Employed in a SNAP? The Impact of Work Requirements on Program Participation and Labor Supply

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Abstract

Work requirements are common in many U.S. safety net programs. Evidence remains limited, however, on the extent to which work requirements increase economic self-sufficiency or screen out vulnerable individuals. Using linked administrative data on food stamps (SNAP) and earnings with a regression discontinuity design, we find that work requirements reduce SNAP participation by 53 percent. Very low-income and homeless adults are disproportionately screened out. We statistically rule out employment increases of more than 3.5 percentage points. We find evidence of increased earnings near a key eligibility threshold, and provide conditions under which this trade-off is efficient.

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1 Introduction

Policymakers seek to provide benefits to low-resource households in times of need without reducing employment incentives. One common strategy is to require adults who are capable of working to sustain formal employment or participate in community service in order to receive benefits. Since 1996, some form of "work requirement" has existed in many means-tested programs, including Temporary Assistance for Needy Families (TANF) and the Supplemental Nutrition Assistance Program (SNAP). Proponents argue that work requirements improve labor force attachment and, in the long run, promote self-sufficiency. Opponents contend that the primary effect of work requirements is to reduce benefits for the most vulnerable recipients in times of need (Hahn and Haskins 2018, Fadulu 2019).

Work requirements are once again taking center stage in policy debates: SNAP enrollment has risen sharply since the start of the Covid-19 pandemic, and while all states initially suspended work requirements due to the crisis, many are debating reintroducing the policy. For example, Florida announced that work requirements would be enforced before suspending them in response to public pressure (Delgado 2020). Congress has debated extending a suspension first passed in March 2020 at the federal level (Peterson 2020). Previously, a proposed expansion of SNAP's work requirements was the central point of contention in the 2018 Farm Bill. In Medicaid, many states attempted to add work requirements before being blocked by federal court decisions in 2019 and 2020.[1]

This paper evaluates the impact of work requirements on the program participation and labor market outcomes of able-bodied adults without dependents (ABAWDs) in the context of SNAP. We use detailed administrative data from Virginia and a transparent regression discontinuity (RD) identification strategy that exploits the fact that participants sharply age out of work requirements at age 50.

To date, research on work requirements has struggled with several empirical challenges. First, commonly used survey data sources severely and non-randomly under-report participation in means-tested programs (Meyer et al. 2014, Ziliak 2015, Meyer and Mittag 2019). Second, studying responses among a sample of able-bodied adults without dependents inadvertently includes individuals who would not participate in SNAP under any policy regime. This overly broad sample produces an estimate that is closer to an intent-to-treat than to treatment-on-the-treated, making it difficult to distinguish small effects from low participation. Third, selection bias may arise from attempts to limit the study sample to those most likely to be impacted by work requirements. For example,

[1] In *Gresham v. Azar*, the United States Court of Appeals for the D.C. Circuit ruled against work requirements in Arkansas.

limiting the sample to incomes below a specified poverty threshold excludes individuals who raise their incomes above this threshold *in response to* work requirements. Some argue that these biases explain the lack of evidence that work requirements cause large improvements in labor market outcomes (Rachidi and Doar 2018).

To overcome these empirical challenges, we leverage unique administrative data spanning nearly a decade to focus on a relevant subset of non-disabled, childless beneficiaries subject to work requirements. We identify a sample of ABAWDs who likely *would* be on SNAP absent work requirements. From 2009 to 2013, Virginia experienced a prolonged period without SNAP work requirements, which were suspended during the Great Recession and reinstated in October 2013. We identify all ABAWDs who were enrolled in SNAP at the end of this multi-year period without work requirements and then follow them forward after work requirements are reinstated. By defining the sample during a time before work requirements, this "stock" population captures our ABAWD population of interest, yielding reliable estimates that both minimize selection bias and capture the treatment-on-the-treated.

We find strong evidence that work requirements dramatically reduce SNAP participation among ABAWDs. Virginia's introduction of work requirements reduced overall participation among ABAWDs (including individuals outside our "stock" population) near the age cutoff by 53 percent eighteen months after work requirements were reinstated. This decline is twice the size estimated in other studies. Time patterns of participation, RD estimates, and placebo checks all corroborate this conclusion. Moreover, we provide suggestive evidence that the estimated magnitude of the participation reduction is generalizable to ages further from the policy cutoff. In RD analyses focusing only on the stock population, we find that the introduction of work requirements reduced the rate of eighteen-month program retention by 37 percent (23.4 percentage points) among existing SNAP participants.

Our longitudinal data also allow us to study screening using *ex ante* observed covariates by classifying individuals on the basis of characteristics measured up to eight years prior to treatment. This avoids the bias that would arise from conditioning on characteristics that may themselves be endogenous to the policy, such as contemporaneous employment. We find that work requirements induce disproportionately higher exit among beneficiaries who are documented to be homeless or to have no earned income prior to the reinstatement of work requirements. In contrast, induced exit is disproportionately lower among those with a history of disability, who are more likely to be exempt from the work requirements.

Unlike the large effects on program participation, effects on employment are limited. Our point estimates are close to zero and we statistically rule out average employment

increases above 3.5 percentage points. There is evidence of increased earnings near a key eligibility threshold, however, based on unconditional quantile regressions. To evaluate the costs and benefits of the policy, we calculate the marginal value of public funds (MVPF) by comparing the value to participants of eliminating work requirements against the costs to the government. The MVPF implies that eliminating work requirements is likely efficient given the available evidence.

The paper builds upon a body of research studying work requirements and screening in means-tested programs. It is closely related to the theory developed by Besley and Coate (1992), which formalizes the trade-off between providing safety net benefits and avoiding work disincentives. The corresponding empirical literature documents the work disincentives inherent in means-tested and social insurance programs, providing evidence that income effects explain much of the causal relationship between government assistance and work (Autor and Duggan 2007, Fetter and Lockwood 2018). A handful of papers explore this relationship specifically in the setting of food stamps (Fraker and Moffitt 1988, Keane and Moffitt 1998, Hagstrom 1996, Hoynes and Schanzenbach 2012).

A complementary empirical literature studies whether work requirements can help to circumvent the trade-off in Besley and Coate (1992) by promoting work. In the context of traditional welfare programs, a number of studies find that work requirements increase employment and program exit, but decrease total income as many households exit without employment (Fang and Keane 2004, Grogger and Karoly 2005, Greenberg et al. 2009, Chan 2013, Card and Hyslop 2005, Chan and Moffitt 2018). A number of papers investigate this question in the context of SNAP. They find mixed results, likely due to differences in methods, data, and the potential presence of selection biases and non-treated populations as discussed above. Among these are several papers that use the age 50 eligibility cutoff for identification (Stacy et al. 2018, Harris 2021, Han 2020, Cuffey et al. 2015, Ritter 2018). These studies primarily rely on cross-sectional survey data, and find mixed results for participation and labor market outcomes. In a study using administrative SNAP data, Ribar et al. (2010) find moderate impacts on participation but do not estimate causal effects on labor market outcomes. Research describing how aggregate SNAP participation moves with macroeconomic conditions finds that large reductions in participation coincide with work requirements (Wilde et al. 2000, Ziliak et al. 2003, Ganong and Liebman 2018). We review these closely related papers in detail in Section 2.2.

Our results also contribute to the literature on screening in means-tested programs, which Nichols and Zeckhauser (1982) and Besley and Coate (1992) highlight as a policy tool to increase targeting efficiency. A recent literature empirically studies the role of screening by enrollment and recertification processes in Medicaid, SNAP, and disability programs

(Deshpande and Li 2019, Finkelstein and Notowidigdo 2019, Gray 2019, Homonoff and Somerville 2019). Our finding of disproportionate program exit among the homeless and individuals without pre-SNAP income provides new insights on the screening effects of work requirements, in particular.

This paper proceeds as follows. Section 2 discusses work requirements in SNAP, the policy variation available, and the administrative data we use. Section 3 documents participation survival curves and trends over time, and presents our main regression discontinuity estimates of total participation reductions. Section 4 uses our stock population definition to estimate the effect of work requirements on program retention, assess screening impacts, and study the role of additional verification requirements. Section 5 presents regression discontinuity evidence regarding labor market outcomes, including analyses of heterogeneous impacts along the earnings distribution and a discussion of the implications for the marginal value of public funds. Section 6 concludes.

2 Setting and Data

2.1 SNAP Work Requirements and Policy Variation

The Supplemental Nutrition Assistance Program (SNAP), previously called the Food Stamp Program, is among the largest poverty alleviation programs in the United States. In 2015, the program provided over $69 billion in benefits to over 45 million individuals, representing 14 percent of the U.S. population (Ganong and Liebman 2018). SNAP is administered at the state level, but the core aspects of the program are the same nationwide, regulated by the United States Department of Agriculture (USDA).

Each month, SNAP households get money loaded onto an Electronic Benefits Transfer (EBT) card, which they can use to buy most food and beverages at authorized grocery or convenience stores. With some exceptions, households are deemed ineligible for benefits if their gross income (before deductions) exceeds 130 percent of the Federal Poverty Line (FPL) or if their net income (after deductions) exceeds 100 percent of the FPL. Some states also use a household asset test. The federal government annually sets a maximum monthly benefit amount that increases with household size. Households with positive net income, defined as gross income less permitted deductions (e.g., medical expenses, dependent care), receive 30 fewer cents in benefits for each dollar of net income.[2]

To keep track of income and deductions, participants in most states are required to

[2]There is a 20 percent earned income deduction. This implies that SNAP benefits effectively decline by 24 cents for each additional dollar of *earned* income.

submit periodic "recertifications," typically at 6-month or 12-month intervals. Recertifications require substantial paperwork, including documentation of deductions and earnings (e.g., medical bills or pay stubs), and the majority of attrition from the SNAP program happens at these deadlines (Hastings and Shapiro 2018, Gray 2019, Homonoff and Somerville 2019).

SNAP imposes two distinct types of work requirements. This paper studies the "ABAWD" or "time limit" work requirement, which is the more demanding of the two. The requirement applies only to able-bodied adults without dependents (ABAWDs): adults aged 18–49 who do *not* report a child in the household and do *not* meet a limited set of exemptions (e.g., a confirmed disability; see USDA Food and Nutrition Service (2019)). These individuals are required to work, participate in qualifying job training programs, or do approved community service for at least 80 hours each month. ABAWDs who do not meet these requirements may receive benefits for a maximum of three months within a three-year period. The second type of work requirement is both more general and weaker. It requires participants aged 16–59 to consent to work registration, not quit current employment, and accept employment or participate in training programs *only if offered*. Throughout the paper, we focus exclusively on the more stringent ABAWD work requirements and use the phrase "work requirements" to refer to them.

To illustrate how work requirements may affect program participation and labor supply, Appendix Figure A.1 presents a stylized budget constraint for ABAWDs. Work requirements produce a notch in the budget constraint at the minimum hours threshold. Some SNAP participants would choose to increase labor supply to retain benefits compared to their preferred choice without work requirements. This response represents the "incentive effect" of the policy. On the other hand, SNAP participants working few hours in the absence of work requirements might find it too costly to reach the hours threshold and therefore exit the program. Some may work more than they previously did to make up for the lost SNAP benefits. This response represents an "income effect."

Our main identification strategy uses a regression discontinuity (RD) design to take advantage of the sharp change in ABAWDs' exposure to work requirements at age 50. There are no other rules within SNAP, TANF, or Medicaid that change discontinuously at age 50 that can confound this identification strategy, and childless adults were not eligible for TANF or Medicaid in Virginia during our sample period. Eligibility requirements for Supplemental Security Income (SSI) and Social Security Disability Income (SSDI) do loosen at age 50 due to the occupational grids used to determine disability status (Chen and van der Klaauw 2008, Deshpande et al. 2019). We therefore check for (and find no evidence of) confounding effects at the age 50 discontinuity in "placebo" time periods when work requirements were

not in effect.

In addition to the discontinuity at age 50, we take advantage of three other sources of variation in ABAWDs' exposure to work requirements. First, the American Recovery and Reinvestment Act (ARRA) of 2009 exempted *all* counties in all states from ABAWD work requirements as part of the Great Recession stimulus package.[3] Individual states began to reinstate work requirements over the subsequent few years. Virginia reinstated ABAWD work requirements statewide on October 1, 2013. The ARRA time period allows us to construct our "stock" sample consisting of participants who entered SNAP in the absence of work requirements. Second, counties with a sufficiently high unemployment rate can waive ABAWD work requirements (see Appendix A). Starting in May 2014, 23 of Virginia's 133 counties were granted county-wide exemptions from work requirements on this basis.[4] Our main analyses focus on the 110 counties in which work requirements remained in place after October 2013. Data from the 23 counties reinstating exemptions are used in supporting analyses.

Third, Virginia gradually rolled out the reinstatement of work requirements to incumbent SNAP participants. Prior to the reinstatement of work requirements, ABAWDs were generally assigned 12-month recertification periods. After reinstatement, newly enrolling ABAWDs were assigned 6-month or, later, 4-month recertification periods.[5] Importantly, incumbent ABAWDs who were enrolled in SNAP prior to the reinstatement of work requirements were not assigned these shortened recertification periods until the expiration of their ongoing 12-month recertification. Removal from the SNAP program due to non-compliance with work requirements did not occur until the end of these shortened recertification periods. The gradual roll-out of the shortened recertification periods informs our choice of sample period. In order to accurately capture the impact of work requirements while accounting for this gradual roll-out, our main RD estimates focus on participation and employment on March 2015, 18 months after the reinstatement of work requirements. This is the first month that the shortened recertification periods expire for all incumbent participants enrolled prior to the time of reinstatement.[6] We provide

[3] A few states and localities, including Texas and New York City, kept work requirements in place despite the exemption option provided by ARRA (Center on Budget and Policy Priorities 2019). Virginia used the ARRA exemptions as written by USDA.

[4] In addition to Virginia's 95 counties, the state classifies 38 independent cities as county-equivalents for Census purposes. We refer to both "true" counties and these 38 cities as counties. See Appendix A for a list of re-exempted counties.

[5] The 6 months were composed of the 3 allowed months of benefits without meeting work requirements within a 36-month window, an initial partial month of benefits that does not count towards the 3 allowed months, and 2 months of exemptions allotted by the USDA (see USDA Food & Nutrition Service 2015 and Appendix A for more details).

[6] For example, an ABAWD who entered the program in September 2013 (immediately before work

estimates for a range of other time periods in secondary analyses.

2.2 Related Literature

As discussed in the introduction, this paper is most closely related to other papers studying the effects of work requirements in SNAP, although our empirical approach departs from this literature. This section reviews both published work and contemporaneous working papers. While a number of papers have studied SNAP work requirements, including some using the age 50 cutoff, their reliance on survey and cross-sectional data raises specific identification concerns.

First, several studies using aggregated state- or county-level SNAP caseloads document that the implementation of work requirements coincides with substantial reductions in program participation (Wilde et al. 2000, Ziliak et al. 2003, Ganong and Liebman 2018). These studies typically use variation over time and geography in work requirements policies. For example, Ganong and Liebman (2018) find that work requirement waivers can explain 10 percent of increases in SNAP participation during and after the Great Recession. In contrast, Danielson and Klerman (2006) use an index that measures state-level severity of ABAWD time-limits based on state-specific implementations of work requirements and find no significant difference between the index and Food Stamp participation. These studies are somewhat limited by the aggregate nature of their data and the potential for legislative endogeneity.

Second, Ribar et al. (2010) use household-level administrative data from South Carolina between 1996 and 2005 and variation in work requirements across counties and over time. They find participation reductions of up to 20 percent, which are less than half the magnitude that we estimate. This discrepancy may arise from their pre-Great Recession sample period, from heterogeneity in impacts across states, or from the use of a sample selected to exclude those who would enroll in SNAP (only) in the absence of work requirements. In addition, Ribar et al. (2010) do not examine employment or earnings as a separate outcome, but instead analyze the rate of exits from SNAP among those with (UI-covered) employment. As we describe in Section 5.2, however, the interpretation of such regressions is not straightforward because the empirical design conditions on an outcome, thereby inducing changes in sample composition that frustrates causal estimates (Angrist and Pischke 2009).

requirements are reinstated) might not make contact with the SNAP office again until September 2014, when she would be notified of upcoming recertification requirements and removed from the program in March 2015 if they were not met. Virginia stopped the practice of using USDA-allotted exemptions to extend recertification periods in October 2014, possibly shrinking assigned recertification periods for incumbent ABAWDs. As a result, some ABAWDs whose ongoing 12-month recertification periods expired in the fall of 2014 may not have received a full 6 months before their subsequent recertification.

Finally, a set of papers closely related to our work use microdata and the age 50 cutoff as a source of identification (Stacy et al. 2018, Harris 2021, Han 2020, Cuffey et al. 2015, Ritter 2018). We summarize the main differences here, and provide further details of findings, strengths, and limitations of these studies in Appendix B. These studies almost exclusively rely on cross-sectional survey data from either the American Community Survey (ACS) or the Current Population Survey (CPS) to measure labor market outcomes. Labor market participation in survey-based populations exceeds that in administrative records. For example, employment rates exceed 70 percent in the control samples of Harris (2021) and Han (2020), which are three to four times higher than in QC data. By contrast, only 17 percent of the Virginia ABAWD SNAP population (and 19 percent of our stock population) is in UI-covered employment when work requirements are reinstated. This is comparable to the 17 percent employed fraction of the nationwide SNAP ABAWD population, as reported in the 2013 QC data. Subsequently, 29 percent of our stock population near age 50 is employed 18 months after reinstatement, which is appreciably smaller than in other study control groups.

Ritter (2018) additionally uses a sample of administrative records of SNAP participants from public Quality Control (QC) Records, which provides a useful cross-section but cannot be used to create a "stock" population for analysis. Samples in these studies are often constructed based on endogenous criteria.[7] In addition, estimating the effects of work requirements in cross-sectional data is likely to understate the treatment-on-the-treated. This potential underestimation is driven by overly broad sample definitions that include people who would not be on SNAP even absent work requirements. For example, at most 20 percent of those in *control* samples analyzed in survey-based studies participate in SNAP. By contrast, with longitudinal data, we construct a sample that has 100 percent SNAP participation in month zero.

These existing papers find mixed results for the effects of work requirements on employment and SNAP participation. Using ACS data, Stacy et al. (2018), Harris (2021), and Han (2020) find that work requirements decrease SNAP participation by 10 to 15 percent. While Stacy et al. (2018) find no significant impacts on labor market outcomes, Harris (2021) finds employment increases of 1.5 to 1.8 percent. Han (2020) finds no significant impacts on employment but finds impacts on hours worked. Using CPS data, both Cuffey et al. (2015) and Ritter (2018) find no significant impacts of work requirements on labor market outcomes. Cuffey et al. (2015) further find no significant impacts on SNAP participation.

[7] This is particularly true for QC-based samples, which suffer from mechanical selection bias as discussed in Ritter (2018).

Our ability to link SNAP administrative records with administrative earnings histories provides substantial advantages relative to survey data. The first advantage is improved accuracy: linking UI data to administrative SNAP records allows us to avoid the documented under-reporting of SNAP participation and mismeasurement of income in surveys. Survey data have been shown to undercount SNAP participants by up to 40 percent (Meyer and Mittag 2019, Meyer et al. 2014) and to measure income with systematic errors (Bee and Mitchell 2017). Second, by allowing us to construct our stock population, the linked longitudinal data enable us to more closely approach the treatment-on-the-treated estimate while simultaneously avoiding selection bias. Third, the panel nature of the data makes possible two sets of analyses that are not feasible in repeated cross-sections: We can examine the time path of impacts of work requirements, including whether they induce an increase in self-sufficiency in the medium run. Cross-sectional data will, in contrast, average effects from both new entrants and long-term program participants. We can also study heterogeneous impacts of work requirements by examining heterogeneity across endogenous outcomes measured at baseline. Finally, unlike studies that use public-use versions of surveys, we have more precise information on geography, the timing of observations, and age. These features allow us to more accurately identify who is subject to work requirement waivers or exemptions and to execute a more refined RD strategy with age as the running variable.

2.3 Administrative Data on SNAP Participation and Earnings

We use annual administrative records from the Virginia Department of Social Services (DSS) between 2007 and 2015. The files include data on demographics, disability and employment status, housing type, receipt of earned and unearned income, and the first and last calendar months of every SNAP participation spell. Demographics include age in months, gender, education, race, zip code of residence, and county of the participant's SNAP program office.[8] In addition to age, two additional variables are relevant for determining ABAWD status. The first measures the status of general work registration and reasons for any exemption. The second measures disability status, including which disability programs the SNAP participant is enrolled in.

Our main sample definition uses individuals who have no known exemptions or disabilities and have no children in their SNAP-defined household. These individuals would typically be considered ABAWDs if they are under age 50, and non-ABAWDs if they are

[8]Not all city-counties have a physical SNAP office located within their borders, but all ordinary counties do. SNAP applicants who apply for SNAP through the wrong program office are still subject to the rules of the county of their residence and their applications are typically either transferred or denied.

over age 50. To validate this definition in our data, we compare our count of ABAWDs with official counts using external data on ABAWD status and exemptions provided by Virginia DSS. The number of ABAWDs in our data is 96.5 percent of the official count, providing confidence that we are accurately measuring ABAWDs among SNAP participants.

We match the SNAP administrative records to employment records collected for the state's Unemployment Insurance (UI) program. These records contain a panel of quarterly earnings from 2005 to 2017 and have been previously validated against Social Security earnings records (Dean et al. 2017). Using the UI records, we define quarterly employment as an indicator for appearing in the wage data that quarter. Our results are robust to alternative definitions of employment, such as an indicator for earning above the full-time minimum wage. We deflate quarterly earnings to 2018Q1 USD using the all-items CPI.

Despite the advantages outlined in Section 2.2, our data also have some limitations. First, the SNAP administrative data do not report benefit amounts. Second, UI wage records do not capture self-employed workers, federal employees, and independent contractors. This omission may threaten the validity of our estimates if work requirements change the *composition* of employment. In robustness checks, we find no impact on sources of employment that are self-reported by SNAP participants but not covered by the UI data (Appendix Figure C.9).

A second limitation is that our estimates may not generalize outside of Virginia. For example, some states impose greater reporting burdens and more rigorous verification of work status than Virginia. While we are not equipped to evaluate across-state heterogeneity in how work requirements are implemented, we show in Appendix D.1 that the composition of SNAP recipients in Virginia is similar to nationwide averages based on QC data. In terms of broad economic conditions, Virginia's unemployment rate was in the second-lowest quartile among states during our main sample period (Bureau of Labor Statistics 2016).

Table 1 describes the characteristics of Virginia SNAP participants in September 2013 (the last month before the reinstatement of work requirements), as measured from the Virginia administrative data. We report descriptive statistics separately for adults whom we classify as ABAWDs and adults whom we do not classify as ABAWDs due to either their age, having a dependent, or satisfying a specific exemption.[9] There are 90,382 unique ABAWDs, which represents roughly 9 percent of the total beneficiary population. The mean age of ABAWDs is 33.0 years, about ten years younger than other adults. A smaller share of ABAWDs are female (40 percent of ABAWDs vs. 67 percent of other adults), married (7 percent vs. 21 percent), report unearned income to DSS (7 percent vs. 41

[9]We present descriptive statistics of all SNAP households over the entire period of our data in Appendix C.

percent), or have ever reported a disability in the past[10] (10 percent vs. 35 percent). According to UI records, ABAWDs have lower levels of employment and lower annual wage earnings than other adults on SNAP. Finally, ABAWDs are more likely to be homeless (14 percent vs. 2 percent).

While benefit amounts are not included in our data, other sources indicate that SNAP benefits constitute a large and important source of income for this population. We use QC data to tabulate the amount of benefits at stake and how much would be reduced through changes in program participation and labor supply. We restrict the QC data to non-disabled adults aged 18–49 in childless Virginia households who have at least one member of the household who is not excluded from work registration. If work requirements remove participants from SNAP without increasing labor supply, the average household exiting the program would lose $189 per month, the maximum for a single-person household during our sample period. This drop constitutes roughly two-thirds of their gross income. If work requirements induce ABAWDs to work more to retain benefits, then SNAP benefits would decline by about $100, on average, based on their deductions, hours, and phase-out schedule. We estimate that less than 5 percent of ABAWDs would earn enough by meeting work requirements to become ineligible for SNAP. In short, ABAWDs face the prospect of meaningful reductions in SNAP benefits as a result of the policy.

3 Effects on Program Participation

This section estimates the effect of work requirements on total SNAP participation. Section 3.1 documents trends of lower retention and falling total SNAP participation in the wake of work requirements. Section 3.2 then implements RDs to estimate the effect of work requirements on participation. Section 3.2 also shows that slow-downs in the flow of new entrants account for a small minority of the total participation drop. Hence, reduced participation is driven primarily by exit among existing participants and shorter spells among new entrants.

[10]In order to be included in the sample, individuals must have no disability or other exemption as of September 2013. However, as both disability and exemption status can change over time, some of these individuals may have a prior history of disability or other exemptions. Similarly, individuals may be newly categorized as having a disability or another exemption after the reinstatement of work requirements (e.g. Figure C.11).

Table 1: Descriptive Statistics of SNAP Enrollees in September 2013

	ABAWDs		Non-ABAWD Adults	
	Mean	SD	Mean	SD
Age	33.0	9.8	43.1	17.1
Female	0.40	0.49	0.67	0.47
Married	0.07	0.25	0.21	0.41
Household Size	1.32	0.69	2.59	1.62
Homeless	0.14	0.34	0.02	0.13
White	0.42	0.49	0.46	0.50
Black	0.46	0.50	0.42	0.49
Some College+	0.10	0.30	0.12	0.33
Has Earned Income (DSS)	0.17	0.37	0.26	0.44
Has Unearned Income (DSS)	0.07	0.26	0.41	0.49
Avg. Annual Earnings (UI)	3,507	5,785	4,643	8,028
Fraction of Months Employed	0.32	0.34	0.31	0.39
Ever reported...				
Any Disability	0.10	0.30	0.35	0.48
Exempt from Work Registration	0.39	0.49	0.77	0.42
Exempt due to Dependent	0.11	0.31	0.32	0.46
Medicaid Recipient	0.43	0.50	0.78	0.41
TANF Recipient	0.12	0.32	0.24	0.43
SNAP E&T Participant	0.16	0.37	0.07	0.25
Moved County	0.33	0.47	0.30	0.46
N	90,382		473,095	

Note: Table reports descriptive statistics of SNAP enrollees from September 2013. The top panel shows demographic data from DSS records, with the exception of the bottom three rows showing earnings and employment from UI records. Some College+ refers to educational attainment of some college or higher (college graduate or advanced degree). The bottom panel reports the fraction of people enrolled in September 2013 who had the designated indicator at any point since the start of the sample period (January 2007).

