Timing of SNAP disbursement and crime incidence in the United States

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Abstract

Welfare payments help combat poverty and hunger, and thereby potentially contribute to the reduction of financially motivated crimes. Taking the Supplemental Nutrition Assistance Program (SNAP) as an example, this study explores whether and how variations in the timing of food assistance distribution affect crime incidence. Using an extensive incident-based crime dataset from reporting police agencies in 36 states between 2000 and 2017, I estimate the reduced-form effect of staggering SNAP benefit disbursement across recipients on crime incidence. The empirical result suggests a significantly lower incidence of financially motivated crimes (robbery and burglary in particular) when the state-level SNAP disbursement schedule incorporates more distribution days and a longer staggering period (the number of days between the first and last distribution date). I also find evidence for effect heterogeneity by policy stringency and population density. Additionally, county-level analysis suggests that reduced severity of food insecurity may be the mechanism through which staggered SNAP benefit distribution helps reduce crime incidence. On the other hand, the incidence of emotion-driven crimes, such as property destruction cases, is not much affected by the timing of SNAP benefit disbursement. The findings of this study point to an extended SNAP disbursement schedule with more distribution days to deter financially motivated crimes.

Keywords: SNAP, disbursement schedule, crime incidence, food insecurity, United States

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1 Introduction

As part of the social safety net, governments and international organizations around the world have launched a variety of welfare programs to improve the living standard of low-income individuals and households.[1] In particular, food assistance programs play a critical role in combating poverty and food insecurity issues via cash or in-kind transfers (Ratcliffe et al., 2011; Rudolph and Starke, 2020).[2] In-kind transfers of welfare benefits are effective in ensuring recipients' marginal propensity to spend on necessity goods (e.g., food) upon receiving welfare benefits (Klerman and Danielson, 2011; Hastings and Shapiro, 2018). This potentially helps prevent criminal activities related to drugs and alcohol that otherwise could be purchased with cash benefits (Zhang, 1997; Cotti et al., 2016).[3] In addition to the form of welfare payment, the timing of benefit distribution also has potential externalities related to criminal activities. As shown in previous studies, more compressed and less frequent monthly welfare payment is usually associated with a higher incidence of criminal activities (Foley, 2011). Based on evidence from Illinois and Indiana, Carr and Packham (2019) report a 17.5 percent reduction in violent crimes and a 20.9 percent decrease in theft at grocery stores when there is a substantial increase in the number of distribution days.

The main objective of this study is to investigate whether the timing of in-kind welfare payment affects crime incidence, with a special focus on the Supplemental Nutrition Assistance Program (SNAP) in the U.S. Specifically, I evaluate two key dimensions of the state-level SNAP disbursement schedule: (i) whether benefit issuance is staggered across recipients versus delivery of benefits to all recipients on the same day of a calendar

[1] In the U.S., there are in total 83 federal welfare programs, among which six major programs include: Medicaid, Housing Assistance, Temporary Assistance for Needy Families program (TANF), Child's Health Insurance Program (CHIP), Supplemental Security Income (SSI), Earned Income Tax Credit (EITC) and Supplemental Nutrition Assistance Program (SNAP). See the U.S. government website (https://www.usa.gov/benefits) for more details about these programs. I focus on SNAP in this study.

[2] Food insecurity exists not only in the developing world, but also in developed countries such as the United States. According to official statistics from the United States Department of Agriculture (USDA), 10.5 percent (13.7 million) of U.S. households were food insecure at some time during 2019, while 4.1 percent (5.3 million) of U.S. households had very low food security at some time in the same year. For more details, see USDA, Food and Nutrition Service (FNS) (https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx).

[3] Indeed, cash benefits can be used for any consumption, including drug and alcohol use (Dobkin and Puller, 2007). This may result in a higher incidence of street violence and mortality (Evans and Moore, 2011; Borraz and Munyo, 2020).

month; and (ii) if staggered, the total count of distribution days and the total length of the staggering period of benefit issuance across all recipients.[4] The testable hypothesis is that crime incidence is lower when the monthly SNAP benefit is distributed on more calendar days and issued during a longer staggering period across recipients. In the robustness check, I also examine the choice of specific calendar days in a disbursement schedule, which also may affect crime incidence.

There are several possible explanations for why timing of SNAP distribution affects crime or violent conduct. First, for general welfare programs, staggered and frequent welfare payments help smooth consumption for low-income households and therefore provide an effective disincentive against crimes that have a strong financial motive (Foley, 2011). For example, it is easier for families to smooth consumption if they receive public assistance and paychecks at different times.[5] Second, staggering SNAP benefit distribution across recipients allows merchants more time to restock, given the fact that most SNAP recipients spend most of the monthly SNAP benefits upon receipt rather than smoothing their food expenditure over the month (Beatty et al., 2019). Therefore, a staggered SNAP schedule helps reduce crimes related to food shortage and the frustration of not getting desired food items. Third, staggering benefit distribution helps discourage inter-temporal price discrimination, which ensures food affordability for SNAP beneficiaries (Goldin et al., 2019). Last, any change to the timing of SNAP disbursement potentially causes temporary financial disruption to recipients, which may induce violent conduct (Carr and Packham, 2021).[6]

This study is generally consistent with previous studies on the SNAP schedule and the incidence of violence (Foley, 2011; Carr and Packham, 2019; Carr and Packham, 2021), but extends their work in three substantial ways. First, I refine the measure of crime

[4]It is worthwhile to note that the monthly SNAP distribution is currently a lump-sum payment to each recipient. As such, "staggering" in this study does not mean more frequent payment to each recipient. Instead, it refers to the mode of benefit distribution where recipients in a state receive the monthly SNAP benefit on different calendar days. See Section 2 below for more detailed discussion.

