone or buprenorphine) and employment outcomes, such as the job-separation rate and the job-finding rate, among Medicaid enrollees in Rhode Island observed from 2013 through 2020. Results indicate that the onset of OUD diagnosis may limit an individual's chances of maintaining an in-state payroll job, while an

individual's chances of finding a job (from a state of nonemployment) appear to increase following treatment with buprenorphine for OUD, and especially in the quarter just after initiation. Preliminary findings also suggest that receiving MOUD might boost the earnings of OUD patients. The strong association between initiating buprenorphine and the job-finding rate in the following quarter might reflect a pattern of individuals taking an intentional pause from work to enter treatment and subsequently resuming work once their condition has been stabilized, consistent with the notion that having untreated OUD may be incompatible with employment. Furthermore, the improvement in functioning that follows the initial "induction and stabilization" phase of buprenorphine treatment may be more dramatic than the marginal benefit of merely continuing medication at later dates in the "maintenance" phase. From a medical standpoint, the initial phases of treatment may also preclude some forms of labor, as indicated by Mehrdad et al. (2015).

However, in light of data limitations, we can't be sure that these associations are causal. Regarding the increase in the job separation risk following an OUD diagnosis, that pattern could arise spuriously if someone experiences an adverse event—such as a major physical or emotional trauma—which leads to their becoming both dependent on opioids and unable to hold down a job. Analogously, the positive association between buprenorphine treatment and finding a job might arise because an individual experiences a change in their circumstances that leads to receiving treatment *and* finding a job, even though the treatment was not a necessary precursor to the job-finding event. For example, someone might receive an influx of family or public assistance that helps them to secure stable housing, which subsequently makes it easier for them both to find a job and to enter treatment. Alternatively, other unobserved factors may also peak

during the initial phase of treatment, such as an individual's motivation to return to work and/or the extent of extra support they receive in the form of vocational training and other referrals.[48]

Given the limitations of our employment indicator (described above), we might obtain an upward bias of the effect of starting buprenorphine on the job-finding rate. For example, sample members may simply be more likely to find a *payroll job in Rhode Island* after taking buprenorphine, but not more likely to find *any* employment, where any employment includes self-employment and out-of-state work in addition to in-state payroll employment. If so, we would observe that these people appear more likely to become "employed" (defined narrowly as having a Rhode Island payroll job) after starting buprenorphine. We are not aware of any research suggesting that such patterns would apply systematically to eventual buprenorphine recipients in our sample. However, even if they did, other evidence suggests that, for the population under study, having an in-state payroll job would be a preferred outcome to either self-employment or out-of-state employment.[49]

Our analysis does not reveal any statistically significant positive association between starting methadone treatment and becoming reemployed after a nonemployment spell, although earnings increased more among those who found a job after starting methadone in relation to those who found a job before starting methadone. Although the weaker results for methadone might appear discouraging, policy should not discourage the use of methadone to treat OUD. Instead, health

[48] As noted above, Rhode Island law prohibits employers from immediately terminating employees who fail a drug test, and instead the employees must be offered the option to enter a supervised treatment program. Employees entering treatment to avoid being fired might experience a temporary gap in employment, creating a sequence of nonemployment, treatment initiation, and employment resumption. However, it is unlikely that such agreements are driving our results for buprenorphine. To create a gap in employment, individuals would have to be taking unpaid leave to undergo treatment rather than using accrued sick leave or other paid leave. Furthermore, among job finders in the relevant sample, fewer than 25 percent were employed in the same industry subsector both before and after their relevant nonemployment period.

[49] The findings of Edin et al. (2019) indicate that self-employment among working-class men is likely to consist of highly precarious and/or marginal forms of work.

considerations should take primacy, as evidence suggests that methadone is highly effective and should be preferred over buprenorphine for some patients, especially those who are less likely to comply with treatment on their own (McCance-Katz, Sullivan, and Nallani 2010). Our findings, in fact, suggest two different possibilities, each of which might apply to different subgroups of methadone recipients. First, some individuals may face consistently low employment prospects despite starting treatment, not because of it, owing to the severity of their disorder and other limiting factors such as homelessness. Within the regression sample, methadone recipients with no previous employment seem to fit this description, as they exhibit consistently lower job-finding rates compared with methadone recipients who did have prior employment and even compared with buprenorphine recipients with no observed work history. Second, even for patients with relatively strong employment potential, such as those previously employed and eventually receiving methadone, the logistical requirements of starting and staying on methadone may impose extra impediments to finding a job that do not come with buprenorphine treatment. Therefore, MOUD providers might take into consideration whether someone is seeking employment when deciding which treatment to recommend, especially when medical considerations do not strongly favor one medication over the other. Unfortunately, some patients may still lack convenient access to a buprenorphine provider owing to their location, as suggested in Burke et al. (2021).

Our results also suggest implications for employers and policymakers in terms of helping patients achieve greater convenience in accessing medications for OUD. Employers should be encouraged to offer accommodation for employees to take time from work to visit an opioid treatment facility and receive methadone, or to adjust their schedules to allow for such visits. Employers under the ADA are required to offer "reasonable accommodation" for employees

with substance use disorders to comply with treatment programs, but in practice the extent of compliance may be constrained (Aoun and Appelbaum 2019).

Separately, policies introduced during the COVID-19 pandemic allow for a greater number of patients to receive take-home doses of methadone. Brothers et al. (2021) find that these policies have been largely successful and have not led to significant increases in illegal diversion of the medication. Under these policies, Rhode Island allows OTPs to dispense 28 days of take-home methadone doses for fully stabilized patients and 14 days for selected other patients, in accordance with Substance Abuse and Mental Health Services Administration (SAMHSA) guidelines. In August 2022, CODAC Behavioral Healthcare of Rhode Island launched the country's first mobile methadone unit, an option permitted under new federal Drug Enforcement Administration regulations of 2021.[50] The clinic consists of a van operating six mornings per week (6:30 to 10 a.m.) in an area of Woonsocket where there is no nearby methadone clinic, greatly increasing convenience for patients. The clinic dispenses methadone and provides counseling services (via telehealth) as well as blood pressure, glucose, and mental health screenings. Increased deployment of such mobile units may not only offer life-saving benefits but also make it easier for treatment recipients to hold a job.