3.1 Falling Participation

We begin by showing the acceleration of exit from SNAP when participants are confronted with work requirements. We use wide age ranges for these descriptive analyses, before subsequently focusing on narrower bandwidths around age 50 in the RD. The survival plot in Figure 1 shows the fraction of able-bodied adults who continue to be on SNAP for up to thirteen months after the start of their participation spell. The plot subsets to ABAWDs younger than 50, and adults 50 and older who would meet the criteria for ABAWD if not for their age.[11] We also restrict attention to SNAP participants who first enter after the reinstatement of statewide work requirements between October 2013 and April 2014. For the first six months after entry, none of these participants are required to work in order to continue to receive SNAP benefits. Each month, a small fraction of participants leave SNAP for other reasons (e.g., income rising above the threshold) in equal proportions across the under-50 (dashed line with circles) and 50-and-above (solid line with triangles) groups.

After six months, those under 50 years old must demonstrate that they meet work requirements or be removed from program rolls. By contrast, those who are 50 or older have a light reporting requirement six months into their 12-month recertification period. While participation survival declines in both groups after six months due to reporting requirements (Gray 2019, Homonoff and Somerville 2019), the decline among those under 50 is much larger than the the corresponding decline for those 50 or older.[12] By month seven, the surviving fraction of ABAWDs is more than 30 percentage points (over 40 percent) smaller than the surviving fraction of able-bodied adults aged 50 and older. Since the sample consists of SNAP participants who enter the program at different times over the course of several months, the sharp decline we observe among ABAWDs after six months is not explained by a common calendar-time shock.[13]

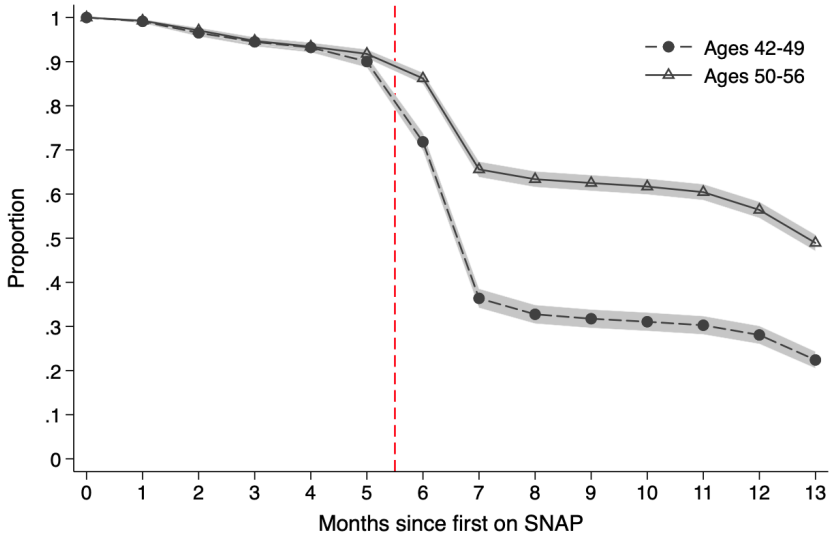
Next, we document the magnitude of total participation declines following the

[11] The under-50 group excludes 49-year olds because they will pass the age-50 cutoff within the year.

[12] The sharper drop between the months we label as 6 and 7 than between the months we label as 5 and 6 is attributable to imperfect measurement. Because we only observe the month of initial entry, rather than the precise date, some of the participants in the plot do not actually face binding work requirements until the month we label as month 7.

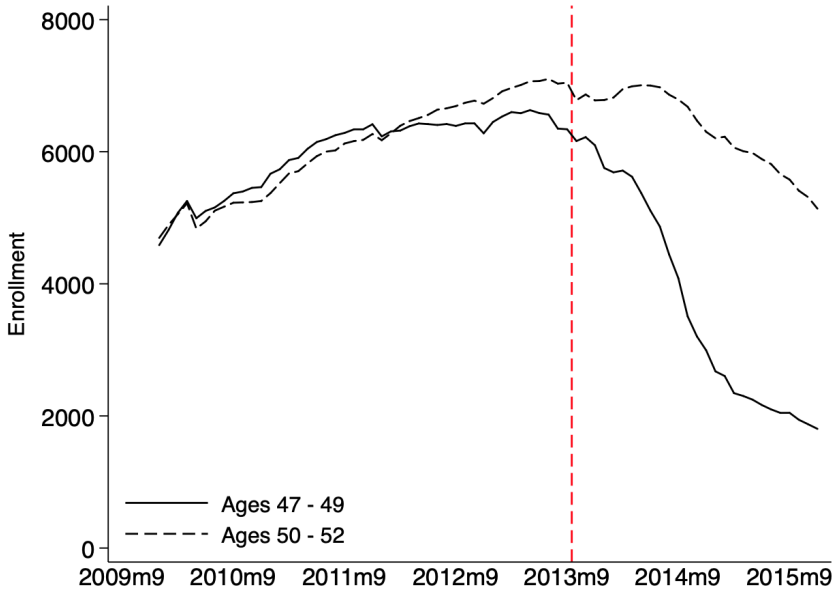
[13] The sharp drop tracks subsequent policy changes. Appendix Figure C.2 repeats the survival plot for later program entrants, those newly entering between July 2014 and December 2014, when the under-50 group was required to meet work requirements after only four months rather than after six months due to the shortening from 6-month recertification periods described in Section 2. The figure shows a remarkably similar pattern to Figure 1, with nearly identical survival curves for the under-50 and 50-and-above groups during the first four months, and then a sharp divergence after the under-50 group must meet work requirements. As a placebo test, Appendix Figure C.1 plots corresponding survival curves for the subset of counties that received exemptions from ABAWD work requirements in May 2014. Participation differs little by age when work requirements are not in effect. Taken together, these survival curves strongly suggest that work requirements reduced retention among new ABAWDs by substantial amounts.

Figure 1: SNAP Participation Survival by Work Requirements Status

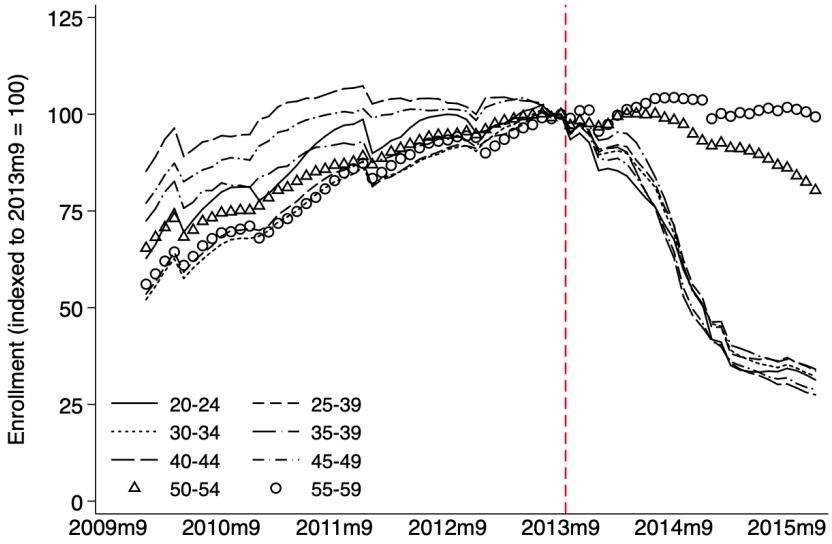


Notes: Figure plots participation survival for ABAWDs aged 42–49 and adults without dependents or disabilities aged 50–56 in counties with active work requirements, and who have not had a SNAP spell earlier in our sample period. Work requirements apply to ABAWDs (dashed line), who are required to start meeting them six months after initial entry (dashed red vertical line) in order to continue to receive SNAP benefits. Figure plots participation survival for participants whose SNAP spells begin between October 2013 and April 2014, prior to the gradual reduction in recertification period from six months to four months. Appendix Figure C.2 repeats this plot for those whose SNAP spells begin between July 2014 and December 2014, who are required to start meeting work requirements four months after initial entry.

Figure 2: Total Participation Around Work Requirements



(a) Total Participation Counts (Raw)



(b) Total Participation Counts (Normalized), By Age Group

Notes: Plots of monthly total participation counts in Virginia, for adults in the specified age ranges who would meet the definition for ABAWD if age were ignored. The dashed red vertical line corresponds to the end of the statewide ARRA exemptions from work requirements in September 2013. Top panel plots raw counts for age groups immediately surrounding age 50. Bottom panel plots counts for a wider range of age groups, normalized to within-group participation in September 2013.

reintroduction of work requirements. Figure 2a shows the total monthly participation counts before and after the reinstatement of work requirements (dashed red vertical line), comparing beneficiaries slightly younger than 50 (dashed line) to those 50 and slightly older (solid line). Across age groups, the participation increase that followed the Great Recession began to flatten and decline after 2012. After the reinstatement of work requirements, participation fell sharply among the under-50 group, whereas it remained stable for nearly a year in the 50-and-above group.

While our main RD identification strategy used in the next section estimates local average treatment effects for 50-year-old SNAP participants, Figure 2b suggests that the participation effects we document may be generalizable to a broad range of ages. The figure plots participation counts for 5-year age bins, as a percentage of the corresponding age bin's count in September 2013 (just prior to the reinstatement of work requirements). While the groups aged 50 and above experience slow and heterogeneous declines in participation, all age ranges from 20 to 49 experience nearly identical relative declines in participation. The patterns in Figure 2b therefore suggest that the impact of work requirements on participation is likely fairly stable across the age distribution.

3.2 Estimates of Total Participation Impact

Section 3.1 shows that SNAP participation dropped differentially among participants subject to work requirements when work requirements were reinstated. However, potential underlying differences between the under-50 and 50-and-above groups make it difficult to draw conclusions about the portion of the differential drop, if any, that is *caused* by work requirements. To obtain a credible point estimate for the causal impact of work requirements on total participation, we exploit the sharp discontinuity in ABAWD classification at age 50 using a regression discontinuity framework.

We first estimate the impact of work requirements on total participation counts for the entire state of Virginia.[14] Our preferred specification is a linear donut RD, with age (the running variable) centered around 50:

$$Y_a = \alpha + \beta \cdot U50_a + \gamma \cdot (age_a - 50) + \delta \cdot U50_a \cdot (age_a - 50) + \varepsilon_a \tag{1}$$

where Y_a is the count of participants who, as of September 2013, are aged a, incremented in months. We follow Gelman and Imbens (2017) in using low-order polynomial specifications, with the local linear model as our preferred specification. Appendix C checks robustness

[14]Participation counts include only the 110 counties in which work requirements remain on after their reinstatement; the 23 counties that later regain exemptions are excluded.

to alternative specifications. The variable $U50_a$ is an indicator for whether age a is strictly below 50, and therefore marks the age range where work requirements apply. The coefficient of interest is β, which measures the jump in the regression function at the discontinuity.

The primary specification estimates the model for participation counts eighteen months after the reinstatement of work requirements. This allows enough time to capture the entirety of the gradual roll-out of work requirements (described in Section 2.1). In evaluating outcomes at eighteen months, we exclude a donut of SNAP participants who are older than 48.5 and younger than 50 as of September 2013. As shown in Figure 3a, these participants cross the work requirements age cutoff between September 2013 and the period when outcomes are measured, and are therefore only partially exposed to work requirements. This age-out during the period between the policy change and the outcome measurement motivates the donut RD approach used throughout the paper. In order to avoid ad hoc bandwidth selection for the RDs, we follow the systematic procedure of Calonico et al. (2014) to select (potentially asymmetric) optimal bandwidths.[15]

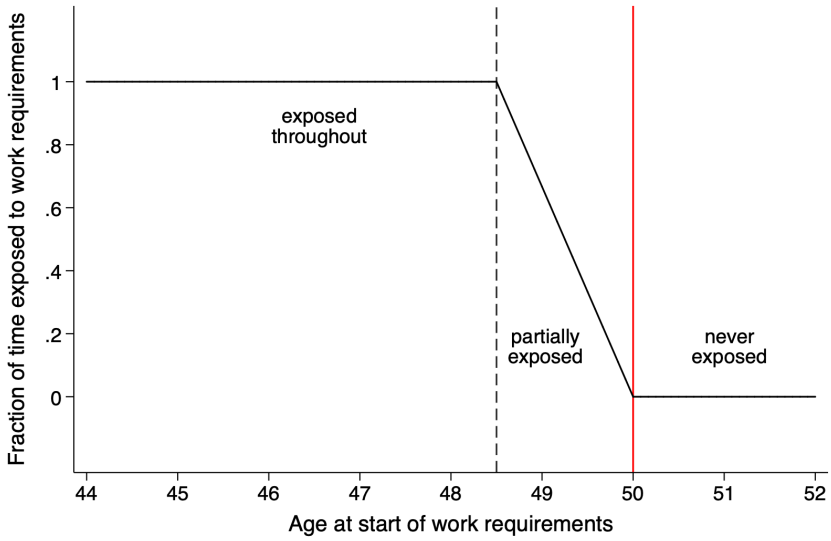
Figure 3b displays the results of the total participation donut RD. The sharp positive increase in participation at age 50 suggests that, eighteen months after reinstatement, work requirements reduce total ABAWD participation by 53 percent. This drop is calculated as the reduction within each monthly age bin (110.8 participants), compared to the number of participants at age 50 (205.4 participants).

Appendix Figure C.3 provides further evidence that the participation reduction is caused by work requirements. The figure shows the total participation RDs estimated at earlier periods: 12 months before the reinstatement of work requirements, the month that work requirements were reinstated, and 12 months after the reinstatement of work requirements. The periods before and at the reinstatement serve as placebo checks: participation on either side of the age 50 threshold is nearly identical, suggesting that the jump in Figure 3b is *not* attributable to discontinuities at age 50 that are present when work requirements are absent. The period 12 months after the reinstatement of work requirements shows a similar pattern to Figure 3b, but the participation drop below age 50 is smaller, consistent with the gradual roll-out of the policy. As further robustness checks, Appendix Figure C.4 plots the donut RD estimates for a wide array of time horizons using linear and quadratic specifications.

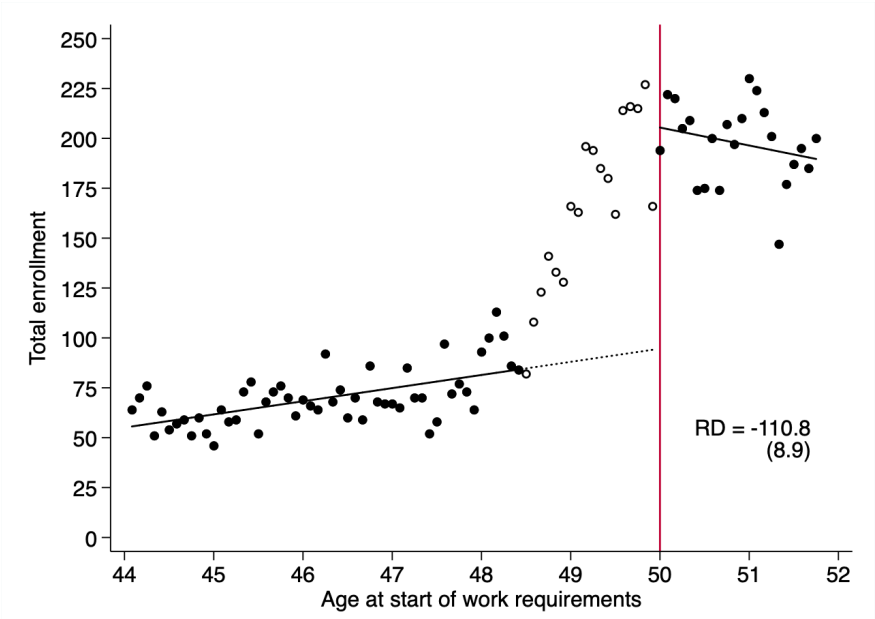
Before moving onto our main individual-level analysis using the stock population, we decompose the total SNAP participation decline into three distinct channels. The decline documented in Figure 3b reflects some combination of increased exit among existing participants, faster exits among new participants entering after work requirements begin,

[15] Appendix Figure C.6 shows that our conclusions remain similar over a wide range of bandwidths.

Figure 3: Exposure to Work Requirements and RD Estimate of Total Participation



(a) Exposure to Work Requirements by Age at Start of Work Requirements



(b) RD Estimate of Total SNAP Participation, 18 Months After Work Requirements

Notes: Top panel shows the fraction of time that SNAP participants are subject to work requirements during the 18 months immediately following the reintroduction of work requirements. Work requirements abruptly cease to apply at age 50. Participants whose age when work requirements start is between 48.5 and 50 fall into the "donut" of those who age out by the time outcomes are measured (18 months after the reintroduction of work requirements). Bottom panel displays the donut RD results for total SNAP participation 18 months after work requirements were reinstated in Virginia. The scatter plot shows total participant counts by age in quarters, and the lines show a linear regression fit on both sides of the eligibility threshold. Standard errors clustered by monthly age in parentheses. The sample consists of the subset of counties for which work requirements remain on after October 2013.

and deterrence of potential new participants who do not enter SNAP because of work requirements. We produce separate RD estimates for each channel, and then compare them to the missing mass of 110.8 beneficiaries per month from Figure 3b to arrive at each channel's approximate contribution to the total enrollment decline. Table 2 summarizes the results of these exercises, which are described in detail in Appendix D.2. These exercises provide suggestive evidence that deterrence is *not* the primary driver of enrollment declines. Instead, the retentions of existing and new beneficiaries appear to be the most important channels driving total enrollment declines.

Table 2: Decomposition of Total Enrollment Declines in Figure 3b

Mechanism	Exercise	Explained % of Enrollment Decline	Details
Decreased retention among existing participants	RD of retention for existing enrollees (main analysis)	48% (RD estimate × num. of 50y.o. enrollees = 53)	Figure 4a; Section 4.2
Decreased retention among new enrollees	RDs of retention for each monthly cohort of new entrants from October 2013 through March 2015	18% (sum of RD estimates = 20)	Appendix Figure D.1
Deterrence of potential new enrollees	RDs of total new enrollment in each month from October 2013 through March 2015	15% (sum of RD estimates = 16)	Appendix Figure D.2

4 Effects on Participant Exit

This section estimates the effect of introducing work requirements on the retention of existing beneficiaries. The regressions are estimated on our "stock" population of childless adults who were participating in SNAP as of September 2013, just before the reinstatement of work requirements. The stock population has three attractive features. First, it defines the sample prior to the reinstatement of work requirements, thereby avoiding selection issues arising from nonrandom work requirement-induced deterrence of entry into SNAP. Second, it better limits the analyzed population to those who are likely to be impacted by SNAP policy changes, bringing the estimate closer to treatment-on-the-treated than studies that use cross-sectional survey data. Third, it allows us to study the heterogeneity of work requirements using individuals' ex ante characteristics. We only include individuals from the counties in which work requirements remained in force for two or more years after their reinstatement, which covers 70.7 percent of the full stock sample. This sample definition

allows us to measure outcomes for all participants after the same elapsed time since the reinstatement of work requirements. This is our main sample for the remainder of the paper.

As before, our preferred donut RD specification is a local linear model, with age centered around 50:

$$Y_i = \alpha + \beta \cdot U50_i + \gamma \cdot (age_i - 50) + \delta \cdot U50_i \cdot (age_i - 50) + \eta \cdot X_i + \varepsilon_i \tag{2}$$

where Y_i is our outcome of interest for individual i in a predetermined future month. The coefficient of interest is β, which measures the jump in the regression function at the discontinuity. We begin by running these regressions on our stock population, and examine outcomes after the October 2013 reinstatement of work requirements.

The vector X_i includes a handful of individual-level controls to increase precision; point estimates are very similar with or without controls. The baseline specification includes indicators for female, married, homelessness, any earned income, any unearned income, some college, race, and household size from SNAP records. It also includes pre-period (January 2007 to September 2013) wage earnings, and the fraction of months with employment in the pre-period from the UI records. Covariates from SNAP records are measured at the last recertification prior to September 2013.

As before, our main specifications measure outcomes eighteen months after work requirements resume (March 2015), with an excluded donut of SNAP participants who are only partially exposed to work requirements between September 2013 and March 2015 (see Figure 3a). Standard errors are clustered by monthly age (the discrete running variable). Again, our main results use MSE-optimal bandwidths determined by the method in Calonico et al. (2014).

4.1 Identification Assumptions

The identification assumptions for these RD regressions of participant exit are analogous to the assumptions required for the labor market outcomes RD regressions in Section 5. We therefore discuss both together here. The key identification assumption of the donut RD is that the potential outcomes would have evolved smoothly through the excluded donut in the absence of the treatment that starts at age 50. This assumption is more demanding than the standard RD assumption that the potential outcomes would have been smooth at the age 50 cutoff that determined treatment.

We perform a battery of checks to validate the research design. First, we test for balance in covariates at the discontinuity by replacing our outcome variable, Y_i, with each of our demographic controls. Table 3 shows there are rarely significant differences across

the threshold, except on the dimensions of marital status and racial composition. These differences, however, are not statistically significant after correcting for multiple tests.[16] Second, we verify that the density of the age distribution is smooth at the discontinuity. Appendix Figure C.7 shows there is no visual evidence of sorting around the cutoff. We fail to reject the null hypothesis of continuity in the density at age 50 based on the manipulation tests in Frandsen (2017), which adapts the standard density tests for a discrete running variable (McCrary 2008, Cattaneo et al. 2018). Finally, we estimate a "placebo" RD using outcomes from the ARRA time period when work requirements were not in effect for any group. We find no "effect" of the age 50 threshold on enrollment or employment in the placebo period (Figures 4b, 5b, and 6b). We also estimate these regressions in the placebo period without excluding ages in the donut to check for violations of the donut RD assumption, and find precisely estimated zeros, as in the main placebo regressions.[17] These checks support the identifying assumptions required for the validity of the research design.[18]

4.2 Estimates of Participant Exit

Figure 4a displays our main donut RD results with the outcome defined as an indicator for whether an individual from our stock population participates in SNAP eighteen months after the reinstatement of work requirements. The figure displays a fitted regression as well as average retention percentages, with age collapsed to quarters for readability. The sharp positive increase in participation at age 50 suggests that work requirements reduce ABAWD participation by a statistically significant 23.4 percentage points. This represents a 37 percent decline from the mean among participants aged 50. As further evidence that this decline is a result of work requirements, Figure 4b replicates the specification using data from the statewide ARRA exemption period between 2011 and 2013, when all participants were exempt from work requirements. This placebo regression uses an analogous "stock" sample of participants enrolled in September 2011 and measures outcomes in March 2013, matching the calendar months of our main stock sample to address seasonality. There is no

[16] Table 3 does not include a donut. Appendix Table C.5 presents the corresponding balance table including an 18-month donut.

[17] The key coefficient of interest (standard error) in the placebo period is -0.001 (0.020) excluding observations in the donut and -0.0003 (0.014) otherwise for the enrollment outcome. For the employment outcome, the corresponding coefficient is 0.007 (0.012) excluding the donut and 0.002 (0.010) otherwise. These are small relative to their respective means reported in Table 5.

[18] We also estimate an alternative specification using regression kink (RK) designs to include the data between ages 48.5 and 50, as described in Appendix D.3. We continue to estimate statistically significant negative effects of work requirements, but while the magnitudes are not statistically distinguishable from our main results, data limitations and noisy estimates prevent strong conclusions using this approach.

Table 3: Covariate Balance in RD

	Discontinuity	S.E.	Control Mean	% diff	N
Female	-0.006	0.019	0.459	-1.3	14,331
White	-0.025	0.014	0.414	-6.0	15,313
Black	0.037	0.015	0.421	8.8	15,476
Married	0.022	0.008	0.096	22.5	21,333
Household Size	0.019	0.016	1.246	1.5	18,703
Household Head	-0.008	0.007	0.932	-0.9	14,547
Homeless	0.015	0.010	0.131	11.7	21,359
High School	0.010	0.014	0.538	1.8	21,369
Some College or Higher	-0.007	0.010	0.110	-5.9	18,554
Has Earned Income	-0.008	0.008	0.176	-4.7	14,715
Has Unearned Income	0.006	0.007	0.091	6.7	18,897
Earned or Unearned Income	0.006	0.010	0.250	2.5	15,679
Fraction of Months Employed, 7yr avg	-0.002	0.011	0.351	-0.7	14,144
Avg. Annual Earnings, 7yr avg	135.249	251.041	6482.530	2.1	18,440
Fraction of Months Employed, 3yr avg	-0.006	0.012	0.281	-2.2	14,722
Avg. Annual Earnings, 3yr avg	-219.885	224.021	4292.832	-5.1	18,525
Number of Months on SNAP	0.685	0.725	27.022	2.5	18,115
Unemployment rate	0.006	0.024	5.820	0.1	16,662

Notes: Table presents balance tests of covariates at SNAP enrollment using our "stock" sample. Each row corresponds to a separate regression with that characteristic as the dependent variable, without controls. The discontinuity measures the jump in the regression function at age 50. Standard errors are clustered by monthly age (the running variable). Earnings measures are winsorized at the 99th percentile. The Control Mean denotes the mean of that characteristic immediately to the right of age 50. Each regression uses MSE-optimal bandwidths calculated separately for each side of the cutoff and for each outcome, and a uniform kernel to weight observations. Sample sizes vary depending on the bandwidth used.

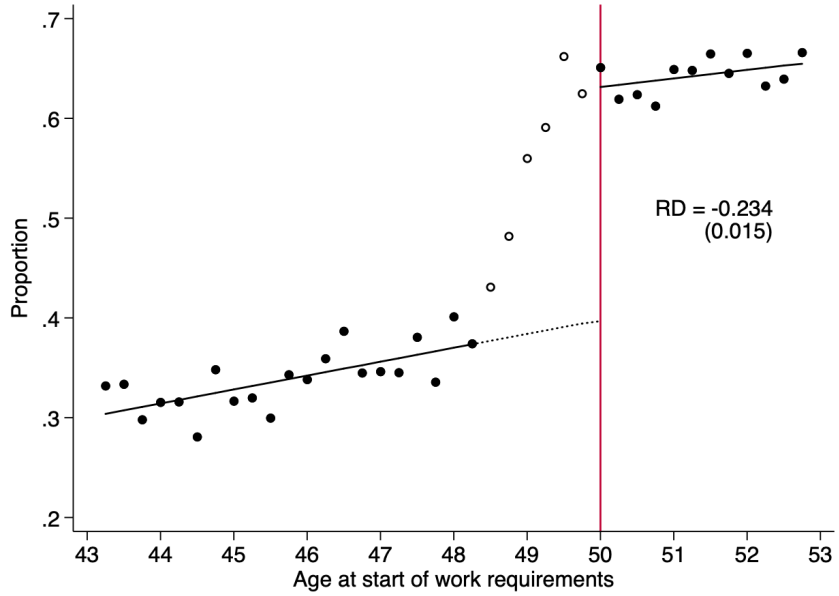
statistically or economically significant difference in participation across the age 50 cutoff during this placebo period.