[5]Foley (2011) examines SNAP and two other federal welfare programs, which are: (i) Temporary Assistance for Needy Families (TANF), a federal assistance program which began in 1997. It replaced the Aid to Families with Dependent Children (AFDC) program, under the 1996 Welfare Reform; (ii) Supplemental Security Income (SSI), a federal income supplement program funded by general tax revenues.

[6]Specifically, Carr and Packham (2021) show that a change in the timing of SNAP issuance in Illinois in 2010, which reduced the proportion of cases processed on the first day of a month, led to a 7.1 percent increase in domestic violence and a 27.5 percent increase in child maltreatment.

incidence in this study. I separately study four specific types of crime that incorporate both instrumental or financially-motivated violence (robbery, theft and burglary) and expressive or emotion-driven violence (property destruction). Second, I expand the spatial and temporal coverage. Instead of focusing on one or two states (Carr and Packham, 2019) or several large cities only (Foley, 2011) during a short period of five years or less, I leverage crime and SNAP disbursement data from 36 states during 2000-2017. Third, I improve the empirical methodology. The greater spatial coverage makes it possible to study the impact on crime incidence of a SNAP disbursement schedule with a longer staggering period and more distribution days.[7] Relatedly, the 18-year study period allows me to explore the dynamics of crime incidence in response to SNAP schedule changes through a series of event studies. Empirical results presented in this study yield direct policy implications for a better design of SNAP disbursement schedules to deter crime.

To explore the impact of welfare payment on crime incidence, I follow two methodological approaches discussed in the existing literature, including the national-level method (Neuwark and Wascher, 1992, 2007) and the local-level approach (Card and Krueger, 1994; Dube et al., 2010; Carr and Packham, 2019; Peng et al., 2020). The first approach features national-level analysis using the traditional fixed-effects model (Neuwark and Wascher, 1992, 2007). In line with this approach, my baseline specification exploits all cross-state variations over time in the disbursement schedule of food assistance benefits and explores how it affects crime incidence in the local communities.

As an alternative to the national-level method, the local-level approach utilizes policy discontinuity at the state borders to investigate the social impact of welfare payments. Specifically, existing studies identify this impact of interest either through a case study of selected states (Card and Krueger, 1994; Carr and Packham, 2019), or through a comparison between constructed county pairs at state borders (Huang, 2008; Dube et al., 2010; Peng et al., 2020). Consistent with this design, I run a separate set of regressions based on evidence from state borders and compare the local-level results with those from the national-level analysis. The use of border-specific time fixed effects helps re-

[7]In this study, I define the staggering period as the number of days between the first and last distribution date. For example, if a state distributes the monthly SNAP benefits on the 1st, the 3rd and the 5th, then the total length of the staggering period is five days, and the number of distribution days is three.

duce bias in identifying the impact of staggering SNAP disbursement across recipients on neighborhood-level crime incidence, but may also be challenged due to the sample selection issue (Dube et al., 2010). As a complement to the baseline analysis on the average impact of staggering SNAP disbursement, I also explore the potential effect heterogeneity. Previous studies have discussed at least three possible sources of heterogeneity in the impact of welfare payment on crime: policy stringency (Stacy et al., 2018), benefit generosity (Rudolph and Starke, 2020), and degree of urbanization/population density (Deller and Deller, 2011; Sameem and Sylwester, 2018). I discuss all three sources of heterogeneity in this study.

Following the reduced-form analysis, I also explore the prevalence and severity of food insecurity as the potential mechanism through which staggering benefit disbursement may affect neighborhood-level crime incidence. Specifically, I decompose the reduced-form impact on crime incidence of staggering the SNAP benefit across recipients into two causal relationships. Based on county-level evidence in the U.S., I establish a causal connection between food insecurity and crime incidence using a linear fixed-effects model.[8] Similarly, I show that the timing of SNAP disbursement affects the severity of food insecurity at the local level. Taken together, I find that a more staggered SNAP disbursement schedule (with more distribution days and a longer staggering period) contributes to lower severity of food insecurity, which may in turn reduce crime incidence.

This study relates to two broad strands of literature. First, it enriches the stream of literature on SNAP enrollment, benefit cycle and household welfare (Wilde and Ranney, 2000; Gundersen and Oliveira, 2001; Wilde and Nord, 2005; Yen et al., 2008; Ratcliffe et al., 2011; Smith et al., 2016; Goldin et al., 2019; Cotti et al., 2021). According to Ratcliffe et al. (2011), the receipt of SNAP benefits reduces the probability of being food insecure and very food insecure by approximately 30 percent and 20 percent, respectively. Relatedly, Shapiro (2005) reports a reduction in caloric intake of 10 to 15 percent over the SNAP month. The change in health-related outcomes is consistent with the "first-of-the-month effect", which characterizes the decline in recipients' food expenditures starting from the first day during the benefit month (Hastings and Washington, 2010; Castellari et

[8]To address the endogeneity concern, I use both the same-period measure and the one-year lagged measure of the county-level food insecurity index. Results based on the two measures are generally consistent, suggesting a linkage between food insecurity and crime incidence.

al., 2017; Tiehen et al., 2017). Following this thread, Goldin et al. (2019) find that SNAP issuance induces large increases in food sales and small but positive increases in retailer prices, which points to potential price discrimination against shoppers redeeming SNAP food credits. This suggests that staggering monthly benefit issuance across recipients may help preserve the purchasing power of the SNAP monthly benefit, thus reducing food insecurity among SNAP recipients. Similarly, Cotti et al. (2021) find that a 10-day increase in the median SNAP distribution date contributes to a 6.5 percent decrease in the standard deviation of weekly household expenditures, which suggests more effective consumption smoothing for SNAP-eligible households. Their discussion of the SNAP benefit cycle and household welfare lays a solid foundation for exploring the mechanism behind the proposed impact of staggering SNAP distribution on crime incidence.