Our findings also relate to the debate over the factors that have restrained labor force participation in recent decades. As stated above, we find that the chances of separating from an in-state payroll job increased after the onset of OUD diagnosis (among those eventually diagnosed), controlling for a variety of other factors that might predict job separations. The

[50]See G. Wayne Miller, "A First in US, New Mobile Methadone Unit Seeks to Reduce Fatal Overdoses in RI," *Providence Journal*, July 23, 2022. https://www.providencejournal.com/story/news/healthcare/2022/07/23/rhode-island-mobile-methadone-unit-seeks-reduce-fatal-overdoses/10125640002/

individuals who moved out of payroll employment following an OUD diagnosis may or may not have actually left the labor force—the data do not allow us to make that distinction. Nonetheless, these results are consistent with evidence of a negative association between OUD and labor force participation found in previous research. Furthermore, even temporary exits from the labor force related to OUD onset might have contributed to secular declines in labor force participation; Coglianese (2018) argues that an increase in temporary exits among prime-age men helped to explain a large portion (somewhere between 20 and 40 percent) of the decline in that group's labor force participation rate from 1984 to 2011. Coglianese did not observe an increase in the share of intermittent labor force participants who cited health reasons to explain their temporary exits, although the period he examined (1984 through 2011) preceded the period of the steepest ascent of OUD prevalence in the United States (see Figure 1).

Finally, we have not explored associations between employment and OUD running in the other direction, such as whether opioid use and dependence might be precipitated by job loss or dim labor market prospects (as in Case and Deaton 2015, Edin et al. 2019), or by workplace accidents and repetitive stress injuries (Shaw, Roelofs, and Punnett 2020). Nonetheless, policy recommendations emerging from such studies are consistent with the goal of improving employment retention for individuals with OUD, such as recommendations that employer organizations seek to encourage early substance use treatment (rather than stigmatizing those who would seek treatment) and integrate opioid education into workplace safety training and health promotion programs (Shaw, Roelofs, and Punnett 2020).

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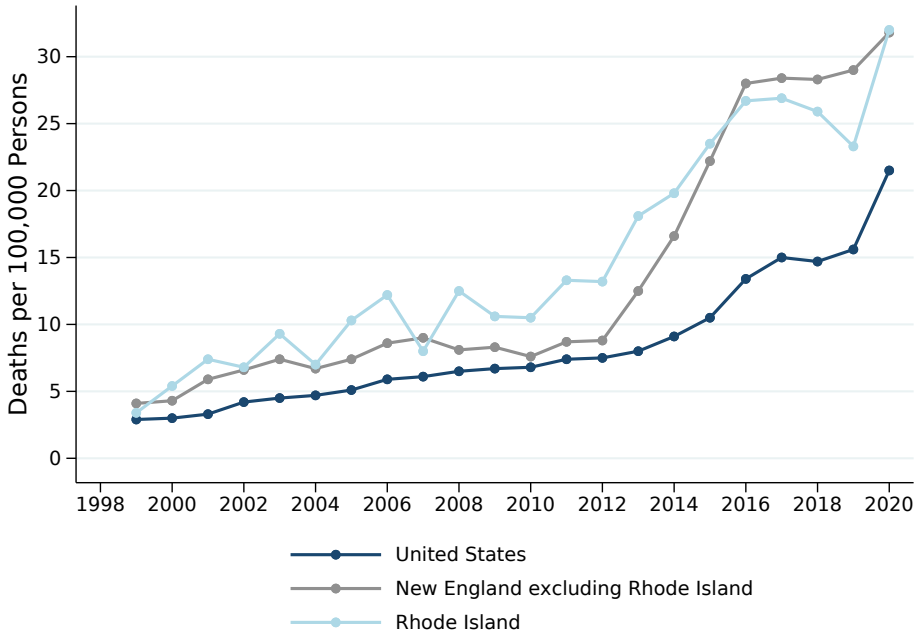
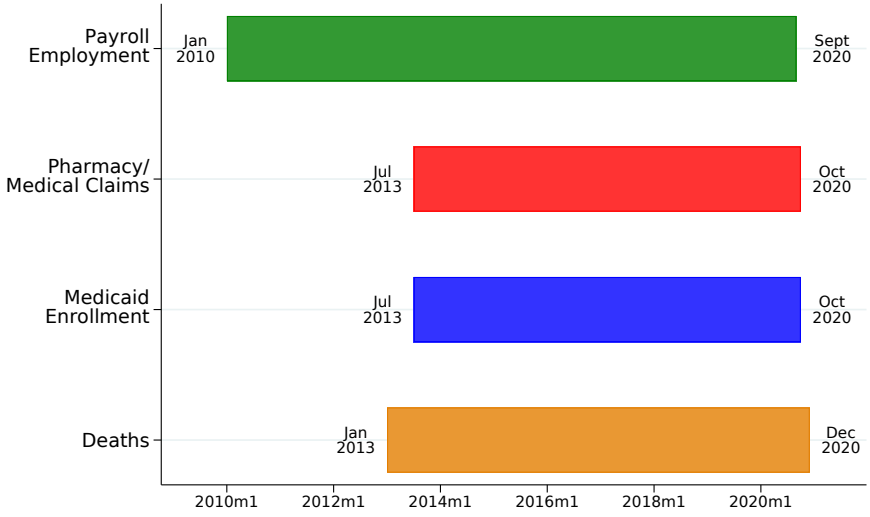
Figure 1: Age-Adjusted Opioid Overdose Mortality Rates per 100,000 Persons, 1999–2020




*Source:* Centers for Disease Control and Prevention.
*Notes:* The base population in each geographic area includes all residents. Values for New England excluding Rhode Island are population-weighted average mortality rates per year among Connecticut, Maine, Massachusetts, New Hampshire, and Vermont.