Appendix Figure C.5 traces out the donut RD results for participation where outcomes are measured at alternative time periods, ranging from 1 to 27 months following the reinstatement of work requirements. The effect begins to appear in the seventh month after work requirements resume, which is the first month that we should expect SNAP participants to be disenrolled if they were not meeting the requirements. The participation drop reaches 24 percentage points within roughly eighteen months and then declines slightly thereafter, consistent with the disenrollment schedule described in Section 2.1.

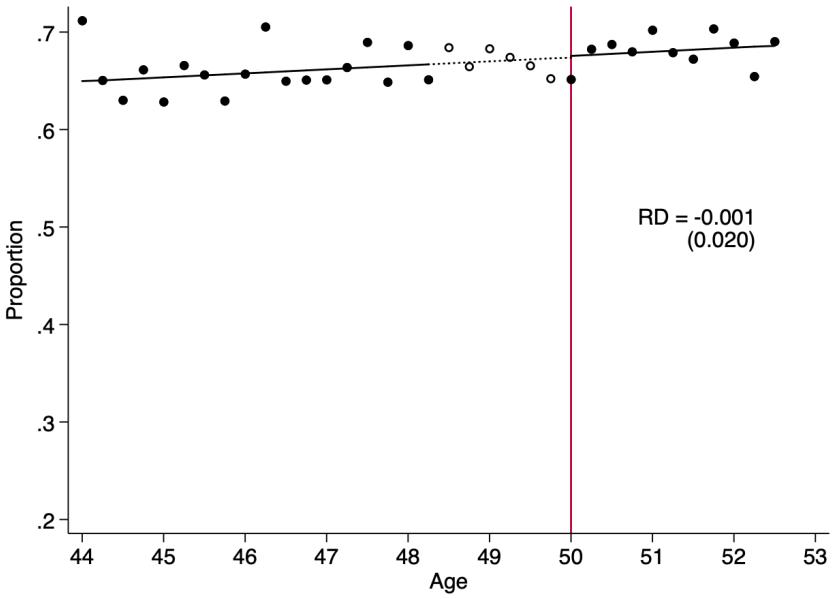
Program exit due to work requirement policy can occur through at least two distinct channels, which we decompose here. First, SNAP participants may exit as a result of failure or unwillingness to work or perform other qualifying activities. Second, participants may exit due to a more demanding recertification schedule, given the 6-month grace period associated with Virginia's policy. We can isolate the first channel by looking only at a subset of stock population participants who share the same recertification burdens regardless of age. Specifically, all participants under 50 as of September 2013 must complete two recertifications in the 18 months between September 2013 and March 2015. Participants 50 and older with initial enrollment between October and March also face two recertifications over this period. Yet participants over 50 whose enrollment spells began between April and September must only complete *one* recertification in the 18 months following September 2013.

This variation in recertification requirements by month applies irrespective of the year in which the enrollment spell begins. For example, consider two 50-year-old non-working beneficiaries with recertifications due in March and April, respectively. The March recertifier must submit paperwork in March 2014 and March 2015 while the April recertifier must submit paperwork in April 2014 and April 2015, which is one month past the 18-month window. By the time we assess retention in March 2015, the March recertifier must have submitted two rounds of paperwork, while the April recertifier must have submitted one. Appendix Figure C.8 shows the RD estimate only for those in the stock population who have scheduled recertifications in the months of September 2013 through March 2014. These participants are scheduled to undergo two recertifications by March 2015, regardless of their age in September 2013. The RD estimate of 24.8 percentage points is not statistically distinguishable from the main estimate of 23.4 percentage points in this section. The limited impact of this extra recertification step is not surprising, given that most SNAP participants either miss all recertifications or successfully complete numerous recertifications in a row (Hastings and Shapiro 2018, Gray 2019). That we find no significant difference in participation as a function of number of recertifications

Figure 4: RD Estimates of SNAP Retention, 18 Months After Work Requirements



(a) Participation During Work Requirements



(b) Placebo Test: Participation During ARRA Exemptions

Notes: Panel (a) visually displays the RD results for SNAP participation after eighteen months of work requirements. The scatter plot shows covariate-adjusted means by age in quarters, and the lines show a linear regression fit in months on both sides of the eligibility threshold. Standard errors clustered by monthly age in parentheses. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties for which work requirements remain on after October 2013. As a placebo test, Panel (b) replicates the analysis among those enrolled in September 2011 and measures enrollment in March 2013, over which period no work requirements were in effect.

confirms that the failure to meet work requirements, and not the extra recertification associated with work requirements in Virginia, is the primary driver of our results.

4.3 Heterogeneous and Screening Effects of Work Requirements

Section 4.2 documents that work requirements lead to substantial exit from SNAP. This section examines *who* exits from SNAP as a result of work requirements using two alternative measures. First, to assess whether participants with certain characteristics are more sensitive to work requirements, we fully interact the standard RD specification with an indicator for observable binary characteristic x. The x characteristics are captured in September 2013. We estimate the following specification:

$$\begin{aligned} Y_i = \alpha_1 + \alpha_2 x_i + \beta_1 U50_i + \beta_2 U50_i \cdot x_i + \gamma_1(age_i - 50) + \gamma_2(age_i - 50) \cdot x_i \\ + \delta_1(age_i - 50) \cdot U50_i + \delta_2(age_i - 50) \cdot U50 \cdot x_i + \varepsilon_i \end{aligned} \tag{3}$$

where Y_i is an indicator for participation in SNAP of individual i from our stock population eighteen months after the reinstatement of work requirements. Observable characteristics x include several of the demographic variables previously introduced in the text and variables indicating above-median time spent on SNAP (either over the lifetime of individuals as captured in our data or in their most recent spells). We also create an earnings "index" by predicting earnings from a regression of 2013Q3 earnings against these our other demographic variables. α_1 estimates the SNAP program eighteen-month retention rate for those *without* characteristic x. β_1 estimates the corresponding impact of work requirements on this retention rate in percentage points. The new coefficient β_2 estimates how much larger the discontinuity is for those with a given characteristic ($x_i = 1$), as a percent of all members of the "stock" population with that characteristic.

We scale the effect of work requirements on retention among those with $x_i = 0$ by the baseline retention rate absent work requirements $\left(\frac{\beta_1}{\alpha_1}\right)$ in order to construct more interpretable parameters. We then perform the analogous scaling for those with $x_i = 1$ as $\left(\frac{\beta_1 + \beta_2}{\alpha_1 + \alpha_2}\right)$. These numbers capture the fraction of participants who left the program due to work requirements out of those who *would have been* on the program absent work requirements. They therefore have a more intuitive interpretation as the sensitivity of participants to work requirements.

Estimates of β_2, $\left(\frac{\beta_1}{\alpha_1}\right)$ and $\left(\frac{\beta_1 + \beta_2}{\alpha_1 + \alpha_2}\right)$ are reported in columns 1, 2 and 3 of Table 4, respectively. Each row in Table 4 refers to estimates from a separate regression corresponding

Table 4: Sensitivity RD, 18 Months After Work Requirements

	β_2	β_1/α_1	$\frac{\beta_1+\beta_2}{\alpha_1+\alpha_2}$	p-value of difference
Above Median Earnings Index	0.048	-0.400	-0.365	0.345
	(0.029)			
Female	0.062	-0.446	-0.325	0.007
	(0.035)			
Married	0.068	-0.396	-0.316	0.432
	(0.067)			
Homeless	-0.140	-0.357	-0.559	0.000
	(0.040)			
White	0.034	-0.407	-0.361	0.238
	(0.026)			
Black	-0.058	-0.367	-0.417	0.296
	(0.035)			
Some College+	0.015	-0.387	-0.416	0.700
	(0.052)			
Has Earned Income	0.096	-0.414	-0.273	0.006
	(0.035)			
Has Unearned Income	0.102	-0.401	-0.260	0.111
	(0.061)			
Ever Before UI Recipient	0.030	-0.392	-0.374	0.771
	(0.050)			
Ever Before Disability	0.190	-0.476	-0.122	0.000
	(0.041)			
Above Median Unemployment Rate	-0.022	-0.386	-0.394	0.843
	(0.031)			
Above Median Previous Time on SNAP	-0.091	-0.381	-0.399	0.696
	(0.036)			
Above Median Previous SNAP Spell	-0.119	-0.346	-0.410	0.152
	(0.030)			

Notes: Table presents RD estimates of Equation 3. Each row presents results from a separate regression corresponding to the characteristic listed. Separate MSE-optimal bandwidths calculated on each side of the donut. The column β_2 presents the differential jump at age 50 for people with the characteristic relative to those without. Standard errors clustered by monthly age in parentheses. The second column reports the retention of people without the characteristic, calculated as β_1/α_1. The third column reports retention for those with the characteristic, calculated as $(\beta_1+\beta_2)/(\alpha+\alpha_2)$. The p-value from the test that columns 2 and 3 are equal is reported in the last column, calculated using the delta method.

to a different characteristic x. We use the delta method to evaluate whether $\left(\frac{\beta_1}{\alpha_1}\right)$ and $\left(\frac{\beta_1+\beta_2}{\alpha_1+\alpha_2}\right)$ are statistically different, and report the p-value in column 4. Greater sensitivity to work requirements among the group with characteristic x in comparison to the group without characteristic x is indicated by a negative and statistically significant estimate of β_2 (column 1), or a larger negative value of $\left(\frac{\beta_1+\beta_2}{\alpha_1+\alpha_2}\right)$ (column 3) compared to $\left(\frac{\beta_1}{\alpha_1}\right)$ (column 2) and a statistically significant p-value (column 4). We find that work requirements have disproportionately larger impacts on participants who are homeless, participants without earned income, and men. On the other hand, those who have a history of reporting a disability are less likely to be impacted by work requirements. This group may be more likely to be reclassified as exempt from work requirements due to not meeting the definition for able-bodied. Appendix Figure C.11 shows that an additional 5.6 percent of the stock population stay on the program by claiming a new exemption.

We repeat these analyses using a second screening measure that describes how the composition of retained participants is affected by work requirements. This measure captures changes due to work requirements in the characteristics of the population of SNAP participants, rather than the differential group-specific exit sensitivities captured by our first measure. Results may differ from those using the first measure when the number of people with a given characteristic is small. In such cases, even large sensitivities may translate to very small compositional changes in the pool of SNAP participants. The findings using this compositional measure of screening are similar to the findings in Table 4. Work requirements reduce the proportion of homeless individuals and individuals with no earned income among those who remain on SNAP; and increase the proportion of those who have a documented history of disability. The details of this measure are described in Appendix D.4. Overall, the results suggest that work requirements disproportionately impact beneficiaries with characteristics suggesting greater economic vulnerability, while disproportionately exempting those with a history of disability.

5 Effects on Labor Market Outcomes

This section estimates the effect of work requirements on individual-level labor market outcomes using the stock population and regression specification described in Section 4. We first present estimates of the effects on employment, wage earnings, and other labor market outcomes. We then conduct robustness checks for both the employment and earnings estimates. Finally, we estimate RDs on quantiles of the earnings distribution to

examine heterogeneity in the labor market impacts of work requirements.

5.1 Estimates of Labor Market Effects

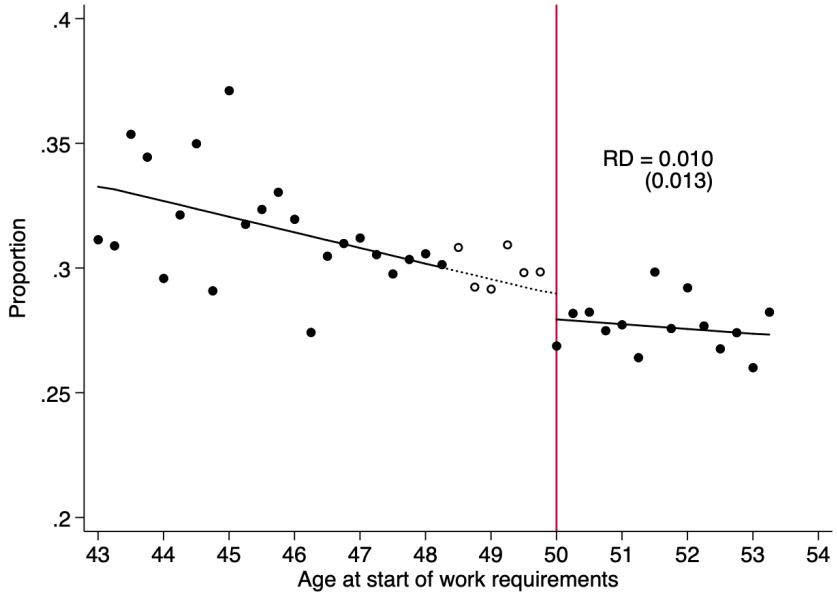
Section 3.2 documents the large participation drops due to work requirements. In contrast, this section shows that the average effects on employment and earnings are small in magnitude and not statistically different from zero. Figure 5 shows the donut RD results with an indicator for employment as the dependent variable, defined as having any UI-covered earnings six quarters after work requirements were reinstated. This regression uses the same controls as Equation 2, and the same MSE-optimal bandwidth selection procedure. We fail to detect a statistically significant impact of work requirements on employment on average, and we statistically reject employment increases larger than 3.5 percentage points. We find nearly identical results in the placebo period. To test robustness, Appendix Figure C.9 defines the dependent variable as the union of having a wage in the UI data or reporting earned income to the SNAP agency. This allows us to capture possible effects on self-employment, under the assumption that work requirements only induce additional self-employment if the affected individuals remain on SNAP. The point estimates are nearly identical and still not statistically different from zero. Furthermore, the donut RD may overstate any employment effect if younger SNAP recipients exit SNAP more quickly than older recipients due to the improving economy. The time series patterns by age in Figure 2a suggest this possibility, which reinforces our interpretation of a very small average employment effect.

A potential explanation for this null result is that many SNAP participants have very low labor force attachment, making employment responses unlikely and diluting the average estimate. We further investigate this null result in Appendix Table C.4, which shows our primary specification using individuals with greater or lesser labor force attachment. To measure labor force attachment, we predict UI-covered employment in the third quarter of 2013 with LASSO regression, using a large set of demographic covariates.[19] Work requirements do not clearly increase UI-covered employment even for individuals who we predict to have moderate or strong pre-existing attachment to the labor force.

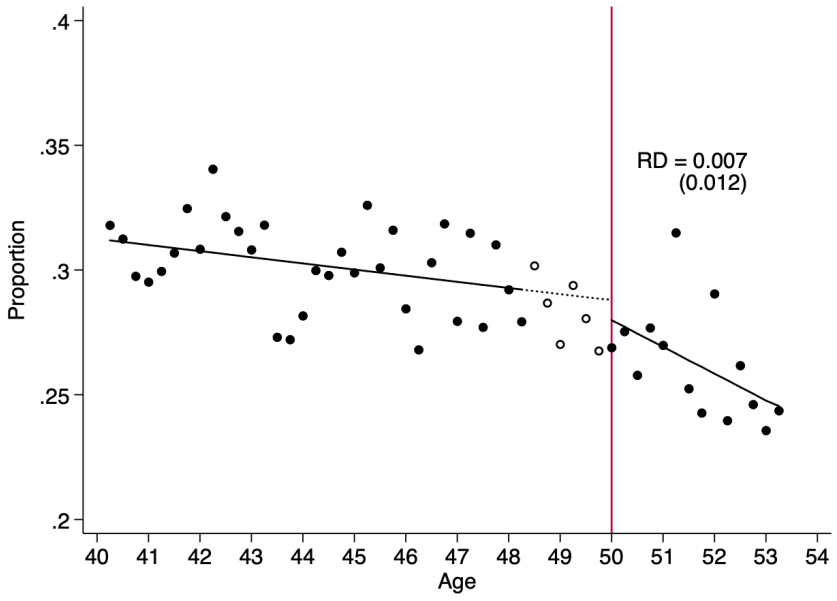
We then assess whether UI-covered earnings change at the age 50 cutoff. Figure 6a

[19]Specifically, we use data-dependent penalization methods based on Belloni et al. (2012). The regression includes the following controls to predict employment: indicators for yearly age, indicators for earnings in each month of the previous 7 years prior to Sept. 2013, household size, and indicators for gender, married, private living arrangement, white, black, some college or higher education, reporting earned income on the SNAP application, and reporting unearned income on the SNAP application. In predicting employment probabilities, we randomly divide the sample into fifths and use data from four-fifths to fit a model to predict employment in the remaining fifth.

Figure 5: RD Estimates of Employment, 18 Months After Work Requirements



(a) Employment During Work Requirements



(b) Placebo Test: Employment During ARRA Exemptions

Notes: Panel (a) visually displays the RD results for employment after eighteen months of work requirements. The scatter plot shows covariate-adjusted means by age in quarters, and the lines show a linear regression fit in months on both sides of the eligibility threshold. Standard errors clustered by monthly age in parentheses. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties where work requirements remain on after October 2013. Panel (b) replicates the same analysis among those enrolled in September 2011, when the ARRA exemption that suspended work requirements was in effect for an additional two years.

shows no statistically significant impact on average earnings. While the estimate is somewhat imprecise, we are able to statistically rule out increases over $28 per month. Appendix Figure C.10a shows qualitatively similar results for log earnings. We also find imprecise estimates by different levels of labor force attachment, as shown in Appendix Table C.4.

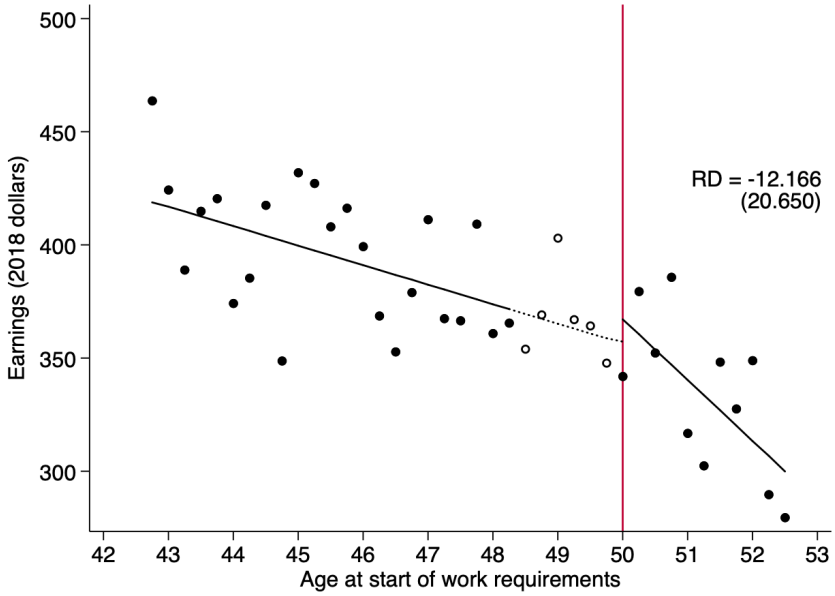
Table 5 summarizes the point estimates and standard errors of interest from the donut RDs described in the preceding two sections. Below the coefficient estimates, we report the mean of each corresponding outcome variable at age 50 (immediately to the right of the RD threshold). For the two outcomes where we find statistically significant effects in our main stock sample, the estimate from the placebo period is a precisely estimated zero. Overall, the findings suggest that work requirements do not increase labor force attachment by a meaningful amount on average eighteen months after their reinstatement despite a very large corresponding drop in SNAP participation.

A number of robustness checks in Appendix C also fail to find strong evidence of employment effects. Appendix Figure C.6 shows robustness to alternative bandwidth choices for employment and earnings, using a symmetric bandwidth on both sides of the cutoff. Appendix Figure C.12 presents estimates for other durations ranging from 1 to 27 months after work requirements. We also obtain similar estimates if we use triangular kernels instead of a uniform kernel to weight observations (Appendix Table C.2). We reproduce Table 5 without covariates in Appendix Table C.3. The estimates on employment and earnings are slightly higher, but still not close to statistical significance. Appendix Figure C.13 plots these estimates over time to examine robustness to the choice of duration. While there are signs of an upward trend in both employment and earnings, none of the estimates are statistically significant and they remain within the confidence intervals for models with controls (Appendix Figure C.12).[20] Collectively, these results reinforce that our findings are consistent with zero or moderate average impacts on employment or earnings.

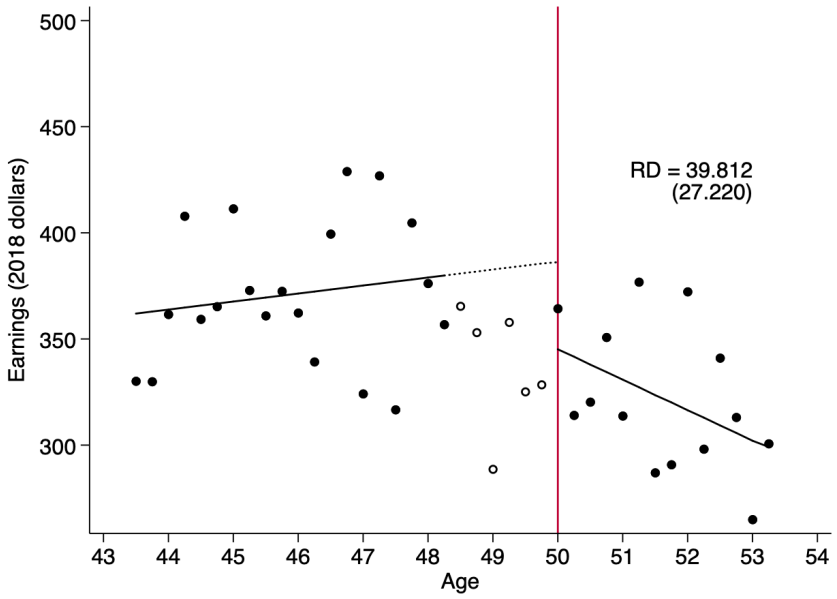
Although our null results for earnings are consistent with some small estimates of earnings elasticities from the literature, they are inconsistent with the much larger elasticity estimates in populations similar to our sample. Typical estimates in the literature range from -0.1 to 0 (Imbens et al. 2001, McClelland and Mok 2012, Cesarini et al. 2017). However, these estimates come from populations with substantially higher incomes than our sample. Less than one third of 50-year-old ABAWDs are employed. Papers studying populations more similar to our sample imply substantially higher income elasticities: Gelber et al. (2017) report an earnings decline of $0.20 for every $1 increase in SSDI benefits, and Deshpande (2016) reports a dollar-for-dollar parental earnings response to SSI benefits for children. In light of these larger estimates, our null results might be viewed as surprising. Our results

[20] Appendix D.3 presents corresponding regression kink estimates and also yields statistical zeros.

Figure 6: RD Estimates of Earnings, 18 Months After Work Requirements



(a) Earnings During Work Requirements



(b) Placebo Test: Earnings During ARRA Exemptions

Notes: Panel (a) visually displays the RD results for earnings (including zeros) after eighteen months of work requirements. Earnings are top-coded at the 99th percentile within yearly age bins for each calendar month. The scatter plot shows covariate-adjusted means by age in quarters, and the lines show a linear regression fit in months on both sides of the eligibility threshold. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties where work requirements remain on after October 2013. Panel (b) replicates the same analysis among those participating in September 2011, when the ARRA exemption that suspended work requirements was in effect for an additional two years.

Table 5: RD Estimates of Key Outcomes, 18 Months After Work Requirements

	Main Stock (September 2013)	Placebo Stock (ARRA Period)
Panel A. SNAP Participation		
Discontinuity	-0.234	-0.001
	(0.015)	(0.020)
Control Mean	0.632	0.669
N	15,692	13,097
Panel B. Employment		
Discontinuity	0.010	0.007
	(0.013)	(0.012)
Control Mean	0.273	0.277
N	16,840	20,233
Panel C. Employed or Earned Income		
Discontinuity	-0.004	0.009
	(0.014)	(0.014)
Control Mean	0.348	0.333
N	18,859	19,140
Panel D. Earnings		
Discontinuity	-12.2	39.8
	(20.7)	(27.2)
Control Mean	365.2	347.7
N	15,930	15,701
Panel E. Log Earnings		
Discontinuity	-0.012	0.078
	(0.080)	(0.083)
Control Mean	1.935	1.876
N	19,729	19,955
Panel F. Exemption (Other than Age)		
Discontinuity	0.056	-0.020
	(0.013)	(0.011)
Control Mean	0.095	0.115
N	16,379	17,893

Notes: Table shows regressions coefficients from local linear RD specifications with a uniform kernel, corresponding to RD figures in the text. Standard errors clustered by monthly age (the running variable) are reported in parentheses. Control mean is the predicted mean of the corresponding outcome variable immediately to the right of the age 50 threshold (the intercept with the cutoff). Employment and earnings are measured from UI records. Log earnings calculated as $\ln(y+1)$. Earnings include those with zero UI earnings, and are winsorized at the 99 percent level by yearly age within each calendar month. The variables Earned Income and Exemption status are reported on DSS records.

are, however, consistent with emerging evidence that populations with low to no earnings do not respond to shocks in unearned income. For example, despite her estimate of large intensive-margin responses, Deshpande (2016) finds no corresponding employment response to SSI income despite the income losses being over $600 per month. We turn next to an examination of whether our average null results hold across the entire sample.

5.2 Heterogeneity of Labor Market Effects

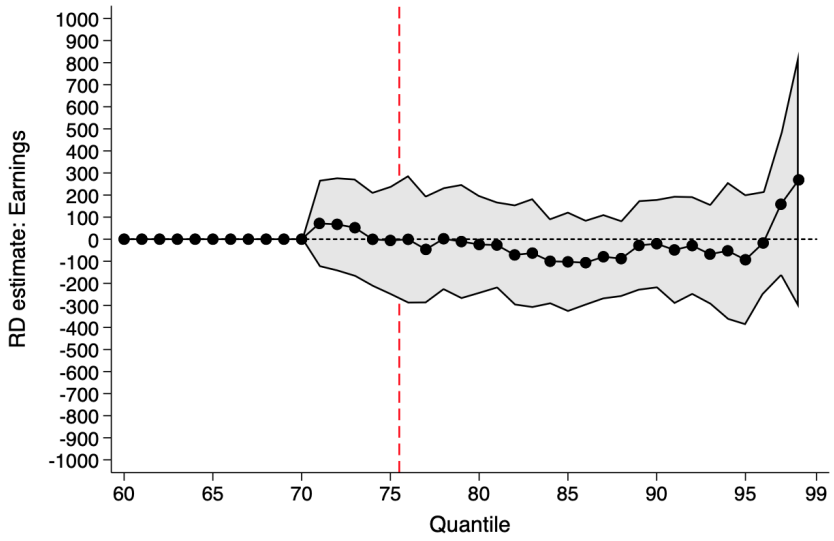
The RD regressions in Section 5.1 fail to detect a statistically significant impact of work requirements on labor market outcomes on average. This null result may mask a positive effect for a small subgroup of participants. Work requirements may induce no change in earnings among the majority of participants who are far from the threshold—either because they are so far below it that meeting it would be too difficult or because they would be above it even in the absence of work requirements—while inducing a substantial change in earnings among individuals near the cutoff.