Second, this study fits into the stream of literature on the connection between the policy design of welfare programs and crime or violent conduct.[9] Early studies show that welfare payments reduce the time allocated to illegal activities under risk aversion and other reasonable assumptions (Zhang, 1997). More recent studies find that crimes with a strong financial motive are more likely to increase over the course of monthly welfare payment cycles, and are more responsive to changes in the benefit disbursement schedule (Foley, 2011; Carr and Packham, 2019). Properly designed food assistance programs can contribute to crime control by providing assistance on consumption for low-income recipient households with very limited savings (Duflo et al., 2006). By contrast, the federal public assistance ban on drug offenders has increased their likelihood of recidivism (Yang, 2017; Tuttle, 2019). A number of other studies extend the discussion to other criminal offenses, domestic violence and mortality (Cotti et al., 2016; Carr and Packham, 2021). These studies provide suggestive evidence for the linkage between the timing of SNAP disbursement and crime incidence.

In summary, existing studies have found that food assistance programs like SNAP contribute to improved food security status and nutritional outcomes among recipient households. Additionally, staggered issuance of welfare benefits across recipients, as well

[9]The criminology literature discusses different motivations for different types of crime. The instrumental violence theory views certain criminal activities as a tool to extract resources or attain a subsidiary goal; the expressive violence theory treats certain crimes as a means to express anger or to relieve frustration (Tedeschi and Felson, 1994; Miethe and Drass, 1999; Card and Dahl, 2011).

as more frequent payment to each recipient (in other programs like TANF), are both conducive to crime reduction. However, several key issues remain understudied. First, it remains to be explored whether and how the length of the staggering period and the choice of specific calendar days in a benefit disbursement schedule affect crime incidence. Second, the SNAP policy stringency, benefit generosity and population density can vary significantly across counties and states. It is intriguing to explore whether and how these three factors contribute to heterogeneity in the causal impact of benefit issuance on crime incidence. Finally, despite the rich literature on the role of SNAP enrollment and benefit issuance in alleviating food insecurity, very few studies have empirically tested whether there indeed exists a causal linkage between food insecurity and crime incidence. This results in a logical gap in understanding the causal impact of staggering SNAP benefit distribution on crime incidence. This study completes the story by unveiling the underlying mechanism for the impact of interest.

This paper proceeds as follows. Section 2 provides background information on SNAP, the food assistance program that I analyze in this study. Section 3 describes the multiple sources of data used in this study and provides corresponding summary statistics. Section 4 presents the methodology and empirical results for the reduced-form effect on crime incidence of staggering SNAP benefit distribution. Results of several heterogeneity tests and robustness checks are also reported in this section. Then, Section 5 discusses the potential mechanism of the reduced-form impact through the prevalence of food insecurity. Finally, Section 6 concludes and provides some discussion on relevant policy implications.

2 Institutional Background

The Supplemental Nutrition Assistance Program (SNAP), previously known as the Food Stamp Program, began on an experimental basis in December 1939 to subsidize the food consumption of low-income households (Jensen, 2002; Wilde and Nord, 2005). This welfare program, administered by USDA, is by far the largest and most influential among all food assistance programs in the U.S.[10] It is the most critical component of the safety net

[10]The Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Program for Women, Infants and Children (WIC), and Food Distribution Program (FDP) are the three largest federal food

against hunger because it provides basic protection for citizens of all ages and household status (USDA, 1999; cited from Gundersen and Oliveira, 2001). In 2019, SNAP benefited over 35 million low-income Americans by providing food-purchasing assistance.[11] For many years, recipients were issued coupons once a month that could be redeemed for food at supermarkets, grocery stores, convenience stores, or participating restaurants (Carr and Packham, 2019). The coupons were replaced by an electronic benefit transfer (EBT) card in all states after 2004.

Applicants need to meet certain requirements to enroll in this program. In general, there is a uniform income and asset criterion for SNAP enrollment across the nation, while heterogeneity remains on the state level in terms of eligibility, recertification and other requirements (Bartfeld and Dunifon, 2006).[12] Individuals or households are eligible if they earn a gross monthly income that is no greater than 1.3 times the federal poverty line (based on household size). After deductions, the net income may not exceed the federal poverty line. Other requirements on assets, working status, resources, vehicles, housing expenditures and immigration status may also apply.[13] For example, a large disparity in program eligibility was created between citizens and documented non-citizen immigrants following the 1996 Welfare Reform. However, subsequent policies restored the eligibility for most of these immigrants at different times in different states (East, 2018). For example, the Farm Security and Rural Investment Act of 2002 (also known as the *2002 Farm Bill*) restores SNAP eligibility to most legal immigrants who meet one of the following criteria: (i) have lived in the country for five years; (ii) are receiving disability-related assistance or benefits; or (iii) have children under 18. Following Stacy et al. (2018), I create a SNAP policy stringency index to explore the potential differences across states in these requirements. This index captures four aspects regarding the state-level SNAP policy, including eligibility, transaction costs, stigma and outreach.[14]

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assistance programs. In total, USDA implements sixteen food assistance and nutrition programs. See Sanders (2007) and Yen et al. (2008) for more details.