Figure 2: Time Intervals Covered by Ecosystem Data Files



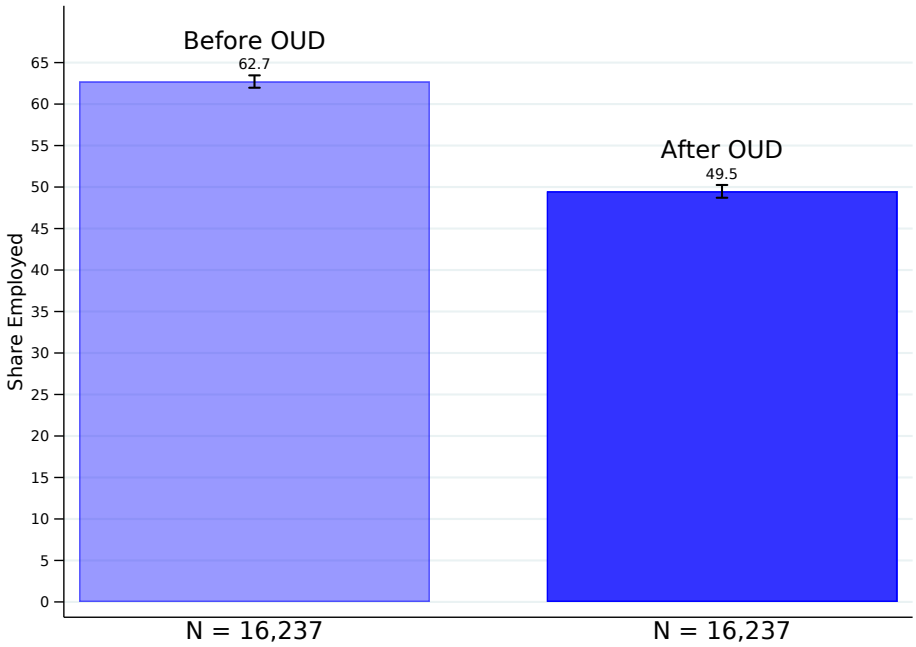

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem. Within the Ecosystem, the payroll employment data are furnished by the Rhode Island Department of Labor and Training, the Medicaid claims and enrollment data are furnished by the Rhode Island Executive Office of Health and Human Services, and the deaths data are furnished by the Rhode Island Department of Vital Records.

Table 1: Descriptive Statistics of Medicaid Enrollees by OUD Status

| | Full Medicaid Sample | OUD (Never) | OUD (Ever) |
|---|---|---|---|
| Median Age in 2018 | 36 | 35 | 39 |
| Ever Observed Employed | 75.0 | 75.6 | 69.1 |
| Quarters Employed, if Ever Employed | 18.1 | 18.4 | 14.3 |
| Employment Spells, if Ever Employed | 1.9 | 1.9 | 2.3 |
| Employment Supersector | | | |
| Natural Resources and Mining | 0.3 | 0.2 | 0.3 |
| Construction | 3.8 | 3.4 | 9.2 |
| Manufacturing | 5.5 | 5.6 | 4.4 |
| Trade, Transportation, and Utilities | 20.0 | 20.0 | 19.4 |
| Information | 0.6 | 0.6 | 0.3 |
| Financial Activities | 3.0 | 3.1 | 2.1 |
| Professional and Business Services | 17.2 | 17.2 | 17.2 |
| Education and Health Services | 19.6 | 20.3 | 10.7 |
| Leisure and Hospitality | 23.2 | 22.7 | 30.0 |
| Other Services | 4.3 | 4.3 | 4.7 |
| Government | 0.9 | 0.9 | 0.5 |
| Unknown | 1.5 | 1.6 | 1.1 |
| Quarters on Medicaid | 20.9 | 20.4 | 25.4 |
| On Medicaid Before Expansion | 38.4 | 36.3 | 59.1 |
| Hepatitis C | 2.8 | 1.1 | 19.3 |
| Alcohol Use Disorder | 13.7 | 10.2 | 47.5 |
| Disabled | 19.7 | 18.1 | 34.6 |
| Blind | 3.3 | 3.2 | 4.9 |
| Female | 56.5 | 58.1 | 42.5 |
| Number in Sample | 218,826 | 197,840 | 20,279 |

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.
*Notes:* Full Medicaid Sample consists of people enrolled in Medicaid in at least one month of 2018 and who were aged 18 to 64 as of 2018. The OUD (Never) sample consists of the subset of the Full Medicaid Sample who were never observed with any of the following: an OUD diagnosis, an opioid overdose diagnosis, or receipt of MOUD (methadone or buprenorphine) The OUD (Ever) sample consists of the subset of the Full Medicaid Sample who were ever observed with an OUD diagnosis. The "Ever" and "Never" determinations refer to the period 2013Q3 through 2020Q3.

Figure 3: Employment Status Before and After First OUD Diagnosis




*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.
*Notes:* The sample consists of Medicaid enrollees aged 18 to 64 who were diagnosed with opioid use disorder at least once during the 2013Q3–2020Q3 period.