We therefore examine the heterogeneity of the effect of work requirements on earnings. We estimate unconditional quantile regressions using the recentered influence function method (Firpo et al. 2009). For the qth quantile of the overall monthly earnings distribution, y_q, we compute that quantile in each age bin and estimate a donut RD of how that quantile changes at the age 50 cutoff. The regression specification excludes controls other than age and otherwise mirrors our baseline donut RD specification (Equation 2). The coefficient on the indicator for below age 50 in the qth regression can be interpreted as the effect of work requirements on earnings at y_q, the qth percentile of the unconditional monthly earnings distribution. By estimating the unconditional quantile effect at each percentile, we trace out the potentially heterogeneous effect along the earnings distribution. Because these unconditional quantile regressions compute the unconditional (marginal) effects across the underlying distribution of observables, they recover average impacts without needing to hold other covariates (such as age) constant. We discuss identification for the unconditional quantile regressions in Appendix D.5.

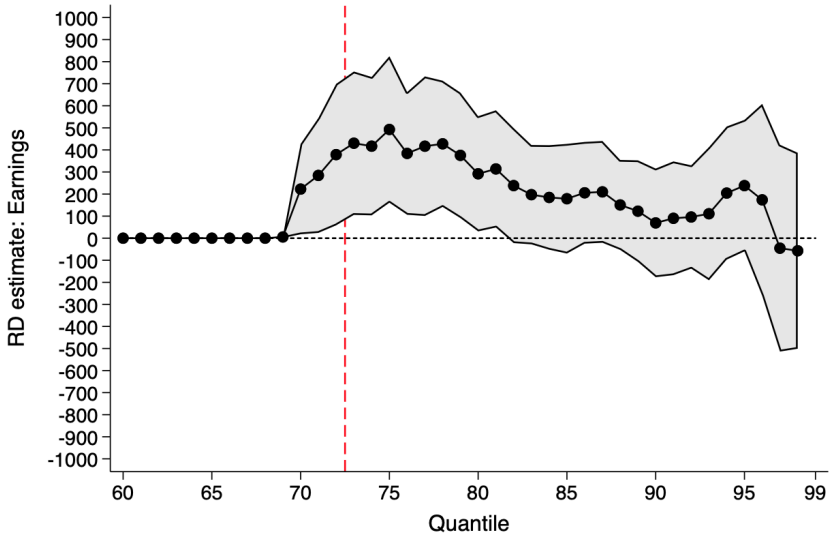
Figure 7 plots the main coefficients of interest at each percentile using the stock population, and the shaded region shows 95 percent confidence intervals. Since the RD estimate of the effect in the lower range of the distribution is mechanically zero, we only report results for the 60th percentile and above.[21] The vertical red line is placed at the minimum earnings required to maintain eligibility through working, calculated as 80 times the hourly minimum wage over the period ($7.25 per hour).

[21] The bottom two-thirds of the earnings distribution on both sides of the age 50 cutoff have zero earnings.

Figure 7: Heterogeneity in RD Estimates of Earnings



(a) 18 Months After Work Requirements



(b) 24 Months After Work Requirements

Notes: Figure plots coefficients from individual-level regressions of monthly earnings. Each coefficient is from a separate regression for that quantile using the recentered influence function method of Firpo et al. (2009). Top panel measures earnings in March 2015; bottom panel measures earnings in September 2015. Shading denotes 95 percent confidence intervals. For visual clarity, we omit presenting the 99th percentile because the point estimate at 18 months is very imprecise, making it difficult to discern the magnitudes of the other estimates.

Figure 7a shows the estimates 18 months after the start of work requirements; Figure 7b shows them at 24 months. At 18 months, just after the completion of the gradual roll-out of work requirements, the estimated earnings effects are not statistically distinguishable from zero across the entire earnings distribution. This result is consistent with the estimated null average effects of work requirements on employment and earnings in Figures 5a and 6a.[22] An additional six months after the completion of the roll-out, however, the estimates are consistently positive and statistically significant between the 69th and 81st percentiles of the earnings distribution, inclusive (Figure 7b). The peak of the point estimates is at the 75th percentile, slightly above the minimum threshold for meeting work requirements. The estimates at the top and bottom ends of the earnings distribution are statistical zeros. With the caveats concerning interpretation of quantile regressions described in Appendix D.5, this pattern is consistent with a positive response among SNAP participants who are already near the work requirements threshold. The increases are primarily in the range of $275 to $500 per month, which is equivalent to shifting a portion of the earnings distribution to the right by three to seven percentiles in the vicinity of the minimum work requirements threshold. This is a substantial increase in earnings: the federal poverty line for a single-person household in 2015 was $981 per month.

The pattern documented in Figure 7b would imply that work requirements have a meaningful positive earnings impact in a narrow subset of the earnings distribution of SNAP participants. However, the zeros estimated just six months earlier in Figure 7a dictate caution in the interpretation of these results. Because our primary dataset ends in December 2015, we cannot check whether the positive effects documented in September 2015 (Figure 7b) persist. We discuss possible explanations for a delayed response in Appendix D.5, including labor market improvements in mid-2015 and features of SNAP that make work requirements effectively more stringent over time.

A natural question is whether the earnings increases in Figure 7b, if real, are concentrated among participants who exit SNAP and work more to compensate for the loss of benefits or among those who work more to retain SNAP eligibility. Unfortunately, our RD identification strategy will not yield causal estimates for these mechanisms; examining earnings for those remaining on SNAP in September 2015, for example, involves conditioning on the (endogenous) outcome of not having exited within 24 months of work requirements. We attempt to disentangle the mechanisms in Appendix D.6 using machine learning techniques. Unfortunately, the results are inconclusive (see Appendix Table D.3).

[22] Appendix Figure C.14 considers the analogous exercise for the placebo cohorts (on SNAP in September 2011). We estimate zeros along the entire earnings distribution in the placebo period at both the 18-month and 24-month intervals.

We therefore conclude that work requirements may appreciably increase earnings along a narrow range of the earnings distribution, but the primary mechanism for that possible earnings increase remains uncertain.

5.3 Welfare Impacts

The previous results establish that work requirements dramatically reduce overall participation and retention among the stock population of beneficiaries while possibly increasing earnings among a subset of this population. An optimal policy for SNAP eligibility would trade off these competing forces. While a full accounting of the welfare impacts of work requirements is outside the scope of this paper, this section presents a stylized calculation of the marginal value of public funds (MVPF) of work requirements in SNAP as a starting point.

The MVPF is the ratio of a program's beneficiaries' willingness to pay for the program to the government's cost of providing it (Hendren 2016). In keeping with the literature, we report the MVPF of an expansion, rather than a contraction, in government spending. We therefore calculate the MVPF for the *elimination* of work requirements. The MVPF is given by:

$$MVPF = \frac{WTP}{\underbrace{C}_{\substack{\text{direct} \\ \text{program cost}}} + \underbrace{FE}_{\substack{\text{fiscal} \\ \text{externality}}}}$$

where the numerator represents the relevant ABAWDs' willingness to pay out of their own income to eliminate work requirements, and the denominator represents the total cost to the government of eliminating work requirements. The total cost is the sum of the direct cost of providing benefits to additional ABAWDs who participate in SNAP only in the absence of work requirements (the induced exiters of Appendix D.6), and fiscal externalities such as reductions in income tax revenue. The relevant population for both the numerator and the denominator is the set of ABAWDs who would participate in SNAP in the absence of work requirements.

If the MVPF is larger than the MVPFs of other programs targeting the same population, then eliminating work requirements is efficient relative to these other policies. Our calculations suggest that the elimination of SNAP work requirements likely has an MVPF between 0.86 and 1.35. The upper bound of the MVPF assumes that individuals pay a utility cost for the large behavior change of working more, whereas the lower bound

assumes envelope theorem arguments apply. Appendix D.7 reports the details of the calculations.

Most existing estimates of the MVPF of various aspects of SNAP, and cash transfer programs more broadly, are near one. Hendren and Sprung-Keyser (2020) provide MVPFs for a range of programs based on prior literature that can serve as benchmarks: the MVPFs for other aspects of SNAP range from 0.42 to 1.04, with most estimates close to 1; the MVPFs for housing vouchers are between 0.65 and 0.76; the MVPFs for the 1986 and 1993 Earned Income Tax Credit (EITC) expansions are between 1.0 and 1.20; and the MVPFs for other cash transfer programs are between 0.81 and 0.87. Under the assumption that the earnings response to SNAP work requirements, if any, has a non-marginal utility cost, the MVPF of eliminating work requirements compares favorably with other policies targeting the SNAP population.

Of course, these stylized calculations omit potentially sizable fiscal externalities arising from the elimination of work requirements. In the calculation, we only consider the portion that we can estimate: the income tax revenue change from the direct response to work requirements. However, the literature has documented additional effects from expanding SNAP participation, which may produce other fiscal externalities. SNAP benefits improve nutrition and have been shown to reduce health care spending, much of which is subsidized by the government through the tax treatment of employer-based health insurance or, more directly, through Medicaid (Sonik 2016, East and Friedson 2020). SNAP benefits also decrease crime (Tuttle 2019), which may reduce direct costs to victims and government spending on the criminal justice system. Each of these potential externalities would decrease the magnitude of the denominator in the MVPF calculation, increasing the MVPF. A possible countervailing externality would exist if there are long-term positive labor market effects of work requirements that are not detectable in our sample. The closest available evidence comes from Card and Hyslop (2005), who document no difference in long-run earnings from a Canadian welfare program. On net, the evidence from the literature indicates that any omitted fiscal externalities are likely to increase the MVPF we calculated above, rather than decrease it.

6 Conclusion

As work requirements in means-tested programs come to the forefront of modern policy debates, it is critical to understand their causal impact on program participation and work. On one hand, work requirements may reduce benefits for economically vulnerable adults without a counterbalancing improvement in labor market outcomes. On the other hand,

work requirements could successfully incentivize labor force participation, thereby helping to counter means-tested programs' disincentives to work.

We measure the magnitude of both phenomena by combining SNAP and UI administrative data from Virginia with quasi-experimental policy variation. We find that SNAP work requirements dramatically reduce participation among affected adults, with point estimates suggesting a 53 percent decline in participation by the completion of the roll-out. Focusing on the sample of people already on SNAP just before the reintroduction of work requirements, we estimate a 37 percent drop in retention. These declines are largest among beneficiaries who, prior to the reinstatement of work requirements, are homeless or have no earned income. At the same time, we statistically rule out a large average increase in UI-covered employment, and fail to detect an increase in self-employment or wage earnings along a large majority of the distribution. We find tentative evidence of increased earnings in the vicinity of the eligibility threshold. In practice, work requirements appear to screen out a large number of potential SNAP beneficiaries in exchange for a possible earnings increase among a limited subset of individuals. The similarity of participation patterns at younger ages subject to work requirements suggests that our results may also generalize to SNAP beneficiaries who are substantially younger than 50 (Figure 2b).

Given our large documented impacts on program exit, it is notable that we find no corresponding evidence of substantial labor market responses. This lack of response may indicate that SNAP benefits are not binding disincentives against labor force participation for a population that overwhelmingly has no income, whether earned or unearned. If that is the case, then work requirements aimed at countering the disincentives of benefits will not be effective as they do not address more pressing underlying barriers to work. Future research could identify such barriers, and assess whether removing them would increase self-sufficiency, especially among those who do not earn any income.

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A Institutional Details of Virginia SNAP [Not for Publication]

This Appendix first presents a stylized budget constraint for ABAWDs with and without work requirements, and then discusses exemptions from the work requirements, and reinstatement of the policy in October 2013.

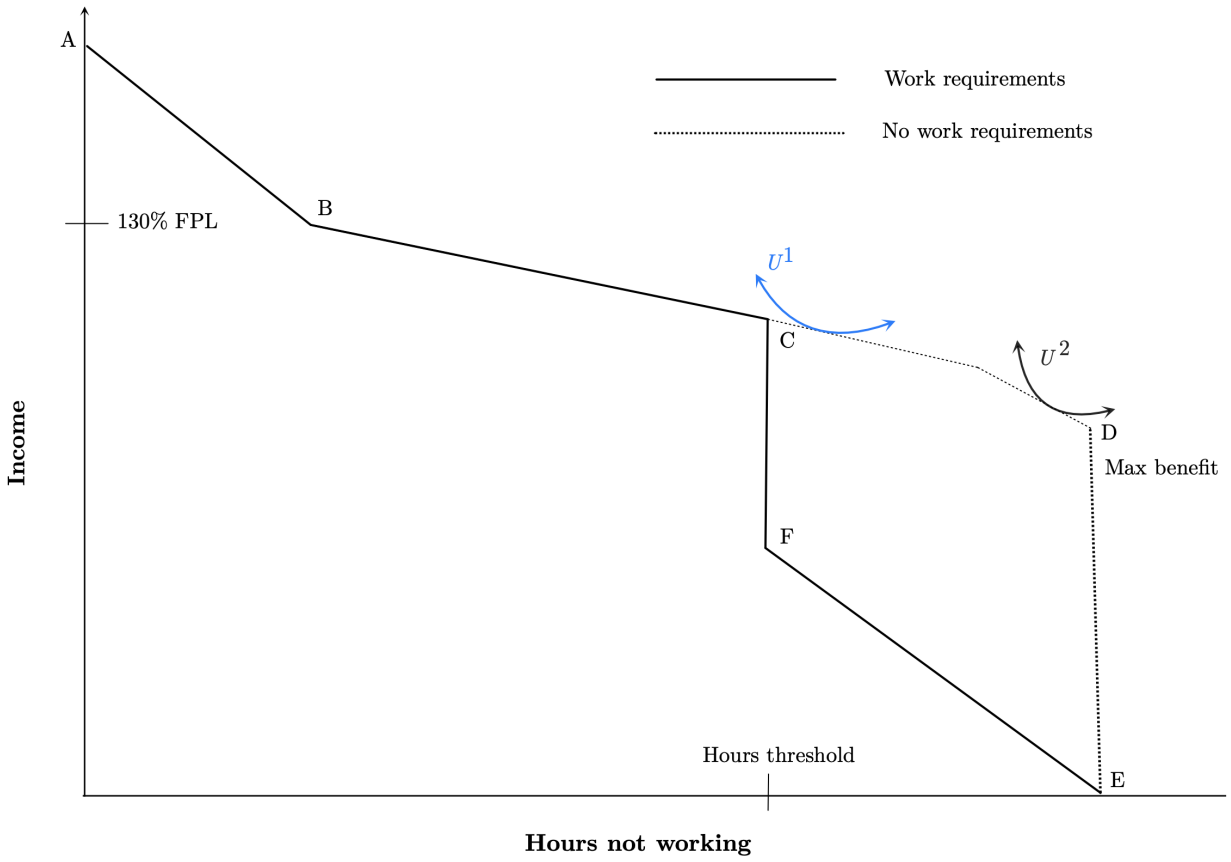
A.1 ABAWD Budget Constraint

Work requirements create a notch in the budget constraint as shown in Figure A.1. The graph plots income on the vertical axis against hours not working on the horizontal axis, similar to the representations in Bitler, Gelbach and Hoynes (2006) and Han (2020). For ABAWDs facing work requirements, the budget constraint is represented by ABCFE, with the notch at C. If an ABAWD does not meet the hours threshold, then they lose SNAP after their 3 months of time-limited benefits are used and the budget line drops down to F. Without work requirements, the budget constraint extends from point C to D. There is a slight kink between C and D to reflect the deduction rules that enable SNAP recipients to receive the full SNAP benefit provided their income is below a certain level. This budget constraint abstracts from asset limits (Virginia has limits on liquid assets, such as cash on hand or money in accounts). The graph also does not plot the minimum SNAP benefits, which would change the slope of the budget line close to point B, since our interest is in the notch created by work requirements. The graph draws indifference curves for two hypothetical ABAWDs who do not face work requirements. The person with preferences U^1 is working near the hours threshold without work requirements, and would relocate to point C with work requirements, rather than drop down to the segment EF. This represents the "incentive effect" of the policy. The person with preferences U^2 works only a few hours without work requirements, and would relocate along FE when faced with work requirements given the curvature of their utility function: reaching the hours threshold is too costly for this person and so they exit SNAP and increase their hours. This response constitutes the "income effect" of the policy that removes recipients unable or unwilling to work enough to retain benefits.

A.2 ABAWD Work Requirement Exemptions

Individuals are exempt from general work registration if they are younger than 16 years old, 60 years old or older, working 30 hours or more each week, receiving or applying to receive unemployment insurance, serving as a caretaker of a child under the age of 6, temporarily or permanently incapacitated, ill or disabled, regularly participating in an

Figure A.1: ABAWD Budget Constraint With and Without Work Requirements



Notes: Figure plots a stylized budget constraint in income-hours space for an ABAWD with work requirements (solid line) and without work requirements (dotted line extension). Without work requirements, the budget set is represented by ABCDE. The number of hours not working is represented on the x-axis, which is a subset of total hours of leisure. Searching for work, which is not part of leisure, does not count towards meeting the work requirements. An ABAWD without work requirements who does not work is represented by the point D, receiving the max SNAP benefit. They can continue to receive the maximum benefit below a certain income threshold due to the deduction rules. Once deductions apply (represented by the slight kink in the dotted line between C and D), SNAP benefits phase out at 30 cents for each dollar of earned income. At point B, the person works enough to earn over 130% FPL and no longer receives SNAP. The budget constraint with work requirements is ABCFE. Under work requirements, the person does not receive any SNAP benefits after their 3 months of time-limited benefits are used unless they reach the hours threshold. Their income in the range below the minimum hours threshold is represented by the segment EF. Working beyond this threshold grants access to SNAP benefits, as represented by the notch in the budget constraint at C. Examples of indifference curves for two types of ABAWDs are drawn tangent to the no-work requirements budget constraint. Under work requirements, ABAWDs with indifference curve U^1 would relocate to C, while ABAWDs with indifference curve U^2 would relocate to E.

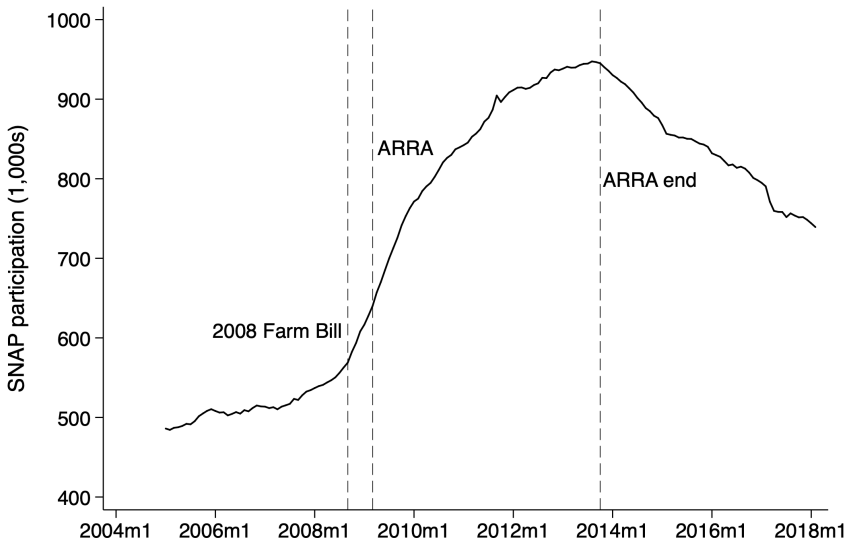
alcohol or substance abuse rehabilitation program, aged 16 or 17 and attending school for at least a half-time basis, aged 16 or 17 but not head of household, enrolled in a recognized school, job skills training, or institution of higher education for at least a half-time basis, already complying with another assistance program's work requirements (e.g., TANF or unemployment compensation), or a full-time caretaker of an incapacitated person. Adults are exempt from ABAWD work requirements if they are younger than 18 years old, aged 50 or older, pregnant, medically certified as unable to work, living in a household that includes a child under the age of 18, exempt from general work registration or living in a locality that is exempt from work requirements. Localities (counties and independent cities) may also receive exemptions from the ABAWD work requirements in some circumstances. Specifically, the state office analyzes data and submits a waiver of the requirements for localities that meet qualifications established by the USDA/FNS. A locality may receive an exemption from work requirements if it has a recent 12-month average of unemployment rate above 10 percent, a recent 3-month average unemployment rate above 10 percent, a historical seasonal unemployment rate above 10 percent, a designation as a Labor Surplus Area by the Department of Labor's Employment and Training Administration, a qualification for extended unemployment benefits by the Department of Labor's Unemployment Insurance Service, a low and declining employment-to-population ratio, a lack of jobs in declining occupations or industries, or a recent 24-month average unemployment rate that is 20 percent above the national average for the same 24-month period.

Other than these exemptions, ABAWDs who have already exhausted their allotted SNAP benefits (i.e., 3 months in a 36-month window) can maintain or regain eligibility for SNAP benefits by working at least 20 hours or more per week, participating in an employment services program operated by the Virginia Department of Social Services for 20 hours or more per week (or for at least the number of hours equal to the household's benefits amount divided by the federal minimum wage), participating in an approved work program for 20 hours or more per week, or volunteering for at least the number of hours equal to a household's benefits divided by the federal minimum wage. The state is also annually allotted (by the USDA) a reserve of monthly exemptions based on 15 percent of the number of ABAWD enrollees who live in the state who are not exempted otherwise and do not live in exempted localities. These exemptions may be used by the state to extend the certification period.

A.3 Virginia's Reinstatement of Work Requirements

ABAWD work requirements were reinstated in Virginia on October 1, 2013 coinciding with the end of state-wide work requirement exemptions under the American Recovery and Reinvestment Act of 2009 (ARRA), which lasted from April 2009 to September 2013. As shown in Figure A.2, participation rose substantially during the ARRA period but began to fall soon afterwards. The end of ARRA also coincided with an approximately 7 percent drop in the level of SNAP benefits allotted to SNAP recipients in Virginia (Figure A.3). The identification strategy based on regression discontinuity accounts for this benefit change in estimating the causal effect of work requirements, since the benefit change occurs similarly on both sides of the age 50 cutoff.

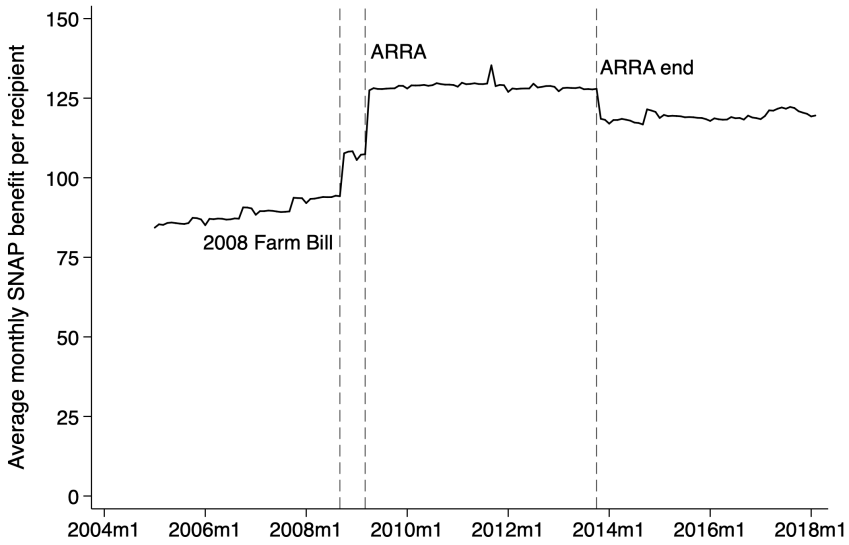
Figure A.2: Monthly SNAP Participation



Notes: Figure plots monthly SNAP participation across Virginia measured in thousands. Participation rose substantially during the ARRA period before falling in 2014.

Prior to the reinstatement of work requirements, individuals typically would receive 12-month recertification periods. Individuals who began their current benefit receipt period prior to the reinstatement of work requirements continued to receive SNAP benefits up to their recertification date, which would occur after reinstatement. At recertification, their work compliance was evaluated. If they were found to be in compliance of work requirements at recertification, they were given a 12-month recertification period. If they were found not to be in compliance, they were given a 6-month recertification period. This recertification period was composed of an initial partial month of benefits, 3 months allotted for a 36-month window, and a remaining 2 months of exemptions from the reserve of 15 percent

Figure A.3: Monthly Benefit Amounts, per SNAP recipient



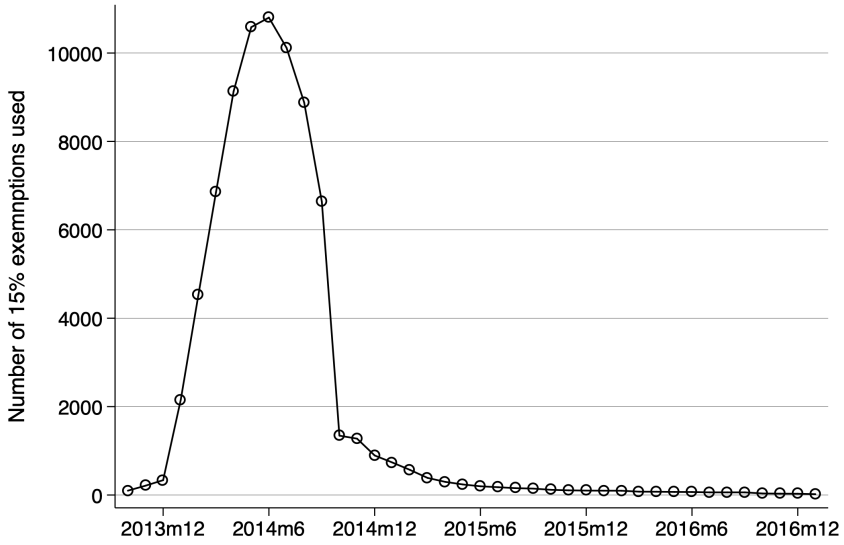
Notes: Figure plots monthly benefits per SNAP recipient across Virginia, calculated as total benefits divided by total SNAP participation. Benefits were reduced by about 7 percent at the end of ARRA.

exemptions allotted to the state. If after this 6-month period they were again found not to be in compliance with work requirements, they were immediately disenrolled from the program and stopped receiving benefits. The distribution of 15 percent waiver exemptions over time is shown in Figure A.4. These waivers were heavily used throughout most of 2014 but were sparingly used after September of 2014. As a result, Figure A.5 displays a correspondingly large spike in exits of ABAWDs in October of 2014 due to exhaustion of allowable benefit months. If after this 6-month period they were found to be in compliance of work requirements, they were given a 12-month recertification period.