[11]Data source: USDA, Food and Nutrition Service. In 2013, SNAP enrollment reached the peak in history at roughly 47.6 million people. There was a drop in SNAP participation in recent years, with the alleviation of poverty and changes in the program eligibility requirements.

[12]This heterogeneity is permitted by the 1996 Welfare Reform bill, officially entitled the *Personal Responsibility and Work Opportunity Reconciliation Act of 1996* (PRWORA) (Stacy et al., 2018).

[13]For more details concerning eligibility for the program, see instructions on the USDA website: *Am I Eligible for SNAP?* (https://www.fns.usda.gov/snap/eligibility). Last update: March 15, 2021.

[14]The policy stringency index is generated based on 10 policies regarding these four dimensions. This

In response to the Great Recession starting in December 2007, the American Recovery & Reinvestment Act of 2009 (ARRA) increased SNAP benefit levels between 2009 and 2013. A four-person household received an additional benefit of approximately $80 per month in 2009. The number of SNAP beneficiaries was steadily on the rise until 2013, when the benefit increase under ARRA ceased. According to annual statistics released by the USDA, the number of SNAP participants in the U.S. has increased dramatically from 2.878 million in 1969 to 39.884 million people in 2020. The reported average benefit of this program has increased from $6.63 per participant ($228.80 million in total) in 1969 to $154.82 per participant ($74.10 billion in total) in 2020. After accounting for other costs, the total cost has also risen from $250.50 million in 1969 to $79.12 billion in 2020.[15] Figure 1 presents the average SNAP enrollment and the average amount of monthly SNAP benefit per recipient from 2000 to 2020. Between 2013 and 2019, there was a decline in total annual costs due to a lower enrollment in SNAP.[16] Then, the outbreak of the COVID-19 pandemic increased SNAP enrollment by approximately 4 million people, and the corresponding total annual cost increased by nearly $19 billion.

SNAP benefit disbursement is currently a lump-sum monthly payment for each recipient. However, a growing number of states have been staggering benefit distribution across recipients on multiple calendar days in each month. States are entitled to choose their own schedule, as long as they comply with federal scheduling regulations.[17] By the end of 2018, only seven states maintained a non-staggered (single-day) disbursement schedule; these were Alaska, North Dakota, Nevada, New Hampshire, Rhode Island, South Dakota, and Vermont.[18] In contrast, only four states chose to stagger SNAP benefit distribution

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index is unweighted, with a value range of 0 to 10. See Appendix Table A1 for a detailed documentation of the procedure and policy variables involved in creating this index.

[15]Data Source: USDA, Food and Nutrition Service (https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap). Last update: June 11, 2021.

[16]For an interpretation of the falling caseload and costs, see the article "*SNAP Caseload and Spending Declines Have Accelerated in Recent Years*", by the Center on Budget Policy and Priorities (CBPP) (https://www.cbpp.org/research/food-assistance/snap-caseload-and-spending-declines-have-accelerated-in-recent-years).

[17]The two main requirements include: (a) no recipient households suffer from allotment reduction due to staggered benefit issuance; and (b) no household experiences an interval longer than 40 days between two monthly benefit disbursements.

[18]Among these seven states, Nevada decided to stagger its SNAP benefit issuing dates to alleviate food shortages starting in July 1, 2019. For detailed information, see related news coverage (https://www.rgj.com/story/news/2019/07/03/snap-benefits-issuing-dates-stagger-alleviate-food-shortages/1622858001/).

across recipients in 2004. With a staggered benefit issuance, all cases can be distributed across multiple calendar days in a month, which contributes to fewer errors and better fraud detection. Additionally, administrative costs for state agencies can be reduced by staggering SNAP benefit issuance (Carr and Packham, 2019). Another motivation is to reduce congestion at grocery stores and to discourage inter-temporal price discrimination (Goldin et al., 2019).

In the states where SNAP disbursement is staggered, the benefit is usually issued in the order generated by the recipients' eighth or ninth Social Security Number digit, first letter of recipients' last name, case number, etc. By exploiting both within- and cross-state variations, I investigate whether and how the timing of SNAP benefit issuance affects crime incidence, and whether this effect of interest is heterogeneous across states at different levels of SNAP policy stringency, benefit generosity and local population density.

3 Data

This section introduces the sources of data and presents summary statistics for key variables utilized in the empirical analysis. Additionally, I describe the key steps to construct the two final datasets for empirical analysis.

3.1 Data Sources and Summary Statistics

Data used in this study come from multiple sources. I categorize all data sources into four groups: (i) agency- and county-level crime data, (ii) SNAP disbursement and policy data, (iii) state-border data and statistics on county- and state-level socioeconomic characteristics, and (iv) food security and grocer establishments data.[19]

[19]In this study, an "agency" refers to a police station or its equivalent law enforcement unit that keeps a record of and reports all crime incidents in its jurisdiction to the Federal Bureau of Investigation (FBI). The present study only includes city and county police; other types of agencies that participate in the National Incident-Based Reporting System are excluded, including university or college, state, federal, tribal and other police agencies.