Table 2: Cox Proportional Hazard Regression, Model of Job-Separation Events, OUD Diagnosis as Explanatory Variable

| | |
|---|---|
| OUD Diagnosed In Previous Quarter | 1.324** |
| | (0.022) |
| OUD Diagnosed More Than One Quarter Ago | 1.199** |
| | (0.010) |
| Female | 0.791*** |
| | (0.000) |
| Age Cohort 18–30 | 1.012 |
| | (0.816) |
| Age Cohort 42–54 | 0.907 |
| | (0.223) |
| Blind | 1.189* |
| | (0.057) |
| Disabled | 1.762*** |
| | (0.000) |
| Hepatitis C | 1.173** |
| | (0.015) |
| Alcohol Use Disorder | 1.243*** |
| | (0.000) |
| Not Employed In Past | 1.277*** |
| | (0.000) |
| On Medicaid Before Expansion | 0.994 |
| | (0.933) |
| Total Observations at Risk | 11,410 |
| Number in Sample | 1,899 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.
*Notes:* The reported coefficients represent hazard ratios. P-values are reported in parentheses. The sample consists of Medicaid enrollees aged 18 to 54 who were employed in at least one quarter in the 2013Q3–2020Q3 period, and who during that same time period were ever diagnosed with OUD and ever received either methadone or buprenorphine. An individual's initial OUD diagnosis must not have occurred on or before their first employment quarter, and they must have been enrolled in Medicaid in at least four quarters (not necessarily contiguous) after their first employment quarter. The model is stratified on whether individuals ever received methadone, ever received buprenorphine, or ever received both medications. Tie-breakers are dealt with using the Efron method, and standard errors are robust. The model also includes dummy variables for each calendar quarter, but their coefficients are not shown. Age cohort hazard ratios are calculated in relation to Age Cohort 31–41. The Disabled indicator does not include blindness, which is flagged separately. Total observations at risk refers to the total number of person-by-quarter observations utilized in the estimation.

Table 3: Descriptive Statistics of Medicaid Enrollees by Medication Status for OUD

| | Full Medicaid Sample | OUD and Buprenorphine | OUD and Methadone | OUD, never MOUD |
|---|---|---|---|---|
| Median Age | 36 | 37 | 37 | 42 |
| Female | 56.5 | 41.9 | 40.1 | 43.8 |
| Employed in Any Quarter in 2018 | 46.6 | 40.3 | 34.6 | 31.8 |
| Median Yearly Earnings in 2018 ($) | 31,175 | 24,339 | 23,418 | 20,613 |
| Received Methadone (Ever) | 3.2 | 36.6 | 100 | 0 |
| Received Buprenorphine in 2018 | 3.5 | 100 | 38.6 | 0 |
| Mortality Rate per 1,000 Persons in 2018 | 4.8 | 10.7 | 12.9 | 16.6 |
| Opioid-related Deaths in 2018 (Number) | 145 | 35 | 35 | 40 |
| Opioid-related Deaths in 2018 per 1,000 Persons | 0.7 | 4.8 | 5.0 | 4.6 |
| Percent of all RI Opioid Deaths in 2018 | 61.7 | 14.9 | 14.9 | 17 |
| Hepatitis C | 2.8 | 23.2 | 32.9 | 10.6 |
| Blind | 3.3 | 5.7 | 6.0 | 4.1 |
| Disabled | 19.7 | 23.2 | 29.7 | 44.6 |
| Opioid Overdose | 1.3 | 18.4 | 18.7 | 6.9 |
| Number in Sample | 218,826 | 7,353 | 6,988 | 8,632 |

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.
*Notes:* Full Medicaid Sample consists of people enrolled in Medicaid in at least one month of 2018 and who were aged 18 to 64 as of 2018. The OUD and Buprenorphine sample consists of people who had at least one OUD diagnosis during the 2013Q3–2020Q3 period and received buprenorphine at least once within that same period. The OUD and Methadone sample is analogous to the OUD and Buprenorphine sample. The OUD never MOUD sample consists of people diagnosed with OUD at least once during the 2013Q3–2020Q3 period and who never received either buprenorphine or methadone within that period. Median Yearly Earnings in 2018 are calculated among individuals with non-zero earnings.

Table 4: Regression Sample Descriptive Statistics

| | Buprenorphine Sample | Methadone Sample |
|---|---|---|
| Female | 38.4 | 36.0 |
| Male | 61.6 | 64.0 |
| Age Cohort 18–30 | 42.1 | 47.6 |
| Age Cohort 31–41 | 33.8 | 31.5 |
| Age Cohort 42–54 | 24.1 | 20.9 |
| Received Buprenorphine Ever | 100.0 | 48.9 |
| Received Methadone Ever | 40.9 | 100.0 |
| Employed In Past | 60.1 | 56.6 |
| On Medicaid Before Expansion | 55.9 | 61.5 |
| Blind | 5.7 | 5.6 |
| Disabled | 20.8 | 23.9 |
| Alcohol Use Disorder | 52.5 | 47.4 |
| Hepatitis C | 22.7 | 31.4 |
| Eventually Hired | 64.4 | 63.4 |
| Time to First Job-Finding Event (Quarters) | 6.6 | 6.9 |
| Number of Quarters Employed | 6.7 | 6.1 |
| Number of Employment Spells | 1.7 | 1.6 |
| Number of Employment Spells, if Ever Employed | 2.2 | 2.1 |
| Length of Employment Spell After First Job-Finding Event (Quarters) | 3.0 | 2.7 |
| Number in Sample | 5,347 | 4,231 |

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.
*Notes:* Buprenorphine Sample and Methadone Sample refer to the samples of individuals used to estimate the Cox proportional hazard regressions described in Tables 5 and 7, respectively. The relevant sample restrictions are described in the notes to those Tables. Employed In Past refers to those who are observed employed before their first nonemployment spell. Eventually Hired refers to those observed finding a job after their first nonemployment spell. First Job-Finding Event refers to the first quarter of employment (if ever observed) after someone's first nonemployment spell.