Virginia initially reinstated ABAWD work requirements for all counties in the state on October 1, 2013. However, starting in May 2014, Virginia obtained exemptions for ABAWDs living in 23 counties. Individuals who live in these counties and whose recertifications occurred after the reinstatement of work requirements but before May 2014 received 6 month recertifications. As a result, Figure A.5 shows that ABAWD exits due to exhaustion of allotted benefit months from exempt counties is almost non-existent after October 2014. Those recertifying after May 2014 in exempt counties received 12 month recertifications. In May 2015, Virginia exempted an additional 14 counties.[23]

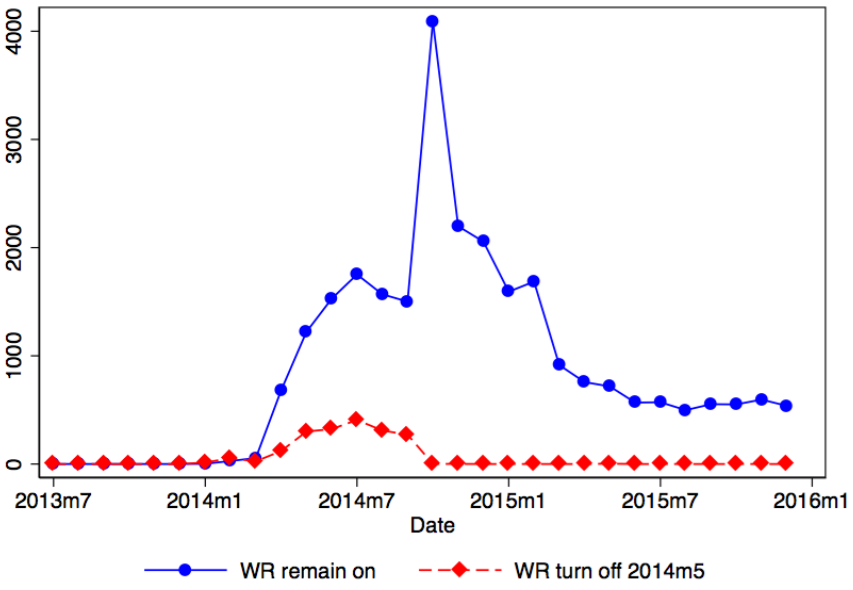
[23]The following counties and cities were exempted in 2014 and 2015: Bristol, Brunswick, Buchanan, Carroll, Charlotte, Danville, Dickenson, Emporia, Franklin City, Galax, Grayson, Greensville, Halifax, Henry, Hopewell, Lee, Luneburg, Martinsville, Mecklenburg, Norton, Page, Patrick, Petersburg, Pittsylvania, Prince Edward, Prince George, Richmond County, Russell, Scott, Smyth, Southampton, Surry, Sussex, Washington, Williamsburg, Wise, Wythe.

Figure A.4: Number of ABAWD 15 Percent Exemptions Used



Notes: Figure plots the count of 15 percent waiver exemptions used in Virginia each month. One unit corresponds to one ABAWD being allowed to remain on SNAP for one additional month despite not meeting work requirements. The 15 percent exemptions were primarily used to extend the benefit eligibility of ABAWDs who would otherwise have been removed from SNAP following the reintroduction of work requirements in October 2013.

Figure A.5: Count of SNAP Exits Due to Failure to Meet ABAWD Work Requirements



Notes: Figure plots the count of SNAP exits that occur as a result of exhausting allowable benefit months without fulfilling work requirements.

Finally, ABAWDs who newly enrolled between October 2013 and September 2014 were (theoretically) given 6-month recertification periods. Again, these recertification periods were composed of an initial partial month of benefits, 3 months allotted for a 36-month window, and a remaining 2 months of exemptions from the reserve of 15 percent exemptions allotted to the state. Since 15 percent exemption waivers were not used as readily after September of 2014, those who newly enrolled on or after May of 2014 did not receive a full 6 months of benefits if they did not meet work requirements. Those enrolling between July 2014 and September 2017 generally only received 4-month recertification periods. The variation in recertification periods corresponds to drops in SNAP participation among cohorts of recipients who enroll after October 2013, as depicted in Figure D.1: Figure D.1a shows that the RD point estimate among new participants with 6-month recertifications (October 2013 to April 2014 cohorts) drops substantially in the seventh month. In contrast, Figure D.1b shows that among those with 4-month recertifications (May 2014 to December 2014 cohorts), participation drops in the fifth month. In both cases the RD effects are large and largely comparable in magnitude to the effect estimated using the stock population in the main text.

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B Summary of Related Literature [Not for Publication]

This Appendix provides further details of the studies described in Section 2.2, and compares them to our paper. We estimate program retention effects that are more than double the magnitudes found in these related papers. Even so, our estimates of labor market effects are comparable to theirs. Our results substantiate a conclusion of truly small labor market effects because of our estimates' tight link to the treatment-on-the-treated combined with accurate administrative data on employment. While some of the differences in results may also arise from across-state heterogeneity in the impacts of work requirements, we view the differences as more likely driven by the data sources used. Table B.1 summarizes the various differences between studies along a number of dimensions.

The public-use versions of the ACS and the CPS aggregate geographic identifiers from low-population counties into larger geographic units, resulting in aggregated units with mixed work requirements policies. The public-use versions also report rounded age, reducing the precision of RD designs using the age 50 cutoff. Stacy et al. (2018) overcome these issues using a restricted-use version of the ACS that reports county-level geography, exact age of respondent on the day of the survey, and the date of survey. However, even in the restricted-use version of the ACS, estimated effects on SNAP participation are diluted because the ACS asks whether a survey respondent was ever on SNAP in the last twelve months, and all ABAWDs (regardless of work status) can receive SNAP benefits for three months when work requirements are in place.

Survey data also severely overstate labor force participation. For example, Harris (2021) reweights survey data to match the demographic composition of ABAWDs in the administrative QC data. Even with this reasonable adjustment, Harris' survey-based ABAWD population has an employment rate of 71 percent, while the ABAWD population in the QC data has an employment rate of 24 percent. Similarly, Han (2020) has a control sample with a 75 percent employment rate. Stacy, Scherpf and Jo (2018) have a control sample with a lower—but still high—employment rate of 48 percent from the same survey, potentially because they condition on SNAP participation in the previous year (which may be endogenous). In Ritter (2018), 40 to 58 percent of the CPS-based control sample work more than 20 hours per week while only 10 to 25 percent of the administrative QC-based control sample do. As shown in Table B.1 below, our administrative data on employment is lower and consistent with patterns observed in QC data. For this comparison, we designate as ABAWDs individuals in the QC data who are non-disabled, aged 18 to 49, in childless SNAP units and who are not exempt from work registration.

Table B.1: Summary Table of Close Contemporaneous Literature

Paper	**Labor Market Data Source**	**SNAP Data Source**	**Data Structure**	**States**	**Identification Strategy**
Stacy, Scherpf, and Jo (2018)	ACS (restricted use)	Administrative SNAP data	Labor: Cross-sectional SNAP: Panel	9 States	RD-DD
Harris (2021)	ACS (public use)	ACS (public use)	Cross-sectional	Nationwide	DD & DDD
Han (2020)	ACS (public use)	ACS (public use)	Cross-sectional	Nationwide	DDD
Cuffey, Mykerezi, and Beatty (2015)	CPS (public use)	CPS (public use)	Cross-sectional	Nationwide	DDD
Ritter (2018)	CPS (public use), QC Data (administrative)	N/A	Cross-sectional	29 States	RD
Gray, Leive, Prager, Pukelis, and Zaki [This paper]	Administrative UI data	Administrative SNAP data	Panel	Virginia	Donut RD

Table B.1: Summary Table of Close Contemporaneous Literature (continued)

Paper	Selected Population for Analysis	Inclusion of Non-treated	Selection Bias? Endogenous variables
Stacy, Scherpf, and Jo (2018)	Ages 25–54 who do not appear to be disabled, have no children under the age of 18, and at or below 250% of the FPL. For labor market outcome analysis, only those who receive SNAP in the 12 months prior to interview date.	Yes	Yes, labor outcomes conditional on SNAP participation, being below 250% of FPL, disability
Harris (2020)	Ages 25–54 who do not appear to be disabled, have no children under the age of 18. Limited to US citizens in continental US who are not institutionalized, in active duty military, or foster care.	Yes	Yes, labor outcomes conditional on disability
Han (2020)	Ages 18–60 who do not appear to be disabled, have no children under the age of 18, and at or below 300% of the FPL.	Yes	Yes, labor outcomes conditional on being below 300% of FPL, disability
Cuffey, Mykerezi, and Beatty (2015)	Ages 18–65 who do not appear to be disabled, have no children under the age of 18, and do not go to school.	Yes	Yes, labor outcomes conditional on disability
Ritter (2018)	CPS: U.S. citizen adults in different age ranges around age 50, who have no children under the age of 18 and who have no High School diploma. QC1: Individuals who do not live with children under the age of 18. QC2: Individuals who do not live with children under the age of 18 and who are not coded as having a disability	CPS - Yes QC1 - Yes QC2 - No	CPS - No. QC1 - Yes, labor outcome conditional on SNAP participation. QC2 - Yes, labor outcome conditional on SNAP participation and disability
Gray, Leive, Prager, Pukelis, and Zaki [This paper]	VA General population (used for case count): SNAP participants who have no children under the age of 18, who are not exempt from work registration and have no known disabilities. Stock population: VA General population members who are enrolled in SNAP in September 2013, who have no children under the age of 18, who are not exempt from work registration and have no known disabilities in that month.	No (at time of sample construction)	No

Table B.1: Summary Table of Close Contemporaneous Literature (continued)

Paper	**SNAP Participation for control group or at 50 y.o. cutoff**	**Average Labor Outcome for control group or at 50 y.o. cutoff**	**Main Findings**
Stacy, Scherpf, and Jo (2018)	20%	Employment (conditional on SNAP): 48.4%	Work reqt. cause SNAP participation to drop by 3pp but have no significant impact on labor outcomes. No evidence it causes an increase in claims of disability.
Harris (2021)	15.6–18.3%	Employment: 71.5–72.5%	Work reqt. cause SNAP participation to drop by 1.6–1.8pp. They increase employment by 1.1–1.3pp.
Han (2020)	16.60%	Employment: 74.9% Annual earnings: $15,026	Work reqt. exemptions cause SNAP participation to increase by 1.6pp. No significant impact on employment. But find that work reqt. exemptions cause usual weekly hours worked if employed to decrease by 0.388 hours.
Cuffey, Mykerezi, and Beatty (2015)	N/A	N/A	No statistically significant impact on SNAP participation, employment or working ≥20 hours.
Ritter (2018)	CPS - N/A QC - 100%	CPS - work >20h: 40–58% QC - work >20h: 10–25%	No significant impact on employment except some evidence among the males with disability population from the QC2 sample with 7.3pp effect, significant at the 10% level. Authors find that this result does not stand up to falsification test.
Gray, Leive, Prager, Pukelis, and Zaki [This paper]	Month 0: 100% Month 18: 63.1%	Month 0 employment (SNAP application): 18.6% Month 18 employment (UI): 29% Month 18 annual earnings (UI): $4,276.80	ABAWD SNAP participation decreases by 52% overall and by 38% (24pp) for the stock population 18 months after Work reqt. reinstatement. Homeless and beneficiaries with no earned income at time of entry are disproportionately impacted. Average employment increases of more than 2 percentage points are ruled out. Evidence found of increased earnings near a key eligibility threshold.

References

Han, Jeehoon. 2020. "The Impact of SNAP Work Requirements on Labor Supply."

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Stacy, Brian, Erik Scherpf, and Young Jo. 2018. "The Impact of SNAP Work Requirements." *Working Paper*.

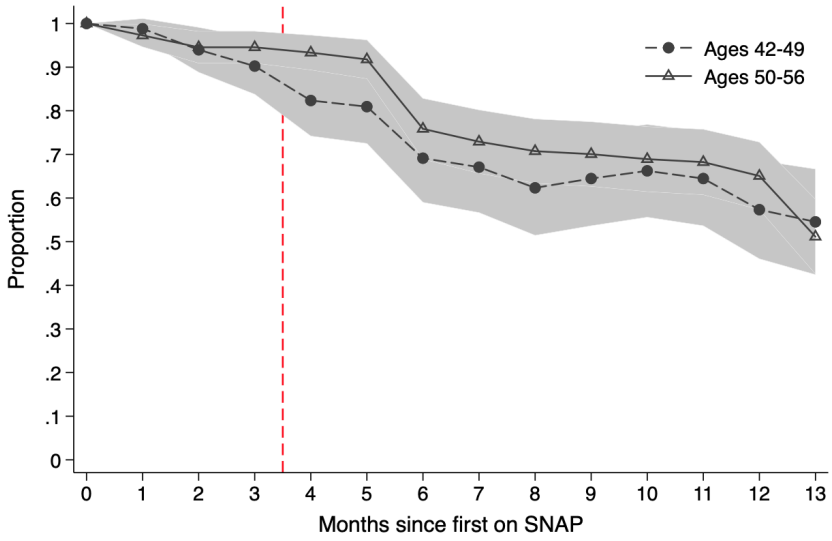
C Additional Tables and Figures [Not for Publication]

Table C.1: Descriptive Statistics of SNAP Participant-Months in Full Sample (2005-2016)

	All		Non-ABAWD Adults		ABAWDs	
	Mean	SD	Mean	SD	Mean	SD
Age	24.3	32.8	41.2	16.4	32.5	9.9
Adult	0.55	0.50	1.00	0.00	1.00	0.00
Female	0.54	0.50	0.62	0.48	0.39	0.49
Married	0.13	0.33	0.27	0.44	0.08	0.27
Household Size	3.0	1.7	2.6	1.6	1.2	0.6
Household Head	0.43	0.50	0.76	0.43	0.88	0.32
Homeless	0.02	0.15	0.02	0.13	0.12	0.32
White	0.41	0.49	0.45	0.50	0.37	0.48
Black	0.36	0.48	0.34	0.47	0.37	0.48
Some College+	0.07	0.25	0.12	0.33	0.12	0.32
Has Earned Income (DSS)	0.13	0.34	0.26	0.44	0.16	0.37
Has Unearned Income (DSS)	0.23	0.42	0.34	0.47	0.08	0.27
Avg. Annual Earnings (UI)	4,200	10,463	7,993	13,484	5,959	11,427
Fraction of Months Employed	0.22	0.36	0.39	0.41	0.37	0.38
Ever reported...						
Any Disability	0.15	0.36	0.29	0.45	0.09	0.28
Exempt from Work Registration	0.39	0.49	0.70	0.46	0.26	0.44
Exempt due to Dependent	0.13	0.34	0.25	0.43	0.08	0.27
Medicaid Recipient	0.69	0.46	0.60	0.49	0.29	0.45
TANF Recipient	0.22	0.42	0.16	0.36	0.05	0.21
SNAP E&T Participant	0.04	0.19	0.05	0.21	0.16	0.36
Moved County	0.06	0.24	0.12	0.33	0.03	0.18
N	2,272,827		1,006,065		240,705	

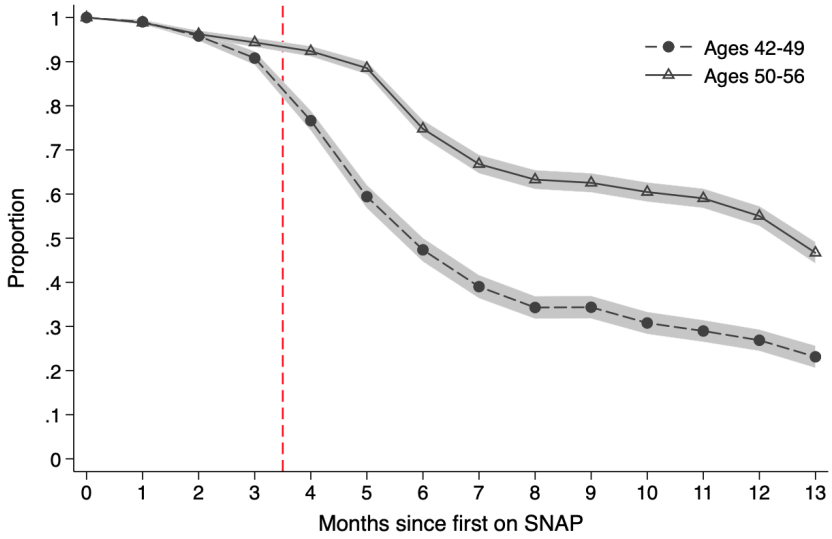
Notes: Table reports descriptive statistics of SNAP participant-months across the whole sample, rather than restricted to the stock population in the main analysis. N denotes count of participant-months. The variables Has Earned Income and Has Unearned Income are reported in DSS files. The variables Avg. Annual Wages and the Fraction of Months Employed are both calculated from UI records.

Figure C.1: SNAP Participation Survival in Counties with Work Requirement Exemptions



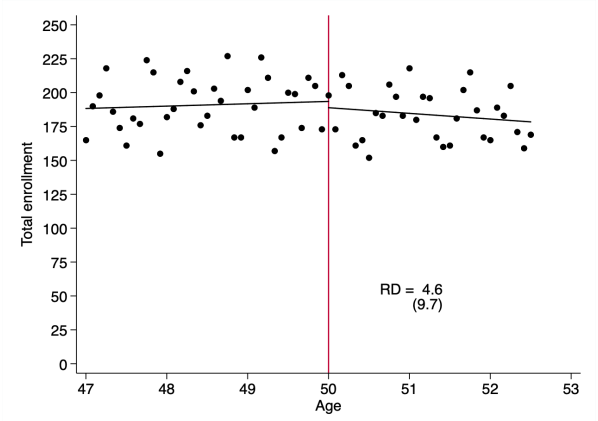
Notes: Figure plots participation survival for ABAWDs aged 42–49 and able-bodied adults without dependents or disabilities aged 50–56 in counties with exemptions for work requirements in May 2014, who have not had a SNAP spell earlier in our sample period, and who first receive benefits between July 2014 and December 2014.

Figure C.2: SNAP Participation Survival by Work Requirements Status: Participants With Four-Month Recertification Periods

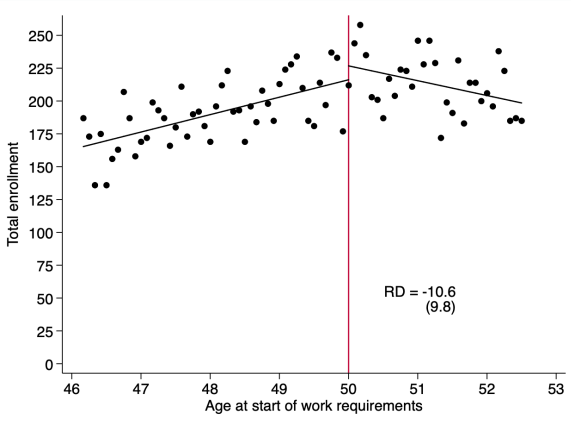


Notes: Figure plots participation survival for ABAWDs aged 42–49 and able-bodied adults without dependents or disabilities aged 50–56 in counties with active work requirements, and who have not had a SNAP spell earlier in our sample period. Work requirements apply to ABAWDs (dashed line), who are required to start meeting them four months after initial entry (dashed red vertical line) in order to continue to receive SNAP benefits. The figure plots participation survival for participants whose SNAP spells begin between July 2014 and December 2014, who are required to start meeting work requirements four months after initial entry. Compare to Figure 1, which plots participation for those required to start meeting work requirements six months after initial entry.

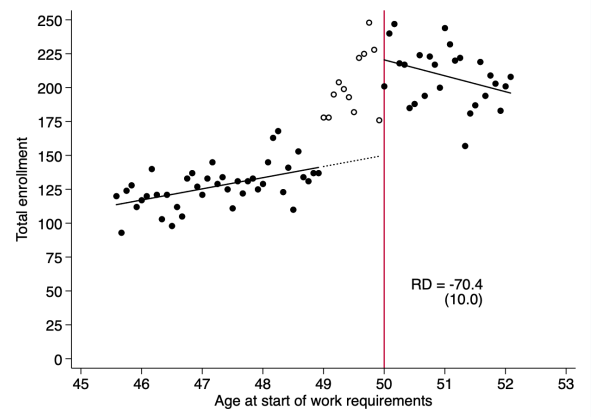
Figure C.3: RD Estimate of Total SNAP Participation



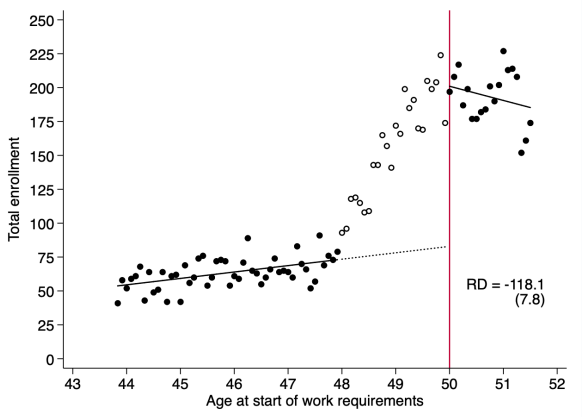
(a) 24 Months Before Work Requirements



(b) Month of Work Requirements



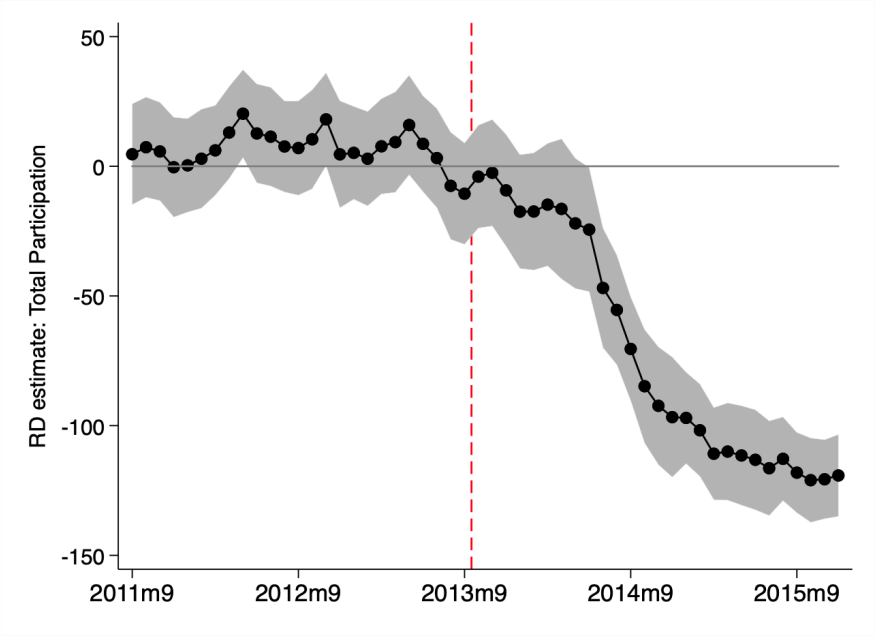
(c) 12 Months After Work Requirements



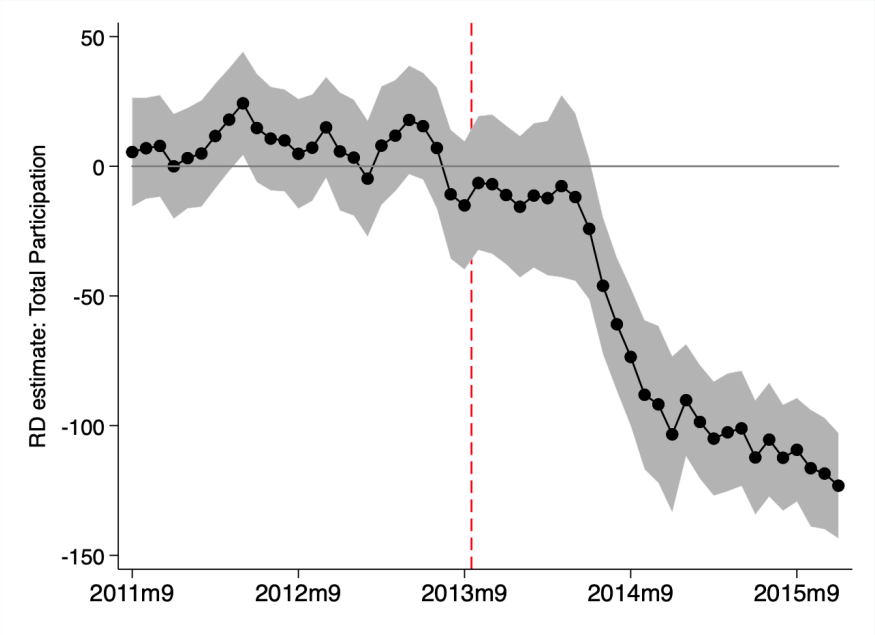
(d) 24 Months After Work Requirements

Notes: Figure visually displays the RD results for total SNAP participation 12 months before, 0 months after, 12 months after, and 24 months after work requirements. In each RD, we define the excluded donut to correspond to those participants whose exposure to work requirements changes between the estimation period and the post-ARRA reintroduction of work requirements. For example, the earlier periods do not require a donut; the period 12 months after the reinstatement of work requirements requires a one-year age donut. Each scatter plot shows total participant counts by age in quarters, and the lines show a linear regression fit on both sides of the eligibility threshold. Standard errors are clustered by monthly age in parentheses. The sample consists of the subset of counties for which work requirements remain on after October 2013.