3.1.1 Agency- and County-level Crime Data

The main crime data utilized in this study, agency-level crime records, come from the National Incident-Based Reporting System (NIBRS), which was launched in 1995 and is administered by the FBI. This database provides detailed information on each crime incident, including time and place, offense type, offender-victim relationship, and summary of reporting agencies in 36 states and Washington D.C. The overall population coverage of the NIBRS program was very low before 2000, and there were some reporting issues with D.C. agencies in 2016 and 2017. Therefore, I restrict my analysis to crime incidents reported by the 36 participating states for the study period of 2000-2017, and focus on four types of criminal offenses that are most relevant for this study: robbery, theft, burglary and property destruction. To avoid potential repetition in crime reporting, I restrict my analysis to incidents reported by city or county police agencies. Additionally, to minimize the impact of zero crime counts in counties with a small population, only agencies with a population coverage greater than 10,000 people remain in the sample for analysis. Summary statistics of agency-level monthly crime counts by offense category are reported in Panel A of Table 1.

In addition, data on county-level offenses and arrests are derived from the Uniform Crime Reporting (UCR) program, which is administered by the Federal Bureau of Investigation (FBI). This dataset documents the crime count of several categories at the county level between 1960 and 2017. I use a small subset of the UCR data from 2009 to 2017 and match with the food insecurity data (see Section 3.1.4) to explore the mechanism for the reduced-form impact of staggering SNAP disbursement on crime incidence, based on county-level evidence. Summary statistics of county-level monthly crime counts by offense category are reported in Panel A of Appendix Table A2.[20] The county-level average count of theft is approximately 1969 incidents per year, which is much higher than robbery (118 incidents) and burglary (609 incidents).

There are a few limitations in the incident-based crime data available in the NIBRS program. First, it only includes police-reported crime incidents, which may underestimate

[20]It is worthwhile to note that statistics in Panel A of Table 1 and Appendix Table A2 are not really comparable, because UCR has significantly greater population coverage than the NIBRS program. Besides, the reporting unit of crime incidents and the data period are also different.

the actual crime counts. Second, enrollment in the NIBRS program is voluntary and the enrollment rate has been relatively low across all police agencies in the U.S. However, the number of participating agencies has been on the rise over the years. Third, the NIBRS program has a much smaller population coverage than the UCR program. As a reference, I present key statistics of the NIBRS program in Appendix Table A3, including the number of states and agencies participating in the NIBRS program, as well as the percentage of population covered during my study period (2000-2017).[21]

Despite these limitations, the NIBRS program has two main advantages for this study. First, it provides the most detailed crime data across 36 states and Washington D.C. during my study period (2000-2017).[22] Second, for each incident reported to each agency, the NIBRS program reports detailed crime category, the date and time of day as well as the incident location (Card and Dahl, 2011). This is especially helpful for generating reliable monthly incident counts for different crime types at the sub-county level, compared with other sources that provide yearly crime data (such as the UCR summary data) or survey data based on post-event recall (such as the National Crime Victimization Survey).

3.1.2 SNAP Disbursement and Policy Data

SNAP disbursement and policy data, including the benefit amount, policy stringency and monthly distribution schedule, are reported by two different agencies under USDA. National- and state-level SNAP average monthly benefit amount between January 1989 and December 2019 are reported in the SNAP Data Tables, which are administered by the Food and Nutrition Service (FNS) under USDA.[23] The monthly disbursement schedule is available for all states and Washington D.C. from 1998 to 2018 in the SNAP Distribution Schedule Database. The distribution schedule database and the policy database are both administered by the Economic Research Service (ERS) under USDA.[24] Additionally, de-

[21]For additional information on the NIBRS program, see the FBI's corresponding webpage (https://www.fbi.gov/services/cjis/ucr/nibrs).

[22]The NIBRS coverage has been higher since 2018, with more states joining the program.

[23]Data source: USDA, FNS (https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap).

[24]Data source: USDA, ERS (https://www.ers.usda.gov/data-products/snap-policy-data-sets/).

tailed information on the state-level policy options on eligibility, transaction cost, stigma and outreach spending to raise awareness of SNAP is documented in the SNAP Policy Database (2000-2016).

In Panel B of Table 1, I present the summary statistics for county-level population density, state-level SNAP policy stringency and benefit generosity, as well as the key variables characterizing the monthly SNAP disbursement schedule. The average county-level population density is approximately 600 people per square mile. The average SNAP policy index is 6.75 (out of 10), which is relatively high, indicating a moderate level of policy stringency. The average monthly benefit per person in the 36 participating states in the NIBRS program is approximately $109, while the national average is about $113. On average, SNAP monthly benefits are distributed on 7.6 calendar days, and the average length of the benefit staggering period is approximately 9.1 days. Additionally, it is a popular choice to start monthly SNAP benefit disbursement on Day 1 of a calendar month and to distribute benefits on consecutive calendar days. Approximately 75 percent and 61 percent of all the agency-month observations are labeled as "yes" for the two variables respectively over the study period (2000-2017).

To identify the reduced-form impact of staggering SNAP benefit issuance on crime incidence, I rely on two measures for benefit staggering: (i) the total number of distribution days in the SNAP disbursement schedule; and (ii) the total length of the staggering period, which is defined as the number of days between the start and end date of the SNAP disbursement schedule. In addition to the linear estimation, I also categorize all states into four types by the total number of distribution days: (i) one day only; (ii) between 2 and 7 days; (iii) between 8 and 14 days; and (iv) 15 days and above. Similarly, I categorize staggering modes of SNAP issuance into five types: (i) non-staggered, meaning all recipients in a certain state receive SNAP benefits on the same day of each month; (ii) staggered within 7 days; (iii) staggered across 8 to 14 days; (iv) staggered across 15 to 21 days; and (v) staggered across 22 or more days. It turns out that only three states fall into the category of "staggered across 22 or more days", resulting in a much smaller number of agency-month observations compared with all other groups. Therefore, later in the empirical analysis, I pool the last two categories into a new group, "staggered across 15 or more days".