Table 5: Cox Proportional Hazard Regressions, Job-Finding Events, Receipt of Buprenorphine as Explanatory Variable

| | (1) | (2) |
|---|---|---|
| Buprenorphine Last Quarter† | 1.181*** | 1.050 |
| | (0.001) | (0.392) |
| First Quarter Post-Buprenorphine | | 1.442*** |
| | | (0.000) |
| Diagnosed with OUD | 0.920* | 0.955 |
| | (0.085) | (0.341) |
| Female | 0.923** | 0.924** |
| | (0.028) | (0.029) |
| Age Cohort 18–30 | 1.332*** | 1.332*** |
| | (0.000) | (0.000) |
| Age Cohort 42–54 | 0.672*** | 0.672*** |
| | (0.000) | (0.000) |
| Disabled | 0.377*** | 0.376*** |
| | (0.000) | (0.000) |
| Blind | 1.153** | 1.154** |
| | (0.046) | (0.045) |
| Hepatitis C | 0.963 | 0.961 |
| | (0.395) | (0.369) |
| Alcohol Use Disorder | 1.157*** | 1.156*** |
| | (0.000) | (0.000) |
| Total Observations at Risk | 66,145 | 66,145 |
| Number in Sample | 5,347 | 5,347 |

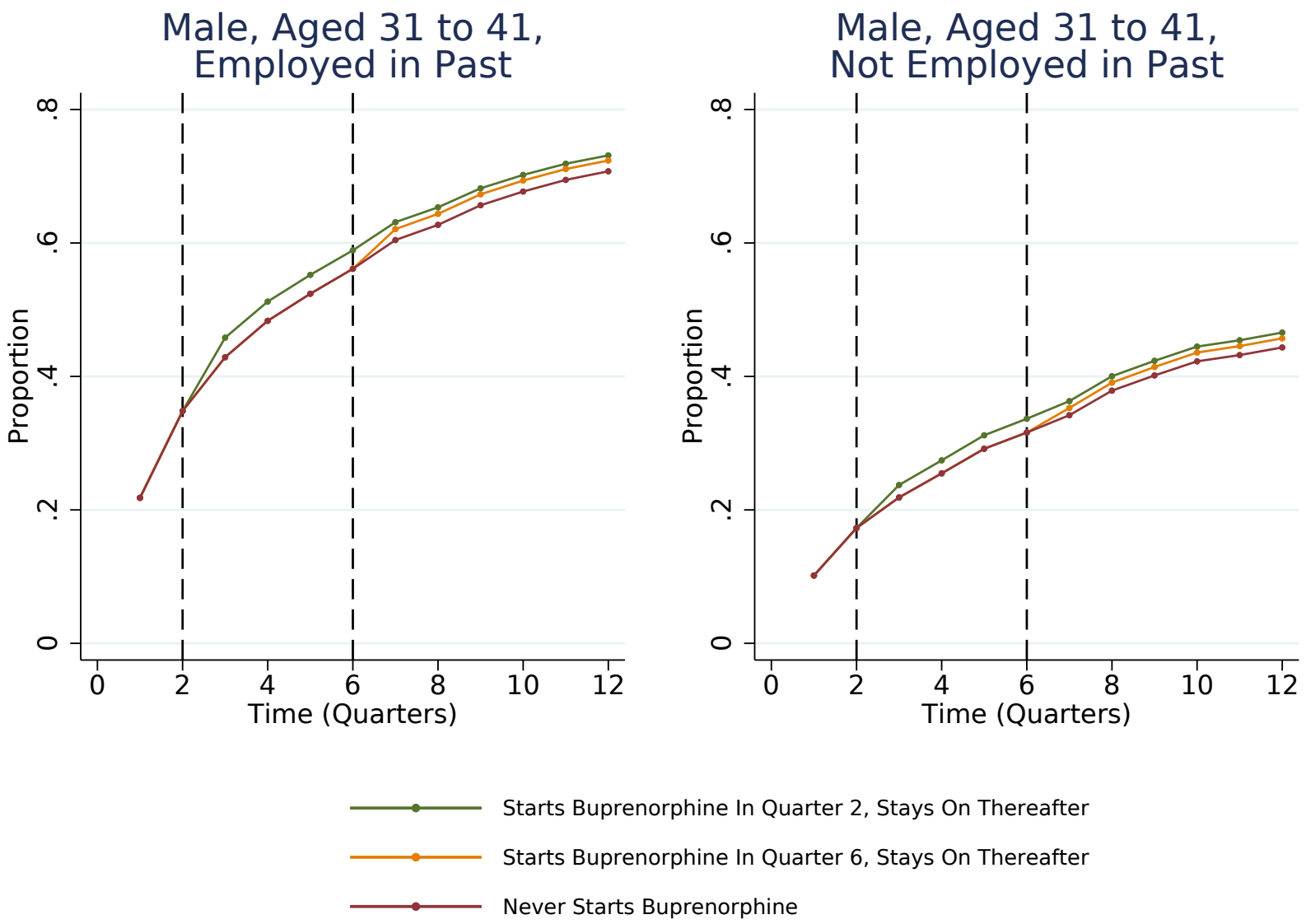
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.

*Notes:* The reported coefficients represent hazard ratios. P-values are reported in parentheses. The sample consists of Medicaid enrollees aged 18 to 54 who were not employed in at least one quarter during the 2013Q3–2020Q3 period, and who during that same time period were ever diagnosed with OUD and ever received buprenorphine. An individual's initial buprenorphine prescription must not have occurred on or before their first nonemployment quarter, and they must have been enrolled in Medicaid in at least four quarters (not necessarily contiguous) after their first nonemployment quarter. The model also includes dummy variables for each calendar quarter, but their coefficients are not shown. The Disabled indicator does not include blindness, which is flagged separately. Age cohort hazard ratios are calculated in relation to Age Cohort 31–41. All models are stratified on past employment, enrollment in Medicaid before the expansion, and ever receiving methadone. Tie-breakers are dealt with using the Efron method, and standard errors are robust. Total observations at risk refers to the total number of person-by-quarter observations utilized in the estimation.