Figure C.4: RD Estimates of Total SNAP Participation at Other Intervals



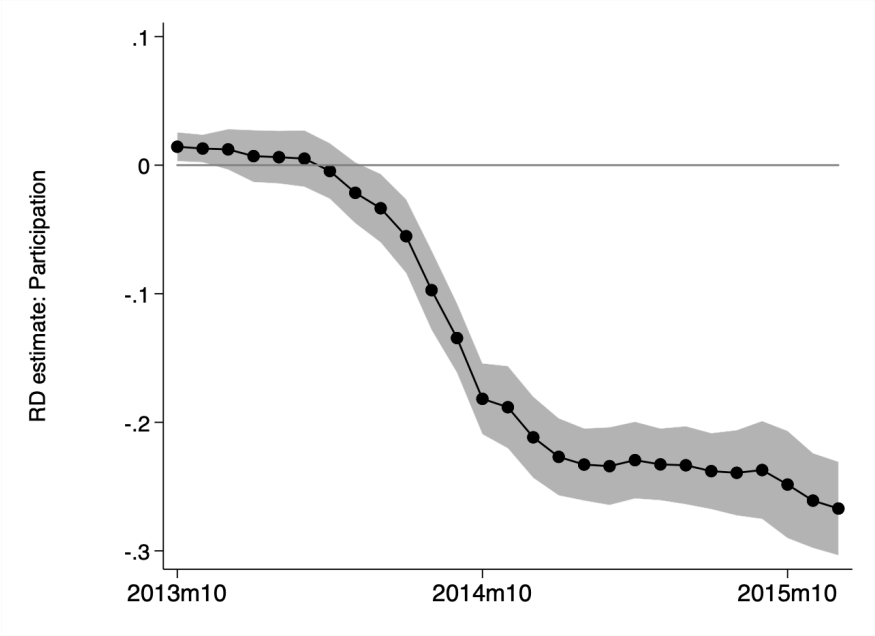
(a) Age Polynomial: Linear



(b) Age Polynomial: Quadratic

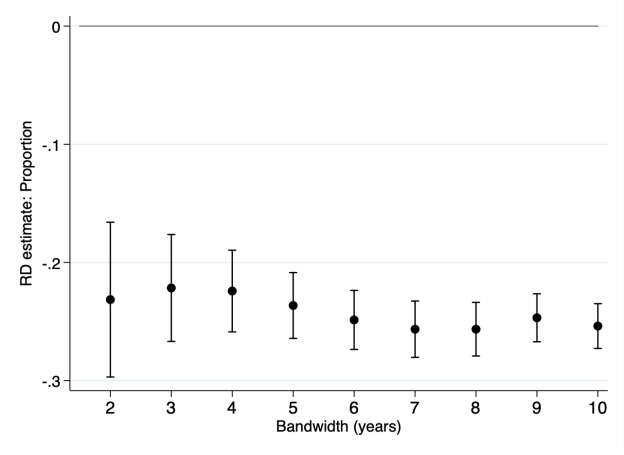
Notes: Figure shows RD coefficients for SNAP participation, repeated for other intervals in addition to the baseline interval (18 months after work requirements). In this figure, the coefficient at 2015m3 corresponds to Figure 4a. Panel A presents RD estimates using linear age polynomials and Panel B presents estimates with quadratic age polynomials for robustness. Shaded regions denote 95 percent confidence intervals that cluster standard errors on monthly age.

Figure C.5: RD Estimates of SNAP Participation at Other Intervals, Stock Sample

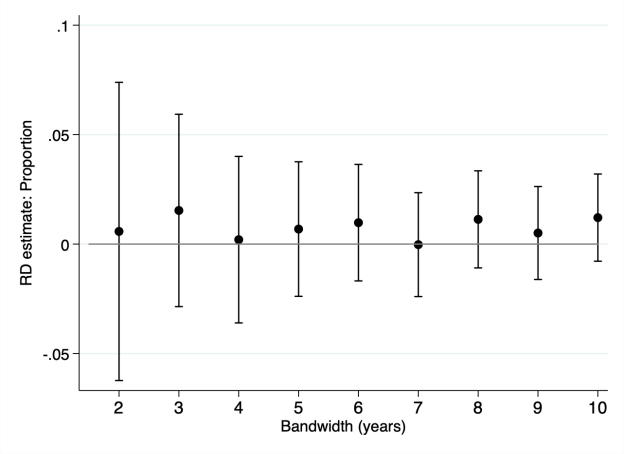


Notes: Figure shows RD coefficients for SNAP participation in the post-ARRA period among the stock population, repeated for other intervals in addition to the baseline interval (18 months after work requirements). In this figure, the coefficient at 2015m3 corresponds to Figure 5a. Shaded regions denote 95 percent confidence intervals that cluster standard errors on monthly age.

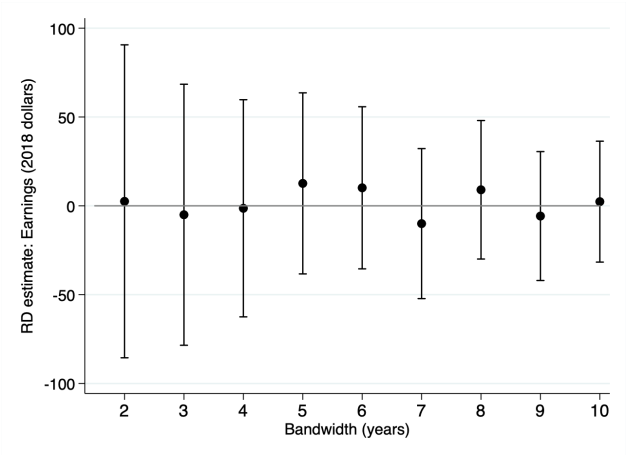
Figure C.6: Robustness to Bandwidth Selection



(a) SNAP Participation



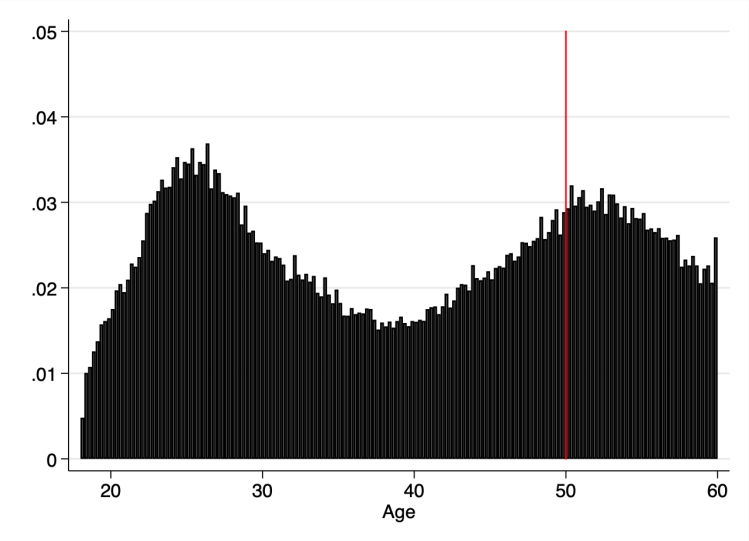
(b) Employment



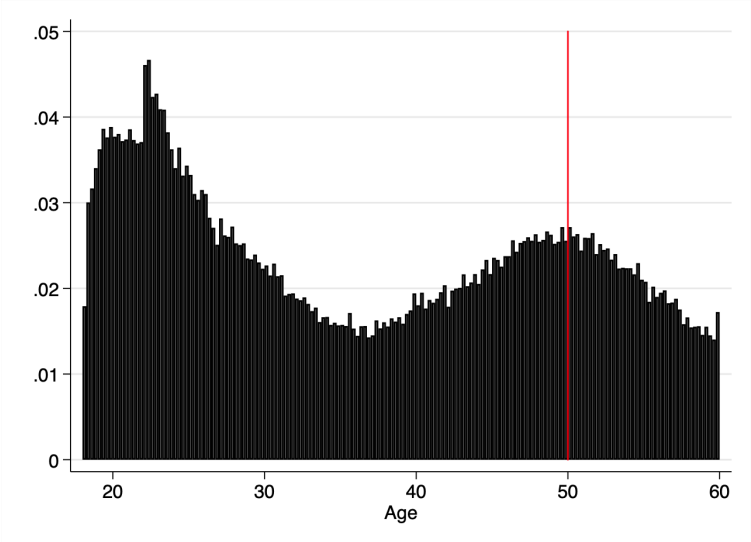
(c) Earnings

Notes: Figures plots the RD estimates 18 months after work requirements were reinstated using different bandwidths. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties where work requirements remain on after October 2013. Earnings are winsorized at the 99 percent level within monthly age.

Figure C.7: Density of Age at SNAP Enrollment



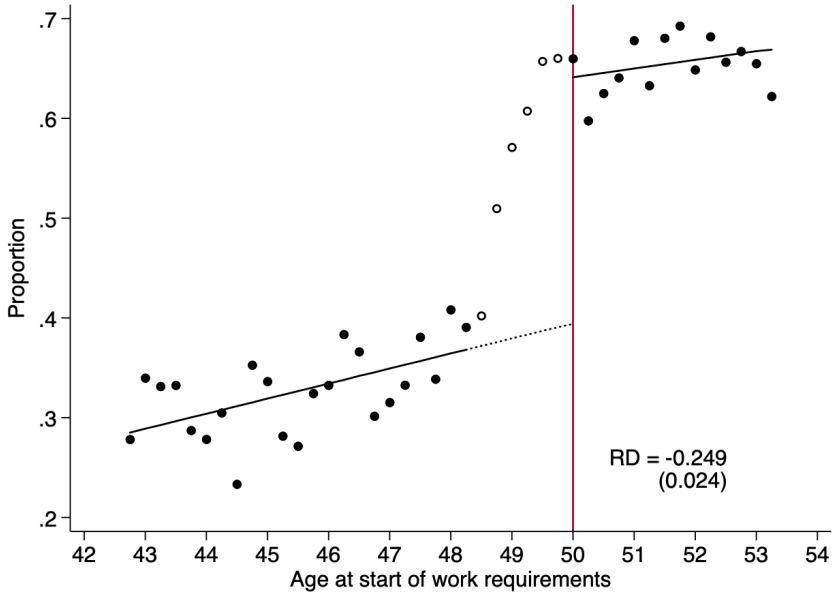
(a) Work Requirements Counties



(b) No Work Requirements Counties

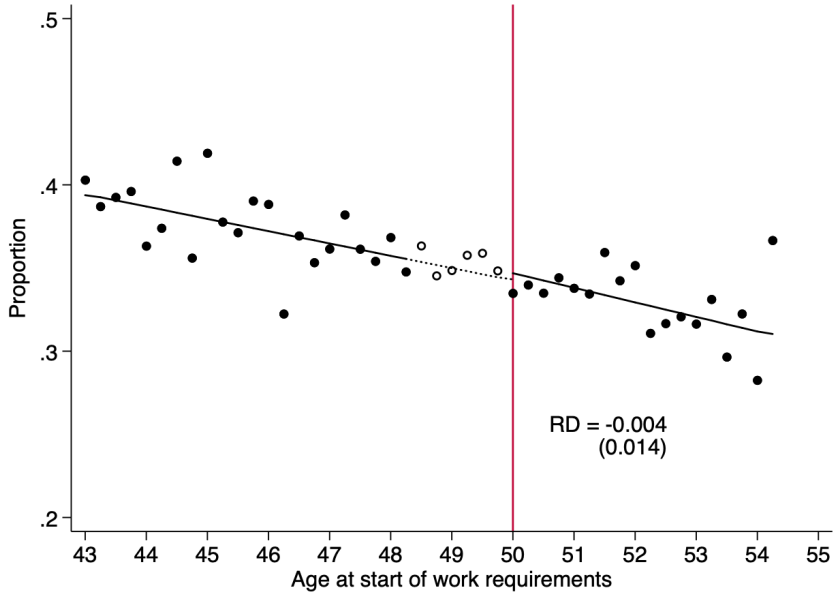
Notes: Figures plots the distribution of age at SNAP enrollment within quarterly bins for those in counties with work requirements and those without work requirements. In counties without work requirements, there is no visible discontinuity in the density at age 50. In counties with work requirements, participation appears to be slightly lower just to the left of 50, although the magnitude is small and formal statistical tests (Frandsen 2017) fail to reject the null that the density is smooth at this cutoff. Taken together, there is not strong evidence of selection based on age around the eligibility threshold for work requirements.

Figure C.8: RD Estimates of SNAP Retention Under Equal Recerticiation Counts

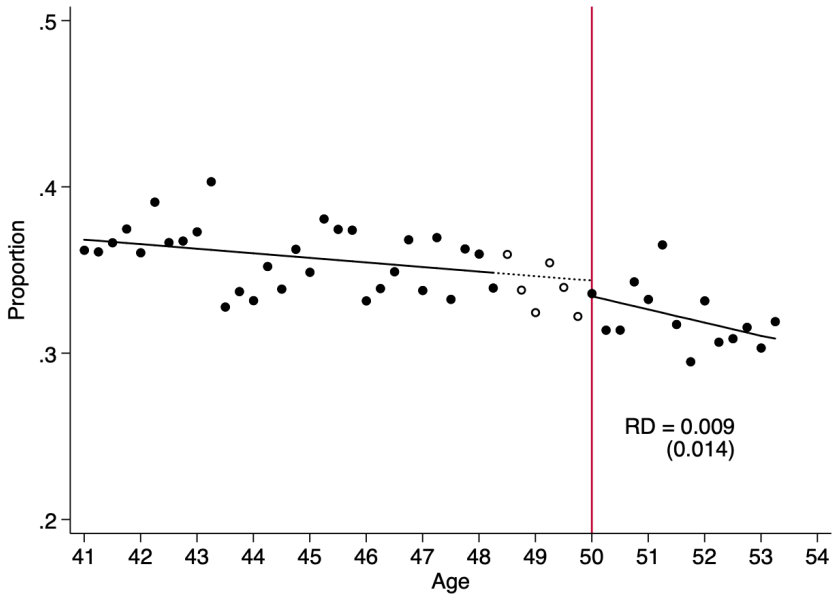


Notes: Figure plots RD results for SNAP participation after eighteen months of work requirements only for the subset of the stock population whose first recertification after the reinstatement of work requirements occurs in the months of October 2013 through March 2014. Participants in this subset of the stock population would have experienced the same number of recertifications (two) if they remain on SNAP 18 months after the reinstatement of work requirements, whether they are in the younger-than-50-group or in the 50-and-older group. Standard errors clustered by monthly age in parentheses. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties for which work requirements remain on after October 2013.

Figure C.9: RD Estimates of Employment (UI or DSS), 18 Months After Work Requirements



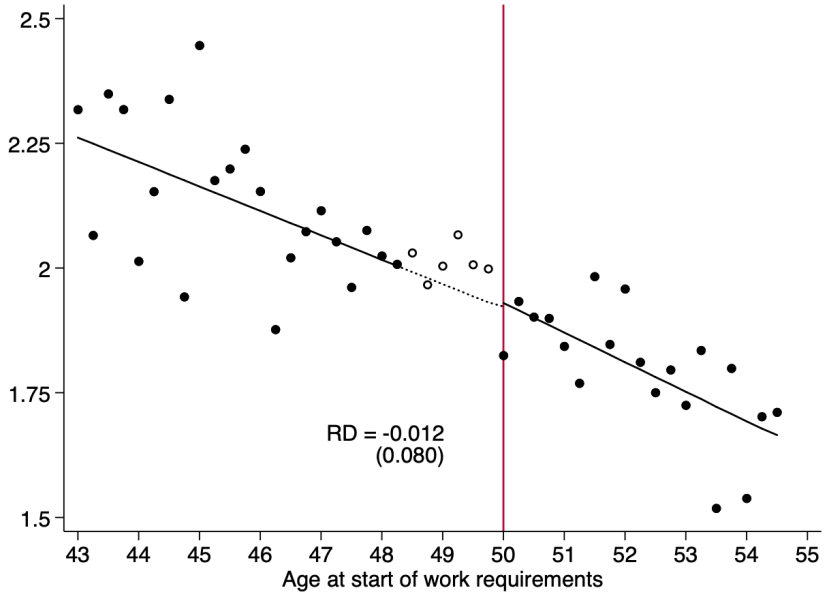
(a) Employment During Work Requirements



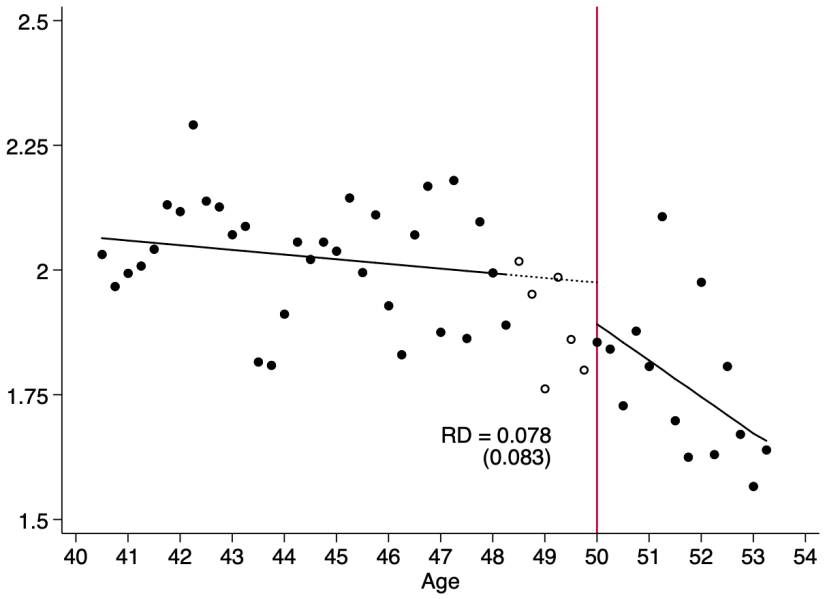
(b) Placebo Test: Employment During ARRA Exemptions

Notes: Panel (a) visually displays the RD results for employment in either the UI data or in DSS-reported earnings after 18 months of work requirements. The scatter plot shows covariate-adjusted means by age in quarters, and the lines show a linear regression fit in months on both sides of the eligibility threshold. Standard errors clustered by monthly age in parentheses. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties where work requirements remain on after October 2013. Panel (b) replicates the same analysis among those participating in September 2011, when the ARRA exemption that suspended work requirements was in effect for an additional two years.

Figure C.10: RD Estimates of Log Earnings, 18 Months After Work Requirements



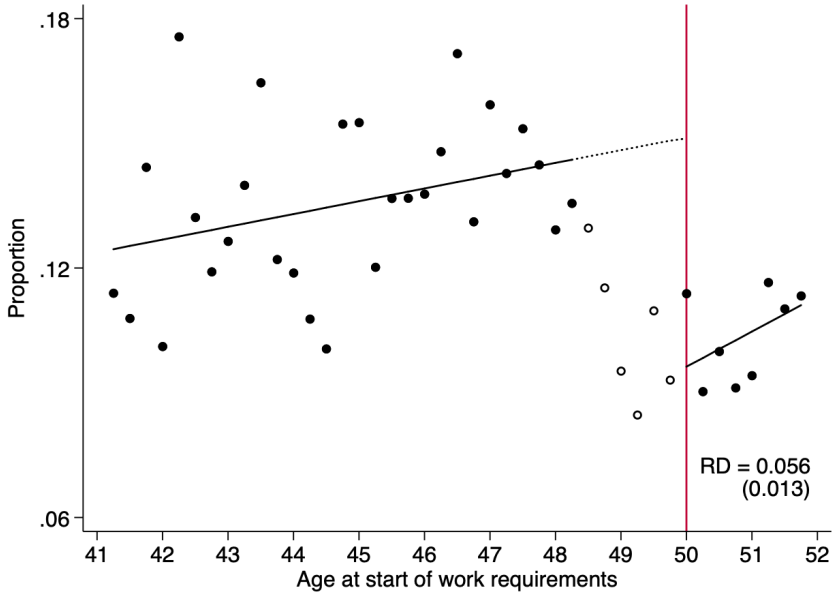
(a) Log Earnings During Work Requirements



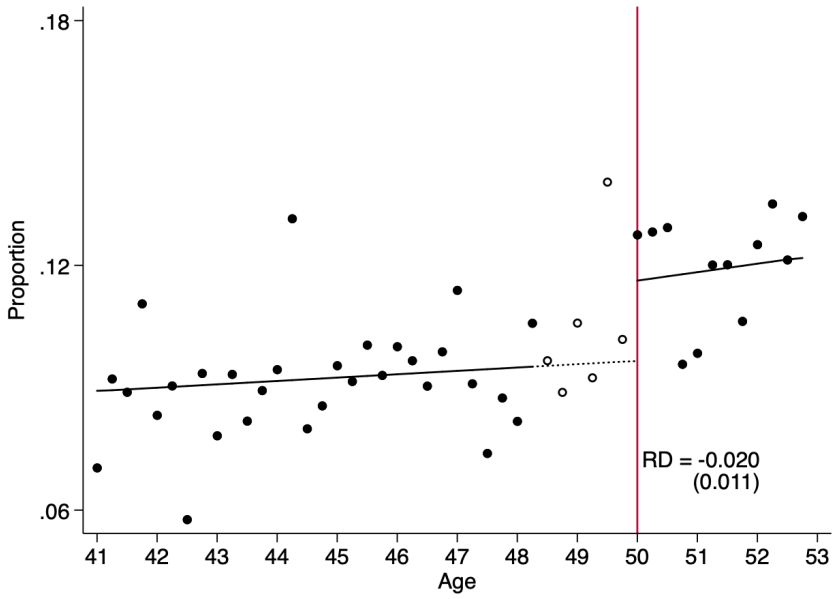
(b) Placebo Test: Log Earnings During ARRA Exemptions

Notes: Panel (a) visually displays the RD results for log earnings after 18 months of work requirements. The scatter plot shows covariate-adjusted means by age in quarters, and the lines show a linear regression fit in months on both sides of the eligibility threshold. Standard errors clustered by monthly age in parentheses. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties where work requirements remain on after October 2013. Panel (b) replicates the same analysis among those participating in September 2011, when the ARRA exemption that suspended work requirements was in effect for an additional two years.

Figure C.11: RD Estimates of Exempt Status, 18 Months After Work Requirements



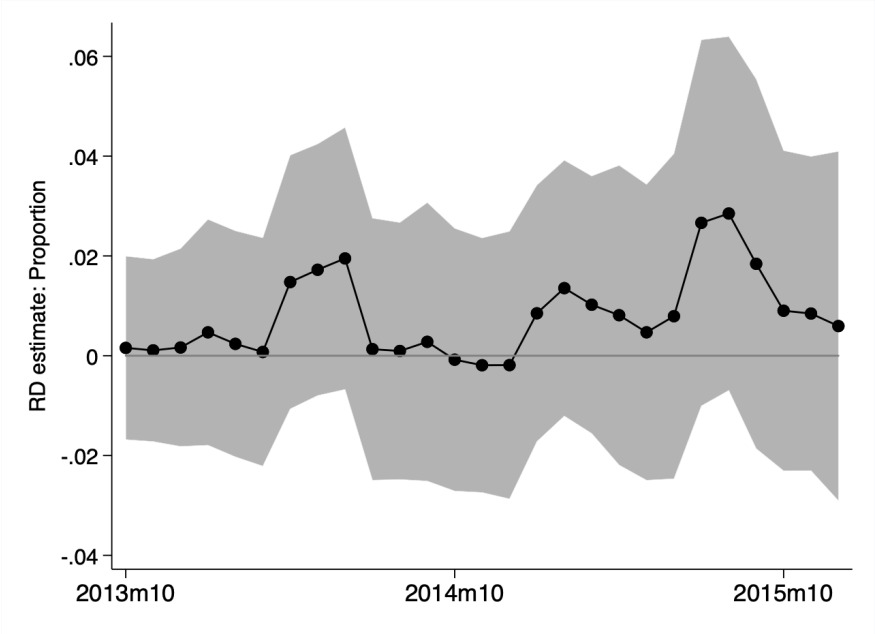
(a) Exemptions During Work Requirements



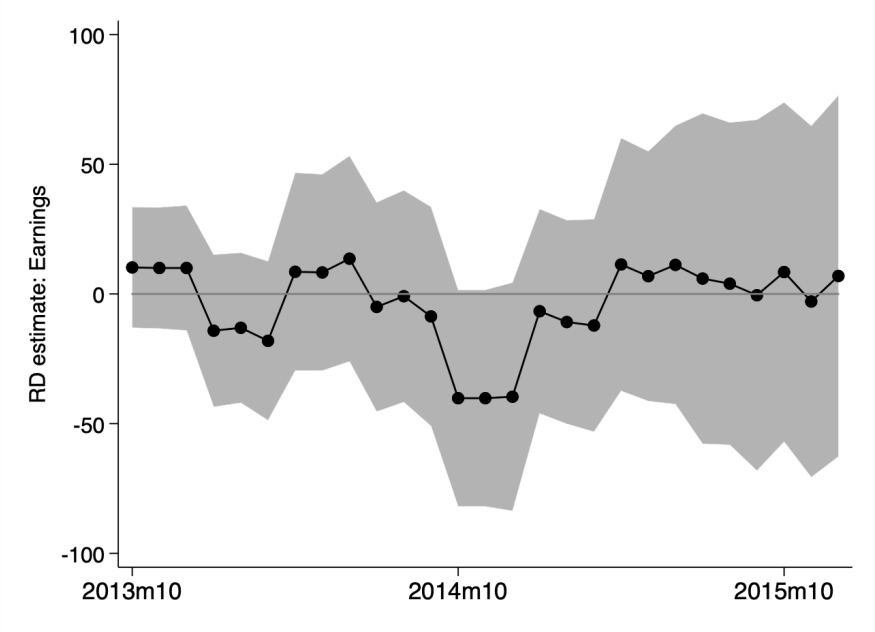
(b) Placebo Test: Exempt Status During ARRA Exemptions

Notes: Panel (a) visually displays the RD results for reported exemptions (except for age) after 18 months of work requirements. The scatter plot shows covariate-adjusted means by age in quarters, and the lines show a linear regression fit in months on both sides of the eligibility threshold. Standard errors clustered by monthly age in parentheses. The sample consists of work-registered individuals on SNAP in September 2013 and in the subset of counties where work requirements remain on after October 2013. Panel (b) replicates the same analysis among those participating in September 2011, when the ARRA exemption that suspended work requirements was in effect for an additional two years.

Figure C.12: RD Estimates of Employment and Earnings at Other Intervals



(a) Employment



(b) Earnings

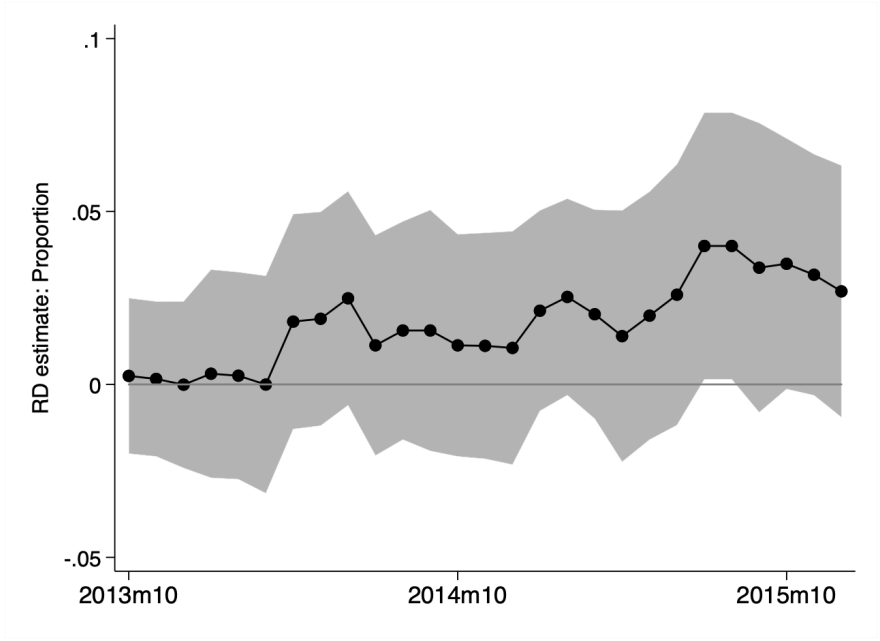
Notes: Figure shows RD coefficients for employment and earnings, repeated for other intervals in addition to the baseline interval. Each estimate calculated using a separate MSE-optimal bandwidths on each side of the donut. Shaded regions denote 95 percent confidence intervals that cluster standard errors on monthly age.