Based on the staggering period and the number of distribution days, Table 2 categorizes the SNAP disbursement schedule in all states and Washington D.C. in 2018. During my study period (2000-2017), 19 states have changed their SNAP disbursement policy at least once (marked in bold in Table 2). Among these 19 states, three of them implemented multiple changes to their SNAP distribution schedule; these were Idaho, Maryland and Pennsylvania.[25] For the remaining 16 states that experienced only one change to their SNAP distribution schedules between 2000 and 2017, Table 3 provides a timeline for when the changes took place. Among these 16 states, only two of them decreased the staggering period (Arkansas and Illinois, denoted as "stagger-decrease states" hereafter). The other 14 states all increased the staggering period at some point between 2000 and 2017 (denoted as "stagger-increase states" hereafter).

3.1.3 State-border Data and Statistics on County- and State-level Socioeconomic Characteristics

The state-border dataset is derived from Holmes (1998).[26] It lists the 109 state borders in 48 contiguous U.S. states and all the counties located at these state borders. It also reports the minimum distance from the geographic centroid of each county to the state border. It is common for a county to lie at the intersection of more than two states. In this study, I treat counties in such border areas as different from those lying at the border between only two states. In total, I identify 187 unique border areas.

County-level socioeconomic statistics come from multiple sources. Specifically, county-level average weekly wage and unemployment rate are derived from the Bureau of Labor Statistics (BLS); county population and poverty rate are available from the Population Estimates Program (PEP) and the Small Area Income and Poverty Estimates (SAIPE) program administered by the U.S. Census Bureau. In addition to these county-level economic and demographic variables that are used as controls in this study, I derive the

[25]Idaho switched from a staggered payment across five consecutive days to a single-day (non-staggered) payment scheme in 2009. Then, it returned to staggered payment (across 10 days) in 2016. In Maryland, the staggering period first increased from 5 to 10 days in December 2003, then increased to 15 days in September 2015, and finally increased to 20 days in October 2015. In Pennsylvania, the staggering mode changed almost every month starting from February 1999, but the staggering period was always longer than 10 days.

[26]The dataset is available at http://users.econ.umn.edu/∼holmes/data/BorderData.html.

county-level geographic area data from the 2010 Census. The geographic area is static for most cities and counties identified by FIPS. I use this along with the intercensal population estimates from the PEP program to compute the population density, which is utilized in one of the heterogeneity tests in the empirical analysis.

Additionally, census statistics on state-level socioeconomic characteristics are available in the UKCPR National Welfare Data (1980-2018), provided by the University of Kentucky, Center for Poverty Research. The complete state-level variable list utilized in this study includes state population, Gross State Product per capita, real minimum wage, unemployment rate, poverty rate, welfare program (SNAP, WIC and Medicaid) enrollment as a percentage of total state population, an indicator for Medicaid expansion (1=yes), as well as an indicator for whether the state governor is a Democrat (1=yes). All the county- and state-level measures for socioeconomic characteristics are used as control variables.

3.1.4 Food Security and Grocer Establishments Data

Two numerical measures for the county-level prevalence of food insecurity, including the food insecurity rate and food insecurity index, are constructed based on the Food Security Supplement of the Current Population Survey (CPS-FSS), which is accessible through the National Bureau of Economic Research (NBER).[27] I use the December FSS data of each year, which is available between 2001 and 2016. The CPS-FSS is a household survey conducted by the U.S. Census Bureau for the Economic Research Service (ERS) of USDA. The CPS-FSS identifies household food security status based on 18 questions (10 for adults and 8 for children, if applicable).[28] All the surveyed households are nationally representative. In this study, I aggregate the household-level food security status and food security scale into the county-level food insecurity rate and food insecurity index. One limitation is that the county of residence is not identified for a considerable proportion of the CPS households. The corresponding counties are dropped in this transition.

[27]Source: NBER (https://www.nber.org/research/data/current-population-survey-cps-data-nber).

[28]The CPS-FSS documents three types of food security status: food secure, food insecure with hunger, and food insecure without hunger. Later in this study, I combine the latter two categories as "food insecure".

Similarly, I include the number of grocery establishments at the county level as a control variable to account for the potential impact of "food deserts" (Whelan et al., 2002; Dutko et al., 2012). This information is available in the county-level Business Pattern (CBP) dataset from the Census Bureau, which identifies the number of business establishments by NAICS code and scale of employment size for every county from 1986 to 2018.[29] In this study, I am most interested in the number of retailers selling groceries in each county, which include club stores, supermarkets and convenience stores.

Summary statistics of food insecurity rate and county-level grocer establishments are reported in Panel B of Appendix Table A2. The average food insecurity rate across the identified counties during my study period is 9.69 percent. On average, the county-level food insecurity index is 4.02, which suggests an overall moderate degree of food insecurity. As for the grocer establishments, there are on average 1.63 club stores, 2.84 supermarkets, and 7.28 convenience stores across all counties during my study period.