† In model 1, Buprenorphine Last Quarter equals 1 in any quarter just after someone received buprenorphine. In model 2, a similar definition applies, with the exception that the indicator is set to 0 in the quarter just after someone's first quarter receiving buprenorphine, when First Quarter Post-Buprenorphine equals 1.

Figure 4: Predicted Cumulative Job-Finding Rates by Buprenorphine Status and Past Employment Status




*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.

*Notes:* The horizontal axis shows the number of quarters since the first nonemployment quarter. The vertical axis shows the (predicted) cumulative proportion of sample members who will have entered employment as of the given number of quarters. Individuals who find a job may or may not stay employed in later quarters. For each scenario shown, we assume the following characteristics: first diagnosed with opioid use disorder in quarter 2, not blind, not disabled, not on Medicaid before the expansion, never received methadone, and never diagnosed with alcohol use disorder or hepatitis C. Estimates are based on model 2 of Table 5.

Table 6: Predicted Cumulative Job-Finding Rates by Buprenorphine Status and Employment Status

| | Employed In Past | | | Not Employed In Past | | |
|---|---|---|---|---|---|---|
| | Starts Buprenorphine In Quarter 2 | Starts Buprenorphine In Quarter 6, | Never Buprenorphine | Starts Buprenorphine In Quarter 2 | Starts Buprenorphine In Quarter 6, | Never Buprenorphine |
| 3 Quarters | 0.458 | 0.429 | 0.429 | 0.237 | 0.219 | 0.219 |
| 7 Quarters | 0.631 | 0.621 | 0.604 | 0.363 | 0.353 | 0.342 |
| 12 Quarters | 0.731 | 0.724 | 0.707 | 0.466 | 0.457 | 0.443 |

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.

*Notes:* The Table reports the predicted cumulative job-finding rates for males aged 31 to 41 under each of the indicated scenarios, as of selected numbers of quarters after the first nonemployment quarter. The estimates are based on model 2 of Table 5 and are consistent with the values illustrated in Figure 4. See the notes to Figure 4 and Table 5 for further details about the estimation.

Table 7: Cox Proportional Hazard Regressions, Job-Finding Events, Receipt of Methadone as Explanatory Variable

| | (1) | (2) |
|---|---|---|
| Started Methadone† | 1.004 | 0.971 |
| | (0.943) | (0.661) |
| First Quarter Post-Methadone | | 1.066 |
| | | (0.478) |
| Diagnosed with OUD | 0.978 | 0.993 |
| | (0.715) | (0.913) |
| Ever Received Buprenorphine | 1.144*** | 1.143*** |
| | (0.001) | (0.001) |
| Female | | 0.865*** |
| | | (0.001) |
| Age Cohort 18–30 | 1.224*** | 1.230*** |
| | (0.000) | (0.000) |
| Age Cohort 42–54 | 0.652*** | 0.659*** |
| | (0.000) | (0.000) |
| Hepatitis C | 0.994 | 0.996 |
| | (0.884) | (0.927) |
| Alcohol Use Disorder | 1.049 | 1.050 |
| | (0.233) | (0.226) |
| Enrolled in Medicaid Before Expansion | 1.069 | 1.070 |
| | (0.220) | (0.215) |
| Total Observations at Risk | 53,292 | 53,292 |
| Number in Sample | 4,231 | 4,231 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.

*Notes:* The reported coefficients represent hazard ratios. P-values are reported in parentheses. The sample consists of Medicaid enrollees aged 18 to 54 who were not employed in at least one quarter during the 2013Q3–2020Q3 period, and who during that same time period were ever diagnosed with OUD and ever received methadone. An individual's initial methadone treatment must not have occurred on or before their first nonemployment quarter, and they must have been enrolled in Medicaid in at least four quarters (not necessarily contiguous) after their first nonemployment quarter. The model also includes dummy variables for each calendar quarter, but their coefficients are not shown. The Disabled indicator does not include blindness, which is flagged separately. Age cohort hazard ratios are calculated in relation to Age Cohort 31–41. Both models are stratified on past employment, disability, and blindness; model 1 is further stratified on gender. Tie-breakers are dealt with using the Efron method, and standard errors are robust. Total observations at risk refers to the total number of person-by-quarter observations utilized in the estimation.

†In model 1, Started Methadone is set to 1 in all quarters after someone's first quarter receiving the drug. In model 2, a similar definition applies except that Started Methadone is not set to 1 until two quarters after someone starts methadone, and First Quarter Post-Methadone equals 1 in the quarter just after the first quarter and is otherwise 0.

Table 8: Predicted Cumulative Job-Finding Rates by Past Methadone and Past Employment Status

| | Employed in Past | | Not Employed in Past | |
|---|---|---|---|---|
| | Started Methadone | Never Started Methadone | Started Methadone | Never Started Methadone |
| 3 Quarters | 0.434 | 0.432 | 0.229 | 0.228 |
| 7 Quarters | 0.617 | 0.616 | 0.377 | 0.376 |
| 12 Quarters | 0.735 | 0.733 | 0.491 | 0.490 |

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.

*Notes:* The table reports the predicted cumulative job-finding rates for males aged 31 to 41 under each of the indicated scenarios, as of selected numbers of quarters after the first nonemployment quarter. Individuals who find a job may or may not stay employed in later quarters. The estimates are based on model 1 of Table 7. The Started Methadone condition assumes that an individual started receiving methadone one quarter after the start of the nonemployment spell. The Never Started Methadone condition assumes that the individual never started taking methadone. In each scenario shown, we assume the following characteristics: not blind, not disabled, not on Medicaid before the expansion, never received buprenorphine, and never diagnosed with alcohol use disorder, opioid use disorder, or hepatitis C. See the notes to Table 7 for further details about the estimation.