Table C.2: RD Estimates Under Alternative Models

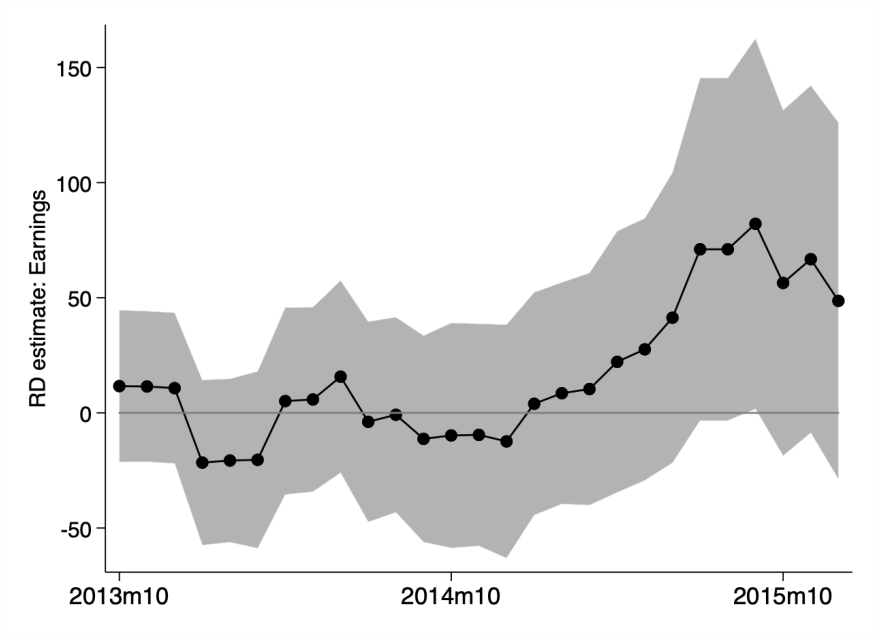
	Linear Uniform		Linear Triangular		Quadratic Uniform		Quadratic Triangular	
	Main Sept 2013	Placebo Sept 2011	Main Sept 2013	Placebo Sept 2011	Main Sept 2013	Placebo Sept 2011	Main Sept 2013	Placebo Sept 2011
Panel A. SNAP Participation								
Discontinuity	-0.234	-0.001	-0.236	0.001	-0.227	0.006	-0.224	0.000
	0.015	0.020	0.014	0.017	0.019	0.024	0.018	0.022
Control Mean	0.632	0.669	0.632	0.669	0.632	0.664	0.630	0.659
N	15,692	13,097	20,144	17,515	24,189	21,270	28,942	24,471
Panel B. Employed								
Discontinuity	0.010	0.007	0.010	0.012	-0.007	0.009	0.007	0.014
	0.013	0.012	0.012	0.011	0.020	0.019	0.018	0.017
Control Mean	0.273	0.277	0.271	0.271	0.263	0.280	0.264	0.274
N	16,840	20,233	19,354	26,079	21,791	23,298	26,383	28,322
Panel C. Earnings								
Discontinuity	-12.2	39.8	-13.6	36.2	-27.7	52.1	-15.7	51.3
	20.7	27.2	17.3	24.8	29.4	34.9	24.8	35.0
Control Mean	365.2	347.7	363.7	340.0	360.1	349.9	362.5	345.8
N	15,930	15,701	22,311	22,108	22,688	24,374	26,592	28,082

Notes: Table shows the main RD estimates under alternative specifications for the kernel and polynomial order. Separate MSE-optimal bandwidths are calculated on each side of the donut for each regression. The first two columns show RD estimates for the stock population (enrolled September 2013) and the placebo stock population (September 2011) using Y_i 18 months later, using the controls described in the text. The third and fourth columns re-weight observations using a triangular kernel. The last four columns replicate this exercise using a quadratic fit on either side of the RD. Control mean is the predicted mean of the corresponding outcome variable immediately to the right of the age 50 threshold (the intercept with the cutoff).

Figure C.13: RD Estimates of Employment and Earnings at Other Intervals, Without Controls



(a) Employment



(b) Earnings

Notes: Figure shows RD coefficients for employment and earnings, repeated for other intervals in addition to the baseline interval, in models without controls. Each estimate calculated using a separate MSE-optimal bandwidths on each side of the donut. Shaded regions denote 95 percent confidence intervals that cluster standard errors on monthly age.

Table C.3: RD Estimates of Key Outcomes Without Controls, 18 Months After Work Requirements

	Main Stock (September 2013)	Placebo Stock (ARRA Period)
Panel A. SNAP Participation		
Discontinuity	-0.245	0.004
	(0.014)	(0.021)
Control Mean	0.629	0.670
N	17,409	13,472
Panel B. Employment		
Discontinuity	0.020	0.010
	(0.015)	(0.015)
Control Mean	0.272	0.277
N	15,570	16,211
Panel C. Employed or Earned Income		
Discontinuity	-0.002	0.014
	(0.019)	(0.018)
Control Mean	0.346	0.333
N	14,705	15,942
Panel D. Earnings		
Discontinuity	10.4	32.3
	(25.4)	(29.6)
Control Mean	368.5	347.1
N	14,943	16,079
Panel E. Log Earnings		
Discontinuity	0.072	0.096
	(0.100)	(0.107)
Control Mean	1.884	1.875
N	16,610	16,079
Panel F. Exemption (Other than Age)		
Discontinuity	0.052	-0.018
	(0.013)	(0.011)
Control Mean	0.095	0.116
N	15,046	19,187

Notes: Table shows regressions coefficients from local linear RD specifications with a uniform kernel, without covariates. Standard errors clustered by monthly age (the running variable) are reported in parentheses. Control mean is the predicted mean of the corresponding outcome variable immediately to the right of the age 50 threshold (the intercept with the cutoff). Employment and earnings are measured from UI records. Log earnings calculated as $\ln(y+1)$. Earnings include those with zero UI earnings, and are winsorized at the 99 percent level by monthly age. The variables Earned Income and Exemption status are reported on DSS records.

Table C.4: RD Estimates for SNAP Participation and Employment Outcomes at 18 months, by Labor Force Attachment

		Quintile of Predicted Employment Probability in September 2013				
	All	Lowest	2nd	3rd	4th	Highest
Panel A. SNAP Participation						
Discontinuity	-0.245	-0.243	-0.305	-0.192	-0.257	-0.128
	(0.014)	(0.030)	(0.026)	(0.057)	(0.036)	(0.033)
Control Mean	0.629	0.653	0.702	0.622	0.630	0.473
N	17,409	4,329	4,561	2,034	3,512	3,645
Panel B. Employment						
Discontinuity	0.020	-0.014	-0.014	-0.095	0.025	0.031
	(0.015)	(0.022)	(0.024)	(0.072)	(0.032)	(0.026)
Control Mean	0.272	0.127	0.203	0.374	0.300	0.677
N	15,570	4,685	4,389	1,771	2,985	3,852
Panel C. Earnings						
Discontinuity	5.670	-24.518	-89.784	-189.442	17.702	-58.622
	(26.564)	(31.444)	(33.195)	(126.791)	(51.881)	(87.309)
Control Mean	378.536	141.316	259.228	603.446	381.259	1064.881
N	15,595	5,174	5,017	1,852	3,822	3,024

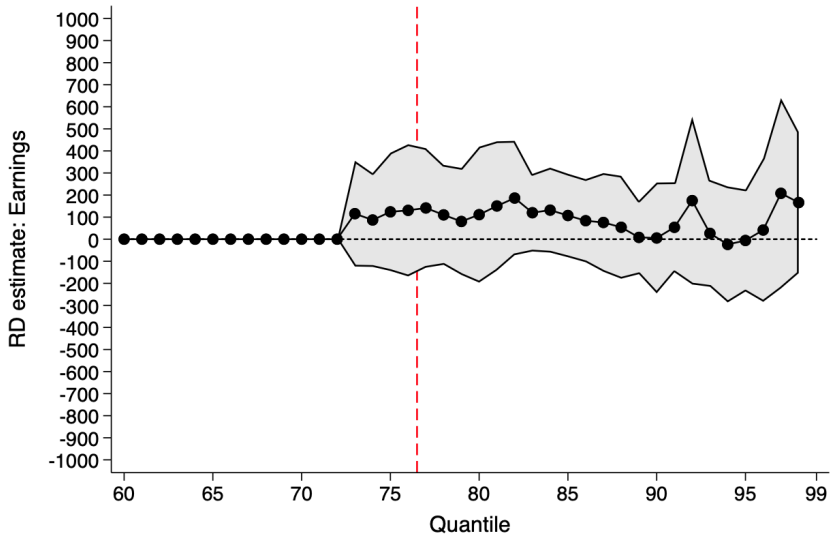
Notes: Table presents the RD coefficient estimates for SNAP participation, employment and earnings for different levels of labor force attachment. Labor force attachment is based on the predicted probability of employment in September 2013, using LASSO regression with data-dependent, theory-driven penalization based on Belloni et al. (2012). The regression includes the following controls to predict employment: indicators for yearly age, indicators for earnings in each month of the previous 7 years prior to Sept. 2013, household size, and indicators for gender, married, private living arrangement, white, black, some college or higher education, reporting earned income on the SNAP application, and reporting unearned income on the SNAP application. Table includes the coefficient, standard error, intercept, and sample size for each specification. Control mean is the predicted mean of the corresponding outcome variable immediately to the right of the age 50 threshold (the intercept with the cutoff).

Table C.5: Covariate Balance in RD, including 18-month Donut

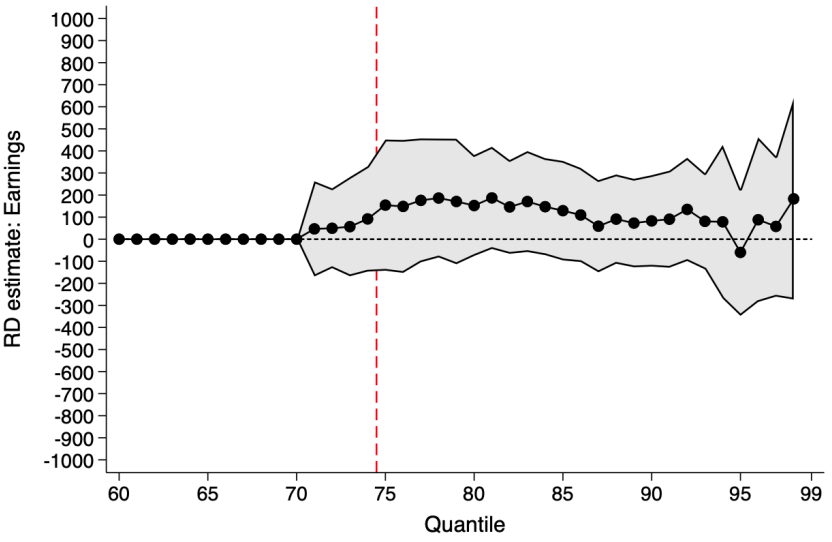
	Discontinuity	S.E.	Control Mean	% diff	N
Female	-0.003	0.023	0.459	-0.7	12,542
White	-0.042	0.018	0.414	-10.1	14,746
Black	0.037	0.021	0.421	8.7	14,490
Married	0.019	0.009	0.096	20.2	20,008
Household Size	-0.004	0.022	1.246	-0.3	16,296
Household Head	-0.011	0.011	0.932	-1.2	13,560
Homeless	0.020	0.011	0.131	15.4	20,213
High School	0.022	0.018	0.538	4.0	18,677
Some College or Higher	-0.014	0.013	0.110	-12.9	17,110
Has Earned Income	0.004	0.011	0.176	2.4	14,943
Has Unearned Income	0.006	0.009	0.091	7.0	16,848
Earned or Unearned Income	0.006	0.015	0.250	2.3	14,567
Fraction of Months Employed, 7yr avg	0.010	0.014	0.351	2.9	14,285
Avg. Annual Earnings, 7yr avg	101.411	255.230	6482.530	1.6	19,321
Fraction of Months Employed, 3yr avg	0.009	0.016	0.281	3.2	14,863
Avg. Annual Earnings, 3yr avg	65.454	316.755	4292.832	1.5	15,960
Number of Months on SNAP	0.254	0.887	27.022	0.9	14,439
Unemployment rate	-0.013	0.029	5.820	-0.2	13,980

Notes: Table presents balance tests of covariates at SNAP enrollment using our "stock" sample. Each row corresponds to a separate regression with that characteristic as the dependent variable. The discontinuity measures the jump in the regression function at age 50. Standard errors are clustered by monthly age (the running variable). Earnings measures are winsorized at the 99th percentile. The Control Mean denotes the mean of that characteristic immediately to the right of age 50. Each regression uses MSE-optimal bandwidths calculated separately for each side of the cutoff and for each outcome, and a uniform kernel to weight observations. Sample sizes vary depending on the bandwidth used.

Figure C.14: Heterogeneity in RD Estimates of Earnings Using Same Bandwidth, During ARRA Exemptions Placebo Period



(a) Placebo During ARRA Exemptions: 18-Month Interval



(b) Placebo During ARRA Exemptions: 24-Month Interval

Notes: Figure plots coefficients from individual-level regressions of monthly earnings. Each coefficient is from a separate regression for that quantile using the recentered influence function method of Firpo, Fortin and Lemieux (2009). Estimates are from the placebo population of individuals on SNAP in September 2011, when the ARRA exemption that suspended work requirements was in effect for an additional two years. Top panel measures earnings in March 2013; bottom panel measures earnings in September 2013. Shading denotes 95 percent confidence intervals using robust standard errors.

References

Belloni, Alexandre, Daniel Chen, Victor Chernozhukov, and Christian Hansen. 2012. "Sparse Models and Methods for Optimal Instruments With an Application to Eminent Domain." *Econometrica*, 80(6): 2369–2429.

Firpo, Sergio, Nicole M Fortin, and Thomas Lemieux. 2009. "Unconditional quantile regressions." *Econometrica*, 77(3): 953–973.

D Additional Analysis Details [Not for Publication]

D.1 Comparison with QC Data

A limitation of this paper is that our estimates may not generalize outside of Virginia. We are not equipped to evaluate across-state heterogeneity in how work requirements are implemented. However, we can compare the compositions of the Virginia and national SNAP populations on observables (measured in the Fiscal Year 2013 QC data). In Fiscal Year 2013, the average SNAP household size in both Virginia and the rest of the country is 1.3. The fraction of individuals whom we would classify as ABAWDs is 7.0 percent in Virginia and 6.3 percent in the rest of the country. The demographic composition is similar except on race. The average age is 36.2 in Virginia and 32.4 elsewhere, and the female fraction is 39.4 percent in Virginia and 40.3 percent elsewhere. The white fraction (47.6 percent in Virginia, 41.6 percent elsewhere) and Black fraction (51.1 percent in Virginia, 36.9 percent elsewhere) are both higher in Virginia than elsewhere, whereas the Hispanic fraction is lower. The fraction with any earned income (unearned income) is 22.6 percent (6.1 percent) in Virginia and 16.4 percent (9.6 percent) elsewhere.

D.2 Details of Total Enrollment Decomposition

This Appendix section describes the details of the calculations summarized in Table 2, which decomposes the total enrollment declines documented in Section 3.2 into three distinct channels:

1. Decreased retention among existing participants.
2. Decreased retention among new enrollees.
3. Deterrence of potential new enrollees.

We perform a series of rough exercises to approximate the relative magnitude of each channel in explaining the overall participation decline. Note that Figure 3b estimates a missing mass of 110.8 beneficiaries per monthly age bin just below age 50. We produce RD estimates for each of the three channels above and compare them to this missing mass. The decomposition into channels need not necessary sum to 100 percent because each channel's contribution is estimated using a separate RD.

To evaluate the first channel, we multiply the number of 50 year olds on the program in September 2013 (226.7) by the main retention effect calculated later in Section 4.2 (-0.235)

and conclude that 53.3 participating individuals per monthly age bin exited due to work requirements. This suggests that the first channel—retention among existing participants—can explain 48 percent (53.3/110.8) of the total enrollment decline.

The second channel—decreased retention among new enrollees—is difficult to estimate credibly given the possible selection of unobservably different beneficiaries into the program over time. As a very rough approximation, we estimate the loss in retention among new enrollees by estimating separate RDs around age 50 for each subsequent monthly cohort of new entrants after September 2013.[24] Point estimates are shown in Appendix Figure D.1. Multiplying each coefficient by the number of new 50-year-old enrollees in each month yields a sum of −19.8, suggesting a modest role for new beneficiary retention of just below 18 percent (19.8/110.8).

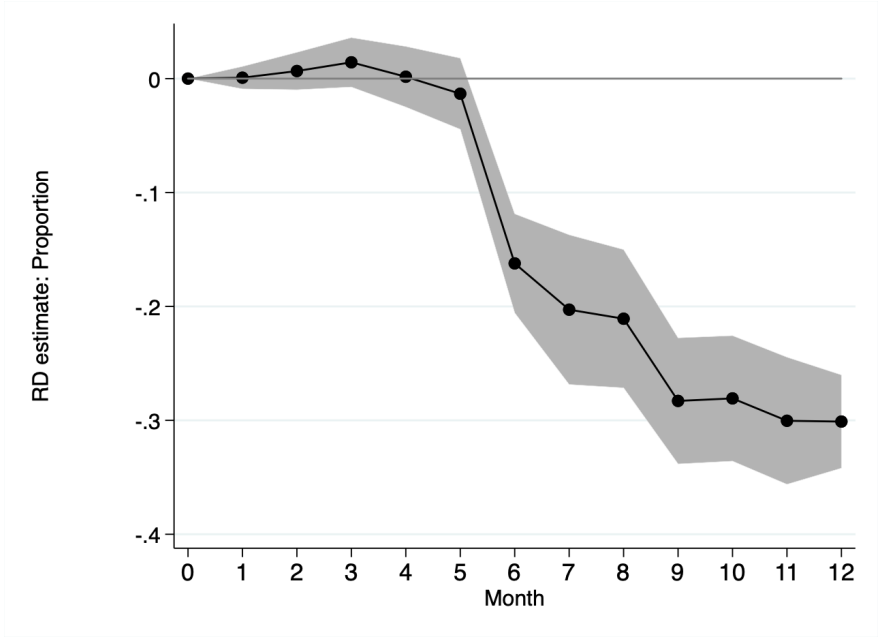
Finally, the third channel—deterrence of potential new enrollees—appears to explain only a small fraction of the total enrollment decline. We estimate (noisy) RDs of total new enrollment in each month from October 2013 through March 2015, and sum the corresponding enrollment drops together. Appendix Figure D.2 shows these coefficients. The coefficients sum to −18, suggesting that new enrollment deterrence can explain less than 17 percent (18.2/110.8) of the total enrollment decline.[25]

These exercises are imperfect but are nonetheless useful. Namely, they provide evidence that deterrence is *not* the primary driver of enrollment declines. Instead, retention of existing and new beneficiaries appear to be the most important channels in total enrollment declines.

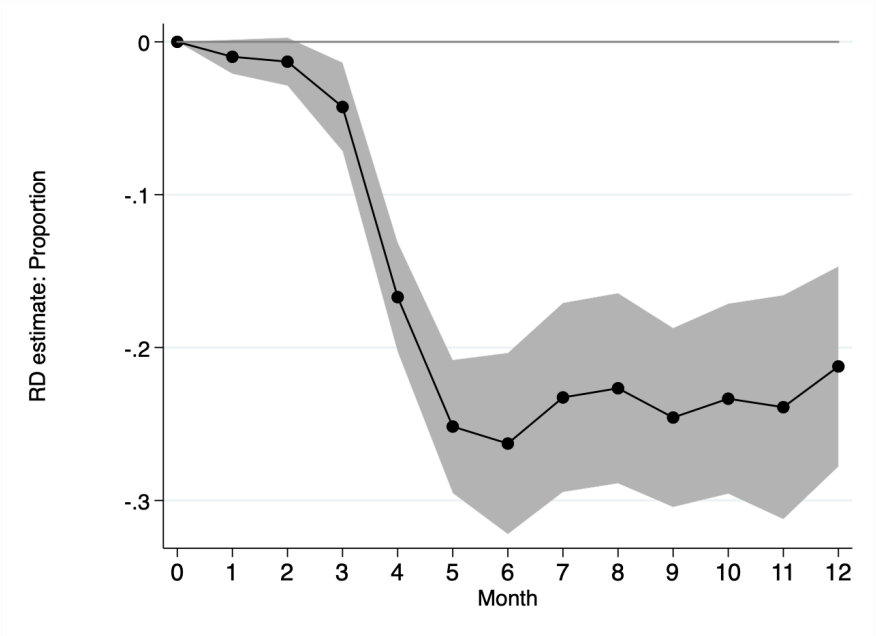
[24] We adjust the donut in each RD to exclude those under 50 who turn 50 before March 2015.

[25] We would ideally examine take-up among those *eligible* for SNAP rather than those newly enrolling, but we have no reason to believe this should jump discontinuously at age 50.

Figure D.1: RD Estimates of SNAP Participation in First Year Since Enrollment



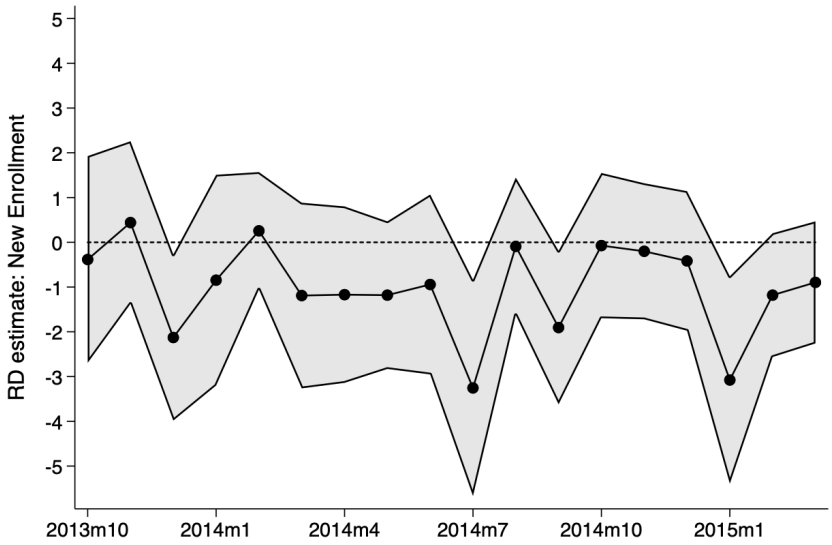
(a) 6-Month Initial Benefit Month Regime



(b) 4-Month Initial Benefit Month Regime

Notes: Figures show RD coefficients for SNAP enrollee cohorts that enter SNAP for the first time since the reinstatement of work requirements in October of 2013, at given points in time since their month of enrollment. Shaded areas represent 95 percent confidence intervals using standard errors clustered by monthly age. Each regression uses the MSE-optimal bandwidth with separate bandwidths calculated on either side of the cutoff.

Figure D.2: RD Estimates of New SNAP Enrollment by Cohort



Notes: Figures show coefficients for total new enrollment RDs across successive cohorts of new SNAP entrants. Each regression uses a different MSE-optimal bandwidth, with the bandwidths calculated separately on each side of the cutoff. Shaded regions denote 95 percent confidence intervals that cluster standard errors on monthly age.

D.3 Details of Regression Kink Estimation

This Appendix section describes the details of the regression kink (RK) estimates summarized in Section 4.2. We estimate RK designs for each of the three main outcomes: participation, employment, and earnings. For each outcome, we begin by estimating a single "joint" RK design using both kinks together. We then follow Card et al. (2016) in estimating two separate RK designs at each policy kink: one at the minimum age when some participants are no longer required to meet work requirements, and one at the maximum age when any participants are required to meet work requirements.

These RK estimates leverage a qualitatively different source of variation from our main donut RD estimates. The donut RD estimates compare participants who had already aged out of work requirements by the time they were reinstated (aged 50 in September 2013) to participants who were just young enough that they would not age out of work requirements until after the 18-month analysis period (aged 48.5 in September 2013). They make no use of the variation provided by participants who were strictly between ages 48.5 and 50 at the time of reinstatement. By contrast, the RK uses the variation "inside" this donut hole by estimating the *change* in the slope of the outcome as participants begin to age out of work requirements (at the left bound of the donut hole) and as they finish aging out of work

requirements (at the right bound of the donut hole).

In our setting, the policy rule is deterministic. The share of participants who are required to meet work requirements for at least one month during the 18 months following September 2013 falls from 1 to 0 between ages 48.67 and 49.5 (inclusive). If the share falls linearly, then the RK estimate would be given by the difference in slopes of the outcome with respect to age on either side of a kink, divided by $-1/(49.5 - 48.67) = -1/0.83$. To obtain the difference in slopes of the outcome, we estimate a "joint" RK using slope changes at both kink points. To obtain a single estimate of the slope change, we assume no jumps at the kink points and equal slopes of the outcome variable with respect to age to the left of 48.67 and to the right of 49.5. (We first verify that this is a reasonable simplification. For example, for the participation outcome, the slope to the left is 0.02 (SE = 0.003) and the slope to the right is 0.01 (SE = 0.007).) This yields the following constrained regression equation:

$$y_i = \alpha + \beta(age_i - 48.67) + \gamma \cdot BW_i \cdot (age_i - 48.67) + \delta \cdot BW_i + \varepsilon_i \tag{4}$$

where BW_i is an indicator for age 48.67 to 49.5, and δ is constrained to be equal to $0.83 \cdot \gamma$.[26]

Table D.1 column 1 reports the estimated slope difference, γ. To check whether these results are consistent with our main donut RD estimates, we focus on the participation outcome, which is the only outcome in which the donut RD does not produce a statistical zero. The estimated slope difference using both kinks is -0.255, making the RK estimate $-0.255 \cdot 0.83 = 0.212$. This is close to the -0.237 estimate obtained using our donut RD specification with a donut between age 48.67 and 49.5 (column 4). For the employment and earnings outcomes, both the "joint" RK estimates and the donut RD estimates are statistical zeros.