3.2 Data Merging and Additional Treatment

For the reduced-form analysis on the impact of variations in the timing of SNAP disbursement on crime incidence (see Section 4), I use crime data from the NIBRS program as the main dataset and compile all incident records from each reporting agency into crime counts on a monthly basis. Then, I merge data on state-level SNAP benefit distribution (including timing, policy stringency and benefit generosity) and state-level socioeconomic characteristics from the UKCPR database into the main NIBRS dataset. Following this procedure, I get a long panel by year and month between 2000 and 2017 as the final sample for reduced-form analysis.

In order to explore changes in the prevalence of food insecurity as the potential mechanism for the impact of staggering SNAP benefits across recipients (Section 5), I combine the food security data and county-level UCR crime data to construct a county-level short yearly panel (2009-2017) for establishing the causal linkage between food insecurity and crime incidence. Additionally, I convert all monthly measures in the original SNAP disbursement dataset to the mean or proportion of the original variables, based on all 12

[29] Source: Census Bureau (https://www.census.gov/programs-surveys/cbp/data/datasets.html).

calendar months in a year. I merge the converted variables into the aforementioned constructed county-level panel. Because states can change their SNAP disbursement schedule at any month during a year, I need to get yearly measures that characterize state-level SNAP disbursement. To do this, I compute the average length of benefit issuance staggering, as well as the proportion of monthly SNAP disbursement that starts on Day 1 or is delivered on consecutive calendar days throughout all months of any year between 2009 and 2017.[30] Using this combined dataset as the study sample, I explore the potential connection between the timing of SNAP disbursement and the prevalence of food insecurity.

4 Reduced-form Analysis: SNAP Benefit Issuance and Crime Incidence

In this section, I explore how SNAP schedule changes and detailed components of the SNAP distribution schedule affect monthly crime incidence at the local level, based on the incident-based crime data reported by police agencies participating in the NIBRS program.

4.1 Empirical Methods

This subsection introduces the empirical specifications for my main analysis. I begin by examining the impact of the policy change itself on crime incidence, using a series of event studies. This step tests the external validity of findings in Carr and Packham (2019) based on evidence from a SNAP schedule change in Illinois. Then, I use the traditional fixed-effect specifications to estimate the average effect on crime incidence of staggering SNAP benefit distribution across recipients. Furthermore, I exploit variations from policy discontinuity at the state borders to examine the potential impact of changes to state-level SNAP disbursement schedules on crime incidence in the state-border counties. Because the level of treatment in this study is the state, I cluster standard errors at the state level

[30] This treatment may be crude, but it is a necessary step to ensure the consistency in the time dimension of key variables utilized in this part.

(Abadie et al., 2017). In addition to the baseline analysis, I also identify the potential heterogeneity in the effect of interest by monthly SNAP benefit generosity and population density. Due to the relatively small number of clusters, I adjust the standard errors through all specifications following the cluster bootstrap approach (Cameron et al. 2008; Cameron and Miller, 2015).

4.1.1 Event Study: SNAP Schedule Change and Crime Incidence

Before diving into the impact of benefit staggering on crime incidence, I first examine whether temporary financial disruption induced by a state-level SNAP schedule change affects the incidence of crime. Given the staggered adoption of SNAP schedule changes in different states (see Table 3), the canonical difference-in-differences approach with two-way fixed effect may induce biased effect estimates when treatment effects are not constant over time (Callaway and Sant'Anna, 2020; Goodman-Bacon, 2021). As a generalized extension of the difference-in-differences model, I exploit the panel event study method proposed by Clark and Schythe (2020) to study the incidence of theft, robbery, burglary and property destruction.[31] The event month ($t = 0$) is defined as the month when changes are first made to state-level SNAP benefit disbursement during my study period (2000-2017). The event-study design is characterized by the following specification:

$$Crime_{imy} = \alpha + \sum_{k=t_0}^{t_1} \phi_k \times \mathbb{1}\{T_{smy} = k\} + \rho X_{sy} + \delta Z_{cy} + \mu_i + \theta_{my} + \epsilon_{imy}, \qquad (1)$$

where i denotes a crime reporting agency in the NIBRS dataset; s is the state in which the agency is located; m and y represent the month and year when a crime incident takes place; and $Crime_{imy}$ is the crime count of robbery, theft, burglary and property destruction per 100,000 people under the jurisdiction of agency i in month m of year y. To improve the efficiency of our estimation, I group every six months into a single bin. T_{smy} denotes the sequence of six-month bins in relation to the change in the SNAP distribution schedule that took place in state s. For example, $T_{smy} = -1$ denotes 1 to 6 months prior to the policy change in the SNAP distribution schedule, $T_{smy} = 0$ denotes 0 to 5 months after the reference month-year, etc. The reference bin for the event study is $T_{smy} = -1$. I

[31] Empirical estimations are implemented using the user-written STATA command "eventdd."

include a wide range of county- and state-level control variables (X_{sy} and Z_{cy}). County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage, and total number of grocery establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes). I also include agency fixed effects (μ_i) and month-by-year fixed effects (θ_{my}) to control for corresponding unobserved factors that might affect crime incidence.

I implement the event study design on three samples: the full sample, agencies in stagger-increase states, and agencies in stagger-decrease states. Results based on the full sample are reported as a main figure, and the other two sets of results are included as supplemental figures in Appendix A. The event study results are informative in two ways: (a) crime incidence in the pre-event period helps verify the parallel trend assumption; and (b) crime incidence in the post-event period shows whether the policy change itself has any short-term or long-term impact on crime control.