Table 9: Cox Proportional Hazard Regressions, Job-Finding Events, among Those Ever Receiving Both Buprenorphine and Methadone

| | |
|---|---|
| Buprenorphine Last Quarter† | 1.167 |
| | (0.143) |
| First Quarter Post-Buprenorphine | 1.294** |
| | (0.041) |
| Started Methadone† | 0.892 |
| | (0.294) |
| First Quarter Post-Methadone | 1.257 |
| | (0.142) |
| Diagnosed with OUD | 0.911 |
| | (0.340) |
| Age Cohort 18–30 | 1.177** |
| | (0.016) |
| Age Cohort 42–54 | 0.653*** |
| | (0.000) |
| Blind | 1.222 |
| | (0.107) |
| Hepatitis C | 1.002 |
| | (0.977) |
| Alcohol Use Disorder | 1.020 |
| | (0.737) |
| Total Observations At Risk | 20,360 |
| Number in Sample | 1,670 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.

*Notes:* The reported coefficients represent hazard ratios. P-values are reported in parentheses. The sample consists of Medicaid enrollees aged 18 to 54 who were not employed in at least one quarter during the 2013Q3–2020Q3 period, and who during that same time period were ever diagnosed with OUD, ever received methadone, and ever received buprenorphine. An individual's initial methadone treatment must not have occurred on or before their first nonemployment quarter, and similarly for their first buprenorphine treatment. They must have been enrolled in Medicaid in at least four quarters (not necessarily contiguous) after their first nonemployment quarter. The model also includes dummy variables for each calendar quarter, but their coefficients are not shown. The Disabled indicator does not include blindness, which is flagged separately. Age cohort hazard ratios are calculated in relation to Age Cohort 31–41. The model is stratified on past employment, disability, gender, and enrollment in Medicaid before the expansion. Tie-breakers are dealt with using the Efron method, and standard errors are robust. Total observations at risk refers to the total number of person-by-quarter observations utilized in the estimation.

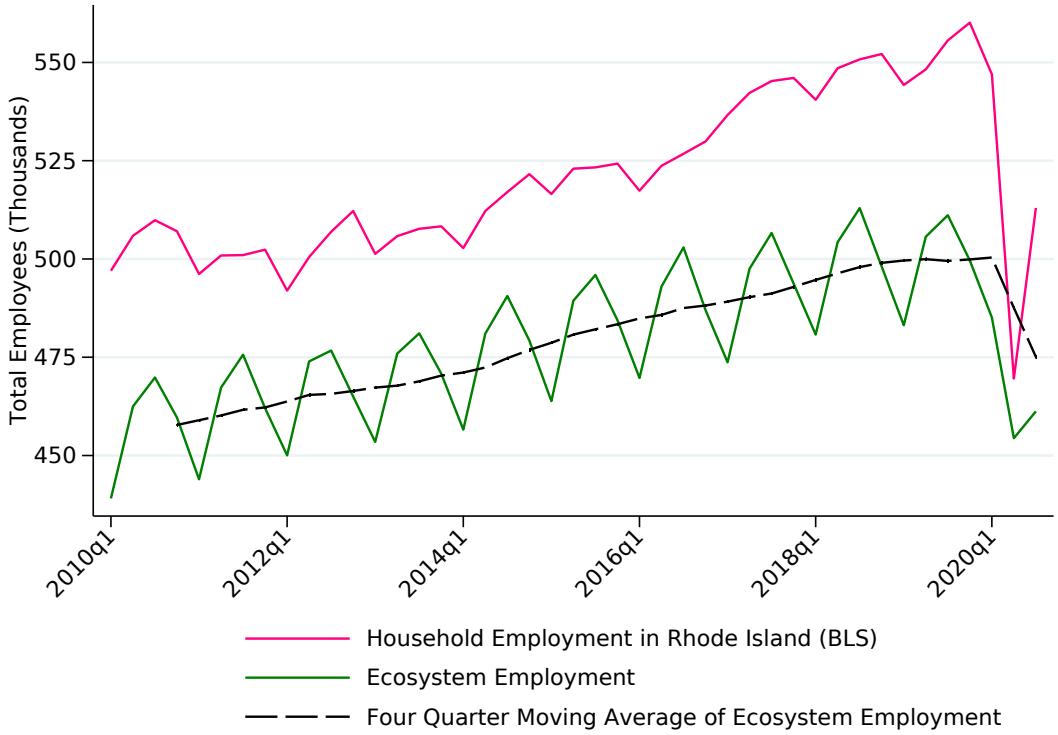
† Buprenorphine Last Quarter is set to 1 in any quarter just after someone received buprenorphine, with the exception of the quarter immediately after someone's first quarter on buprenorphine, when the indicator is set to 0. First Quarter Post-Buprenorphine is set to 1 only in the quarter immediately following someone's first quarter on buprenorphine, and is otherwise 0. First Quarter Post-Methadone is defined analogously in relation to when someone initiates methadone. Started Methadone is set to 1 as of two quarters after someone first receives methadone and then stays at 1 in all later quarters.