In addition to this "joint" RK, we also relax the assumption of equal slopes on either side of the donut hole by estimating separate RK designs at ages 48.67 and 49.5. The motivation for the separate RK designs is primarily institutional: Because of institutional details, the assignment function is only piecewise-linear inside the donut hole, calling into question conclusions drawn from our "joint" RK that assumes a linear assignment function. A change in the length of recertification periods after the reinstatement of work requirements causes a jump in the assignment function between age 48 years 11 months and age 49. From age 48.67 to 48.92, the slope of the assignment function is –1: an additional 1/12 of participants in each age cohort age out of binding work requirements for each month of age.

[26] Equivalently, one can estimate $y_i = \alpha + \beta(age_i - 48.67) + \gamma \cdot \max\{0, \min\{0.83, age_i - 48.67\}\} + \varepsilon_i$ without constraints.

Table D.1: Regression Kink Estimates

	Regression Kink			Regression Discontinuity	
	Both Kinks	Kink at: 48.67	Kink at: 49.5	Donut: 48.67 to 49.5	Donut: 48.5 to 50
Panel A. SNAP Participation					
Estimate	-0.255	-0.480	-0.169	-0.237	-0.245
SE	(0.019)	(0.210)	(0.044)	(0.015)	(0.014)
N	17226	9880	7346	15,762	17,409
Panel B. Employment					
Estimate	0.003	-0.010	0.013	0.009	0.020
SE	(0.016)	(0.133)	(0.038)	(0.015)	(0.015)
N	18953	9767	9186	17,083	15,570
Panel B. Earnings					
Estimate	-1.45	1.64	64.71	0.37	10.36
SE	(25.21)	(146.44)	(49.28)	(20.35)	(25.40)
N	18953	9767	9186	15,954	14,943

Notes: Table shows regression estimates as described in the text. Standard errors clustered by monthly age in parentheses.

The same is true from age 49 to age 49.5. However, between age 48.92 and age 49, there is a *levels* jump of 0.25 in the fraction of participants who age out of binding work requirements.

We therefore estimate two separate RK designs at each bound of the donut hole. To obtain the difference in slopes for the first kink, we estimate:

$$y_i = \alpha + \beta(age_i - 48.67) + \gamma \cdot U48.67_i \cdot (age_i - 48.67) + \varepsilon_i \tag{5}$$

for those who are aged below 48.92 in September 2013. We proceed analogously for the second kink for those aged above 49 in September 2013.

For the RK centered at the lower bound of the donut hole (age 48.67), we use data up to and including age 48.92. This yields an estimated effect of -0.480 for enrollment (Table D.1 column 2). Note that because the slope of the assignment function changes by 1 at each kink, the implied effect size is equal to the raw RK estimate. For the upper bound of the donut hole (age 49.5), we use data starting with age 49. This yields an estimated effect of -0.169 for enrollment. Although they are not statistically distinguishable due to noise, these point estimates are quite different from each other and from our main RD estimates. Taken at face value, they would suggest potentially important conclusions about the effects of *beginning* to age out of work requirements (the estimate from the lower bound of the donut hole) versus *completely* aging out. However, we are cautious in drawing such conclusions. The estimates are noisy and based on small effective sample sizes. The jump in the assignment function at age 48.92 leaves only three age-month cohorts to the right of the kink at age 48.67, and six cohorts to the left of the kink at age 49.5.

Note that we use kink points at ages 48.67 and 49.5 in these RK analyses, rather than our original donut hole bounds of 48.5 and 50 from the main analysis. Briefly, the reason to tighten the donut is that in the RK, it is especially important to place the kinks exactly at the ages where individuals age into and out of being threatened with removal from the program, whereas in the RD we also want to include those who may be affected by other aspects of the reinstatement of work requirements without the actual threat of removal: information about potential removal or shortened recertification periods. The remainder of this Appendix section describes the details.

In our main specifications, we define the donut hole as those who are younger than 50 years old when work requirements are reinstated but who are older than 50 by 18 months after reinstatement. On the age 50 end of the donut, this includes three sets of individuals: (i) those who would be removed from the program during those 18 months if they did not meet work requirements; (ii) those who may be *informed* that they will be removed but who age out of work requirements before the recertification month that would trigger their removal;

and (iii) those who receive a shortened recertification period. In the RD, we included the binding work requirements channel, the information channel, and the recertificiation period shortening channel because a priori, there is no reason to assume away the possibility of any channel affecting outcomes. On the age 48.5 end of the donut, we also included individuals who were temporarily subject to binding work requirements, but aged back out of work requirements by the end of the 18-month analysis period. Again, we include them in the RD because a priori, it is not known whether the impact of work requirements after removal is transient or permanent. Our RD estimates remain similar in magnitude and precisely estimated when we use the narrower RK definition of the donut hole that only includes age cohorts where some (but not all) members would have been *removed* from the program if they did not meet work requirements (Table D.1 columns 4 and 5). This comparison suggests that the removal channel overwhelmingly drives the estimated effects.

In the RK, it is critical to place the kink points at the ages where exposure to the dominant channel changes, because RK estimates rely on highly local changes in slope. Motivated by our finding that the majority of the effect seems to come from the removal channel, we therefore use a narrower age range for defining partial exposure in the RK. We define the donut hole as just those birth cohorts in which some (but not all) members would be required to *meet* work requirements for at least one month prior to turning 50 in order not to be removed from the program. This age interval is 48 years and 8 months to 49 years and 6 months as of September 2013. Whether a particular member of a birth cohort is required to meet work requirements is a function of recertification month and number of "free" SNAP benefit months allotted. (For example, the upper end of the age interval is at 49 years and 6 months rather than 49 years and 11 months because participants were given six "free" months on SNAP before having to meet work requirements.) This definition assumes that the main impacts of work requirements occur during or soon after the first binding month rather than before it (i.e. it assumes no effect of information or shortened recertification period alone); and the marginal impacts of additional binding months are small.

D.4 Details of Second Screening Analysis

This Appendix section provides additional details on the second measure of screening summarized in Section 4.3. The first measure of screening discussed in the main text assesses whether the exit behavior of participants with certain characteristics is more sensitive to work requirements. Our second screening measure, described in detail here, assesses how the composition of retained participants is affected by work requirements. This measure captures changes due to work requirements in the characteristics of the

population of SNAP participants, rather than the differential group-specific exit sensitivities captured by our first measure. Results may differ from those using the first measure when the number of people with a given characteristic is small. In such cases, even large sensitivities may translate to very small compositional changes in the pool of SNAP participants.

To operationalize the compositional measure, we ask which observable characteristics are disproportionately represented among retained participants under work requirements relative to the counterfactual without work requirements. Table D.2 reports estimates from RD regressions on the proportion of cases with characteristics x among the set of all cases that remain on SNAP in March 2015:

$$x_i = \alpha_1 + \theta_1 U50_i + \gamma_1(age_i - 50) + \gamma_2(age_i - 50) \cdot U50_i + \varepsilon_i \tag{6}$$

In this regression, the coefficient of interest is θ_1, which represents the change in composition of retained cases across the age 50 cutoff. Table D.2 shows that, similar to the findings in Table 4, work requirements reduce the proportion of homeless individuals, individuals with no earned income and individuals with below-median predicted earnings among those who remain on SNAP. Also similarly to the findings in Table 4, work requirements cause a greater proportion of those who remain on SNAP to be composed of individuals who have a documented history of having a disability.

D.5 Details of the Labor Market Effect Heterogeneity Estimates

This Appendix section provides additional details regarding the estimates of heterogeneous labor market effects in Section 5.2. The estimates use the unconditional quantile regression method of Firpo, Fortin and Lemieux (2009). Identification in the Firpo, Fortin and Lemieux (2009) approach relies on the assumption that treatment is exogenous conditional on observables. This is equivalent to the assumptions required for identification in our baseline RD, discussed in Section 4.1. If the RD assumptions hold, then exposure to work requirements status is fully determined by observable age and exogenous to other determinants of earnings, and no additional exogeneity assumptions are required for the unconditional quantile regressions.

Note that these estimates do not allow us to identify *which* individuals shifted their behavior as a result of work requirements without stronger assumptions. In other words, it is not possible to say what the counterfactual earnings would be among the people who are at a given quantile in the observed work requirements regime. The identity of the participants

Table D.2: Screening RD by Subgroup, 18 Months After Work Requirements

	Discontinuity	SE	Control Mean	% Diff
Above Median Predicted Earnings	0.026	0.023	0.350	13.8
Female	0.041	0.034	0.472	12.2
Married	0.020	0.018	0.089	24.6
Homeless	-0.032	0.015	0.138	-27.7
White	-0.006	0.024	0.407	0.7
Black	0.002	0.027	0.451	-0.9
Some College+	-0.022	0.020	0.100	-31.7
Has Earned Income	0.041	0.013	0.172	32
Has Unearned Income	0.024	0.015	0.086	25.1
Ever Before UI Recipient	0.001	0.020	0.206	1.3
Ever Before Disability	0.148	0.023	0.179	92.8
Above Median Unemployment Rate	-0.030	0.029	0.418	-7.5
Above Median Previous Time on SNAP	0.001	0.028	0.629	1.2
Above Median Previous SNAP Spell	-0.005	0.026	0.652	-0.1

Notes: Table presents RD estimates of Equation 6. Each row presents results from a separate regression corresponding to the characteristic listed. The first column presents the estimate on the indicator for under 50. Standard errors clustered by monthly age in parentheses are presented in the second column. The third column presents the percentage of 50-year olds who exited SNAP by March 2015 and have the characteristic listed as of September 2013. The last column presents the discontinuity as a percentage of the control mean. The unemployment rate is measured as the county average of the period between October 2013 and March 2015.

at the qth quantile generally will not remain fixed under counterfactual work requirements regimes, except under the assumption that the effect is (weakly) monotonically increasing in the original quantile, which would guarantee rank invariance. The earnings distribution among 49-year-olds stochastically dominates the distribution among 50-year-olds, which is consistent with rank invariance but cannot definitively rule out rank switching.

Figures 7a and 7b suggest that the positive earnings response to work requirements, if it exists at all, takes months to materialize. If real, this delayed response could be explained by three facts. First, it takes time for participants to find (additional) work. Second, improvements in the labor market in mid-2015 may interact with work requirements status. Third, and most relevant, participants can obtain a new 12-month recertification period by temporarily meeting the work requirements after six months. Participants who meet work requirements at the end of their initial 6-month recertification period and then stop working are not removed from SNAP until their next 12-month recertification. In the interim, they can receive several months of benefits without meeting work requirements (see Appendix A). However, a participant who reaches the maximum allowable number of months of not meeting work requirements must subsequently meet them every month to remain on SNAP. Due to this certification schedule, work requirements effectively become more stringent over time (until the work requirements "clock" is reset after 36 months), which is consistent with the observed increase in the earnings impact between Figures 7a and 7b.

D.6 Details of the Machine Learning Algorithm

This Appendix section describes how we attempt to attribute the earnings responses documented in Figure 7b to participants who exit SNAP and work more to compensate for the loss of benefits, or to those who work more to retain SNAP eligibility. We refer to these mechanisms as an income effect and an incentive effect, respectively. As discussed in Section 5.2, our RD identification strategy will not yield causal estimates for these mechanisms: examining earnings for those remaining on SNAP in September 2015, for example, involves conditioning on the (endogenous) outcome of not having exited within 24 months of work requirements.[27] Figure 7b provides suggestive evidence of a role for incentive effects, since the largest earnings increases are near the minimum threshold for meeting work requirements, but we cannot rule out strong income effects within this range.

This Appendix attempts a more formal decomposition of income and incentive effects. The intuition is as follows. We attempt to disentangle the mechanisms by

[27] This is an example of the "bad controls" problem, as it involves conditioning on the endogenous outcome of exit. See Section 4.3 for evidence that beneficiaries who exit due to work requirements differ on observables from those who remain on SNAP.

classifying participants into three underlying types using machine learning techniques: "never exiters" who would remain on SNAP regardless of whether work requirements are in place, "induced exiters" who would remain on SNAP in the absence of work requirements but exit *due to* work requirements, or "always exiters" who would have exited under either policy regime. RD estimates in the never exiters subsample and induced exiters subsample can then be interpreted as the incentive effect and the income effect, respectively.

The remainder of this Appendix section provides complete details on the machine learning algorithm and the results. The goal of the algorithm is to classify participants into never exiters, induced exiters, or always exiters. The last category primarily consists of participants who would exit SNAP by September 2015 regardless of the presence of work requirements, and who are therefore not useful for estimating the income or incentive effects.

The classification proceeds in two steps. In the first step, we identify and discard the set of participants who would attrit from SNAP by September 2015 even in the absence of work requirements. We identify them by training a LASSO of an indicator for program exit on a wide array of features (listed below) for participants aged 50 to 60, who are not subject to work requirements. We then use these estimates (interpretable as predicted probabilities of exit) to classify participants of all ages into those who would or would not exit in the absence of work requirements. Our main specification selects the classification cutoff to match the empirical probability of exit (39.8%). In the second step, we run an analogous LASSO on participants under 50 (and therefore subject to work requirements) who are *not* predicted to be always exiters, classifying them into never exiters or induced exiters. We use these predictions to split both the under-50 and over-50 participants into three groups each, so that RDs within each group have similar composition on either side. We assume away the case of participants who would remain on SNAP if there were work requirements, but would exit SNAP absent work requirements. This assumption is analogous to assuming no defiers in the potential outcomes framework.

More specifically, we begin the process by tuning a LASSO on participants aged 50-60 using ten-fold cross-validation. We implement the algorithm using the *glmnet* package in R using 10-fold cross-validation within each fold to select the tuning parameter λ. We grid search over values of λ between 0.0005 and 0.1 in increments of 0.0005. The features (i.e. covariates) among which the trees select are: indicator variables for female, race is black, race is white, living in a private residence, married, education is less than high school, some high school, high school graduate, some college (omitted category is college graduate), has earned income, has unearned income, ever before had a disability; other variables are household size, 6-month recertification cohort; in the pre-period: fraction of months with wages, sum of pre-period wages, number of months on SNAP; number of months on SNAP

in the last 36 months, number of months on SNAP in the last 12 months; wage history from 2005m1–2013m8; and county indicators.

Using this tuned LASSO, we use five folds to obtain predicted values: we run the tuned LASSO on 80 percent of the sample and use the resulting covariates to predict values for the remaining 20 percent.[28] After five iterations of LASSO (with potentially differing covariates), we have a single predicted value for each participant over age 50. We then divide this sample into always exiters and others by selecting a cutoff in the fitted value to match our empirical distribution. We then classify individual *under* age 50 as never exiters or other by taking the average of the five fitted values we obtained from the aforementioned LASSOs.

For the second step, the training sample includes the under 50 individuals that are *not* classified as always exiters. We use an analogous LASSO prediction exercise to further split that sample into induced exiters and never exiters. We again take averages of the five predicted values for each participant over age 50 who is *not* an always exiter, to further classify them as induced exiters or never exiters.

The result of this two-step classification procedure is a sample classified into never-exiters, induced exiters, or neither. We estimate RDs among the never-exiters and among the induced exiters to measure income and incentive effects. The results are presented in the table below.

While we selected LASSO as our main specification, we also tried using boosted trees from the R package *xgboost*. The predictive power of the tree was not meaningfully better, and the results were not notably more stable. We therefore opted for the less computationally expensive LASSO.

Unfortunately, the results are inconclusive. The classification process substantially decreases our sample size and even sophisticated tree methods have limited predictive power. Appendix Table D.3 reports the RD estimates of labor market outcomes within the never exiters (column 1) and induced exiters (column 2). Although some of the point estimates are large, the estimates for both employment and earnings are statistically indistinguishable from zero in both groups. We therefore conclude that work requirements may appreciably increase earnings along a narrow range of the earnings distribution, but the primary mechanism for the earnings increase remains uncertain.

[28] This helps to prevent bias due to endogenous stratification. For example, suppose we predict earnings and then estimate heterogeneous effect of work requirements on earnings along the range of predicted earnings. Abadie, Chingos and West (2013) illustrate how overfitting in the predictive model causes systematic bias in the estimates at low and high values of predicted earnings. In our case, the classification exercise is on participation, which is highly correlated with earnings and therefore could still make us vulnerable to this form of bias. We use this sample-splitting technique to protect our estimates from this systematic bias.

Table D.3: Income vs. Incentive Effect at 24 months

	Never exiters (incentive effect)	Induced exiters (income effect)
Panel A. Employment		
Discontinuity	0.034	0.036
95% CI	[-0.063 ,0.125]	[-0.105 ,0.215]
Control Mean	0.199	0.209
Panel B. Earnings		
Discontinuity	41.1	40.8
95% CI	[-113 ,185]	[-163 ,298]
Control Mean	228.0	240.8

Notes: Table shows regression estimates on sub-samples produced by machine learning procedure to decompose earnings changes at 24 months into income effects and incentive effects. "Induced exiters" correspond to SNAP recipients predicted to exit in the presence of work requirements, but not in their absence. "Never exiters" correspond to SNAP recipients predicted to remain on SNAP in the presence of work requirements. Changes in labor market outcomes for these two groups estimate income and incentive effects, respectively. Control mean is the predicted mean of the corresponding outcome variable immediately to the right of the age 50 threshold (the intercept with the cutoff). For each outcome, the 95% CI is calculated by bootstrapping using 1,000 replications, taking the 2.5th and 97.5th quantiles. Estimates of the discontinuity and control mean are calculated by averaging the estimates from all bootstrap replications. Employment and earnings are measured from UI records. Earnings include those with zero UI earnings, and are winsorized at the 99 percent level by yearly age within each calendar month.

D.7 Details of the MVPF Welfare Calculation

This Appendix section provides the details of the welfare calculation reported in Section 5.3. The MVPF for the elimination of work requirements is given by:

$$MVPF = \frac{WTP}{\underbrace{C}_{\substack{\text{direct} \\ \text{program cost}}} + \underbrace{FE}_{\substack{\text{fiscal} \\ \text{externality}}}}$$

where the numerator represents the relevant ABAWDs' willingness to pay out of their own income to eliminate work requirements, and the denominator represents the total cost to the government of eliminating work requirements. Section 5.3 defines these terms in detail.

To quantify the MVPF for eliminating SNAP work requirements, consider first the government's cost of eliminating the policy. The direct cost per beneficiary is equal to the average SNAP benefit for ABAWDs of \$189 per month,[29] multiplied by the fraction of the relevant population who participate in SNAP if and only if work requirements are eliminated. For consistency with the rest of the paper, we define the relevant population as ABAWDs who would still be enrolled in SNAP after eighteen months, leaving us with 63.1 percent of the ABAWDs who are enrolled at month zero (the natural retention rate reported in Table 5 Panel A). The fraction of the relevant population who participate if and only if work requirements are eliminated is then $0.235/0.629 = 0.374$ (where 0.235 is our main RD estimate of work-requirements induced exit in Section 4.2). This yields a direct cost of $0.374 \cdot \$189 = \$70.61$ per person per month.

The fiscal externality consists of any changes in net government revenue that result from eliminating work requirements. In our context, a key component is the loss of income tax revenue due to labor market effects. The lost income taxes are given by our estimates of the earnings effect at different durations following the reintroduction of work requirements from Section 5.2. We find no earnings effect 18 months after the reinstatement of work requirements, but a positive earnings effect 24 months after reinstatement. We therefore use the earnings estimate from the 24-month regressions (Figure 7b) to obtain the least favorable MVPF for eliminating work requirements. The most favorable MVPF using the zero earnings estimate from the 18-month regressions (Figure 7a) is also given at the end of this section. Using the point estimates from the 24-month regressions, the average earnings effect is $\$44.41/0.629 = \$70.60$ per person per month. If we instead use the upper bound

[29] The maximum SNAP benefit for a single-person household in the months following the reinstatement of work requirements is \$189. See Section 2.3 for details.

of the 95 percent confidence intervals from the 24-month regressions, we obtain a larger average earnings effect of $\$78.93/0.629 = \$125.48$ per person per month. This yields the least favorable MVPFs for eliminating work requirements among our calculations, but we view it as less realistic than either the MVPF calculated using the 24-month point estimates or the MVPF calculated using the 18-month estimates. The main text of this section therefore uses the \$70.60 magnitude from the 24-month point estimates, and provides the two more extreme MVPFs at the end.

The government's loss of revenue is \$70.60 multiplied by the tax rate on these earnings. For a single unmarried earner working 80 hours per month at the minimum wage (annual earnings of $\$6,960$), the average tax rate is approximately 16.5 percent.[30] Thus, the fiscal externality from lost tax revenue due to earnings responses is $0.165 \cdot \$70.60 = \$11.65$ per relevant ABAWD per month. This amount results in a denominator of $(0.235/0.629) \cdot \$189 + \$11.65 = \$82.26$ per relevant ABAWD per month.

The fiscal externality could, in principle, also include changes in per-participant monthly benefits as a result of partial phase-out of benefits with rising earned income. Average benefits for ABAWDs in Virginia are from the data constructed in Mills et al. (2014), which we obtained from the USDA via the Freedom of Information Act. As discussed in Section 2.1, benefits are reduced by 30 cents for each additional dollar of income, in addition to a 20 percent earned income deduction. This implies that SNAP benefits effectively decline by 24 cents for each additional dollar of earned income. In the MVPF calculation, we assume that the earnings impacts of work requirements are a result of income effects. This means earnings increase only among work participants who exit as a result of the work requirements, so their income changes are already accounted for in the tax revenue calculation. If the earnings impacts are instead driven by incentive effects, then the government has an additional fiscal externality of $0.24 \cdot \$70.60 = \$16.94$ for a total denominator of $\$70.60 + \$11.65 + \$16.94 = \$99.19$ per relevant ABAWD per month.

The numerator of the MVPF is a relevant ABAWD's willingness to pay to eliminate work requirements. In the literature, the numerator is typically equal to the value of the benefits change, as any behavioral response to the policy change is assumed to have zero impact on utility. This assumption of zero impact relies on the envelope theorem combined with benefit changes being "small." In our setting, the policy change being considered does not change the *amount* of benefits received conditional on receipt. Instead, the elimination of work requirements gives benefits to new participants and gives working beneficiaries the

[30] To calibrate the tax rate, we note that few non-disabled, non-elderly childless adults are eligible for social programs that would implicitly tax their income. Therefore, average tax rates are primarily composed of payroll taxes of 15.3 percent applied to all earnings, plus a 10 percent income tax applied to earnings above the standard deduction ($\$6,300$ in 2015).

option to work less. The former is given by the value of the benefits, multiplied by the fraction of the relevant population that gains benefits if work requirements are eliminated: $(0.235/0.629) \cdot \$189 = \$70.61$.[31] The latter benefit is usually ignored in MVPF calculations by assuming that any utility changes from reoptimizing behavior are second-order. In the setting of SNAP work requirements, the reoptimization may lead to substantial utility changes (see Figure A.1). The utility change for this group is bounded between \$0 and \$189 per ABAWD.[32] The largest group to whom these bounds could apply constitutes approximately $0.13/0.629 = 21$ percent of the relevant population, where 0.13 is the fraction of percentiles for which we detect earnings impacts in Figure 7b. Thus, the numerator of the MVPF is bounded between \$70.61 and $\$70.61 + 0.21 \cdot \$189 = \$110.30$.[33]

We now have approximations for the numerator and the denominator of the MVPF for eliminating work requirements. Using our largest estimate of the earnings response twenty-four months after work requirements (see Figure 7b), the MVPF is bounded below by $\$70.61/\$82.26 = 0.86$ if individuals pay no utility cost of working more as a result of work requirements. If individuals pay a utility cost for the large behavior change of working more, the MVPF is bounded above by $\$110.30/\$82.26 = 1.34$.[34]

If the true earnings response is zero, as we find eighteen months after work requirements (see Figure 7a), then the MVPF is bounded between $\$70.61/\$70.61 = 1$ and $(\$70.61 + 0.13 \cdot \$189)/\$70.61 = 1.35$. The strongest case against eliminating work requirements—that is,

[31] Two caveats are in order. First, this amount is not a "small" change for many beneficiaries, so this transfer is directly proportional to a utility gain only if income effects are small (e.g. quasi-linear utility). Second, this willingness to pay will be lower if ABAWDs value a dollar of SNAP benefits at less than a dollar of income. Many studies find that a dollar of SNAP benefits is spent like a dollar of cash (Hoynes and Schanzenbach 2009, Hoynes, McGranahan and Schanzenbach 2015), and this is the assumption we maintain in the main MVPF calculation. However, Hastings and Shapiro (2018) find that a dollar of SNAP is valued at only \$0.50 of cash. In that case, the value of the benefits in the numerator would be reduced from \$70.61 to \$35.31.

[32] We obtain bounds on the effort cost of work requirements-induced work using a revealed preferences argument. The lower bound is equal to the additional income; if the effort cost were less than the additional income, then these participants would work more even in the absence of work requirements. The upper bound is equal to the sum of the additional income and the value of SNAP benefits, which is what participants stand to gain from working when there are work requirements. At the lower bound, the utility cost of working exactly offsets the income gains from working, resulting in a utility of \$189 regardless of work requirements. At the upper bound, the utility cost offsets the income gains plus the SNAP benefits, resulting in a utility gain of \$189 from eliminating work requirements.

[33] This calculation assumes that earnings impacts are concentrated among participants who are induced to exit by work requirements. If we instead assume that earnings impacts are concentrated among participants who remain on SNAP, then eliminating work requirements increases the numerator by a further \$16.94, bounding the numerator between $\$70.61 + \$16.94 = \$87.55$ and $\$110.30 + \$16.94 = \$127.24$ (see discussion of benefit phase-out above).

[34] If the earnings response is driven by incentive effects, then the MVPF is bounded below by $\$87.55/\$99.19 = 0.88$ and bounded above by $\$110.30/\$99.19 = 1.11$ (see footnote **??** and the discussion of benefit phase-out above).

the strongest cast in favor of keeping them—would use the upper bound of our 95 percent confidence interval from the 24-month earnings estimates (see Figure 7b). The MVPF would then be bounded between \$70.61/\$91.31 = 0.77 and \$110.30/\$91.31 = 1.21. However, because these bounds are calculated from the upper bound of the confidence interval of our most optimistic earnings response estimates, we view the resulting MVPF bounds as less reliable than the bounds of 0.86 to 1.34 from the 24-month point estimates or the 1 to 1.35 from the 18-month point estimates.

Recall that most existing estimates of the MVPF of various aspects of SNAP and cash transfer programs are near 1 (Hendren and Sprung-Keyser 2020). Under the assumption that the earnings response to work requirements, if any, has a non-marginal utility cost, the MVPF of eliminating work requirements compares favorably with other policies targeting the SNAP population.

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