Table 10: Median Earnings among Regression Sample Members Employed Before and After Nonemployment Spell

| | Median Quarterly Earnings Before Nonemployment Spell | Median Quarterly Earnings After Nonemployment Spell |
|---|---|---|
| | Buprenorphine Regression Sample | |
| Started Buprenorphine, Then Found Job | $1,014 (N = 745) | $1,342 (N = 745) |
| Found Job, Then Started Buprenorphine | $1,152 (N = 1,575) | $1,241 (N = 1,575) |
| | Methadone Regression Sample | |
| Started Methadone, Then Found Job | $934 (N = 578) | $1,172 (N = 578) |
| Found Job, Then Started Methadone | $1,012 (N = 1,144) | $1,170 (N = 1,144) |

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.
*Notes:* In columns labeled Buprenorphine Regression Sample, the sample consists of the subset of that regression sample's members who were employed both before and after their first nonemployment quarter, and similarly for the columns labeled Methadone Regression Sample. Median Quarterly Earnings Before Nonemployment Spell refers to median single-quarter earnings (in dollars) in the quarter immediately prior to the start of an individual's first nonemployment spell. Median Quarterly Earnings After Nonemployment Spell refers to median single-quarter earnings in the earliest employment quarter after the start of an individual's first nonemployment spell. In all conditions, all events (such as Started Buprenorphine, Found Job) occurred strictly after the start of an individual's first nonemployment spell.

Figure A1: Payroll-Based Employment in Rhode Island (Ecosystem) vs. All Household Employment in Rhode Island (BLS)



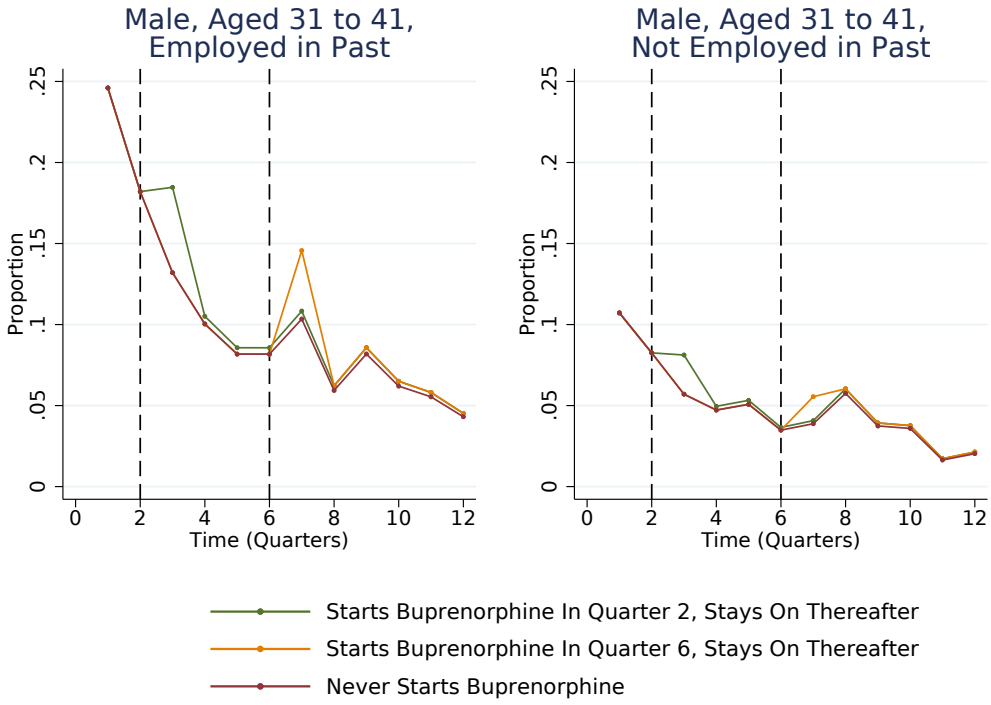

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem and the Bureau of Labor Statistics/Haver Analytics.
*Notes:* Rhode Island Household Employment for a given quarter is calculated as the average monthly number of employed Rhode Island residents (aged 16 and older) within the quarter, using the nonseasonally adjusted monthly values reported by the Bureau of Labor Statistics and accessed via the Haver Analytics database. Ecosystem Employment for a given quarter is calculated as the number of unique individuals with positive payroll earnings in Rhode Island in that quarter as reported to the Rhode Island Department of Labor and Training.

Table A1: Employment Rate by Year, Medicaid Enrollees

| | Full Medicaid Sample | Rhode Island Health Information Survey* |
|---|---|---|
| 2013 | 30.8 | . |
| 2014 | 34.4 | . |
| 2015 | 35.7 | 42.1 |
| 2016 | 35.3 | 42.5 |
| 2017 | 36.5 | . |
| 2018 | 35.6 | 49.1 |
| 2019 | 35.0 | 38.3 |
| 2020 | 30.9 | . |

*Source:* Authors' calculations using data from Rhode Island Data Ecosystem and Rhode Island Health Information Survey. The latter survey was accessed on September 29, 2022, at https://healthsourceri.com/surveys-and-reports/
*Notes:* Full Medicaid Sample refers to the set of Medicaid enrollees aged 18 to 64 observed in at least one quarter during the 2013Q3–2020Q3 period. In that sample the employment rate for a given year and sample is calculated as the average quarterly employment rate for the given year (or partial year) and sample. In 2013, only the third and fourth quarters are observed, and for 2020, only the first three quarters are observed.
* The age range of the survey's Medicaid respondents is unknown, and therefore the comparability with our own sample's rates is uncertain.

Figure A2: Predicted Instantaneous Job-Finding Rates by Buprenorphine Status and Past Employment Status




*Source:* Authors' calculations using data from Rhode Island Data Ecosystem.
*Notes:* The horizontal axis shows the number of quarters since the first nonemployment quarter. The vertical axis shows the (predicted) share of sample members who will find a job in the given quarter, conditional on not yet having found a job prior to that quarter, and based on the individual characteristics and sequences of events specified in each curve. For each scenario shown, we assume the following characteristics: first diagnosed with opioid use disorder in Quarter 2, not blind, not disabled, not on Medicaid before the expansion, never received methadone, and never diagnosed with alcohol use disorder or hepatitis C. Estimates are based on model 2 of Table 5.