4.1.2 Staggering Benefit Issuance and Crime Incidence

The most important feature that characterizes a SNAP disbursement schedule is whether or not the benefit distribution across all recipients is staggered. If it is staggered, I am interested in how the number of distribution days and the total length of benefit staggering period affect crime incidence. Specifically, I explore how benefit staggering affects crime incidence using an ordinary least squares (OLS) model with agency and time fixed effects. The corresponding empirical specification can be characterized as:

$$Crime_{imy} = \alpha + \beta \cdot Stagger_{smy} + \rho X_{sy} + \delta Z_{cy} + \mu_i + \theta_{my} + v_{imy}, \tag{2}$$

where v_{imy} represents unobserved errors; $Stagger_{smy}$ is a measure for whether and how the issuance of monthly SNAP benefit is staggered across recipients, which can be (i) a binary indicator for whether benefit issuance is staggered (1=yes); (ii) the total number of distribution days or (iii) the total length of the staggering period (defined by the start

and end date). I run three separate regressions using these three measures, respectively. Alternatively, I run a separate set of nonlinear estimations with the categorical measures for the number of distribution days and the staggering period in weekly bins (See Table 2 for the categorization and Section 3.1.2 for relevant discussions). The baseline group is the non-staggered or single-day distribution schedule. All other variables are defined in the same way as in Eq.(1). The parameter of interest is β. The null hypothesis is that $\beta < 0$. In other words, more distribution days across recipients help reduce crime, and a longer staggering period leads to a lower crime incidence. One possible explanation is that a disbursement schedule featuring more distribution days and a longer staggering period allows merchants more time to restock and ensure the availability of food items that are most often purchased. This helps reduce crimes related to food shortages and the frustration of not getting desired grocery products. In addition, staggering benefit issuance helps discourage inter-temporal price discrimination targeting SNAP beneficiaries, thereby ensuring the purchasing power of food credits.

4.1.3 Effect Heterogeneity

The impact of staggering SNAP disbursement on crime incidence may be heterogeneous with different levels of policy stringency and benefit generosity across states, as well as the population density across counties. To extend the baseline analysis, I interact these three characteristics with measures for SNAP benefit staggering to explore the potential effect heterogeneity.

A. Heterogeneity by Policy Stringency

I begin with the heterogeneity test on policy stringency. Specifically, I interact the state-level SNAP policy stringency index with measures for benefit staggering. After adding this interaction term to the baseline specification shown in Eq.(2), the regression equation can be written as:

$$\begin{aligned} Crime_{imy} = \alpha + \beta \cdot Stagger_{smy} + \gamma \cdot Stagger_{smy} \times Index_{smy} \\ + \rho X_{sy} + \delta Z_{cy} + \mu_i + \theta_{my} + \epsilon^P_{imy}, \end{aligned} \tag{3}$$

where $Index_{smy}$ is the SNAP policy stringency index for state s in month m of year y;

ϵ^{P}_{imy} represents unobserved errors; and all other variables are defined as in Eq.(1). The parameter of interest is γ, which indicates whether the effect of disbursement staggering on crime incidence is heterogeneous across states with different levels of policy stringency. If $\gamma = 0$, then the effect of SNAP disbursement staggering on the frequency of crime occurrence does not vary by the state-level SNAP policy stringency. Otherwise, the effect of benefit staggering on crime incidence may be heterogeneous by different levels of policy stringency.

B. Heterogeneity by Benefit Generosity

The second potential source of effect exogeneity is benefit generosity. For convenience of interpretation, I subtract the state-level average SNAP benefit per person by the equivalent measure on the national level. Then, I interact this generated benefit difference with measures for SNAP benefit staggering. After adding this interaction term to the baseline specification shown in Eq.(2), the specification for identifying the potential interaction between disbursement staggering and benefit amount can be written as:

$$\begin{aligned} Crime_{imy} = \alpha + \beta \cdot Stagger_{smy} + \gamma \cdot Stagger_{smy} \times \Delta Benefit_{smy} \\ + \rho X_{sy} + \delta Z_{cy} + \mu_i + \theta_{my} + \epsilon^{G}_{imy}, \end{aligned} \tag{4}$$

where $\Delta Benefit_{smy}$ is the average amount of SNAP benefit per person in state s in month m of year y after deducting the national average in the same period of time; ϵ^{G}_{imy} represents unobserved errors; and all other variables are defined as in Eq.(1). The parameter of interest is γ, which indicates whether the effect of SNAP benefit disbursement staggering on crime incidence is heterogeneous across states with different amounts of benefit increase. If $\gamma = 0$, then the effect of SNAP disbursement staggering on the frequency of crime occurrence does not vary by the state-level SNAP benefit amount. Otherwise, the effect of benefit disbursement staggering on crime incidence is affected by benefit generosity.

C. Heterogeneity by Population Density

The impact of staggering SNAP benefit disbursement on crime incidence may be affected by population density. I explore this potential source of effect heterogeneity by adding an interaction term between benefit staggering and population density to the baseline specification. The corresponding specification is analogous to Eq.(3) and Eq.(4)

and can be written as:

$$Crime_{imy} = \alpha + \beta \cdot Stagger_{smy} + \gamma \cdot Stagger_{smy} \times PopDen_{cmy} + \rho X_{sy} + \delta Z_{cy} + \mu_i + \theta_{my} + \epsilon^D_{imy}, \tag{5}$$

where $PopDen_{cmy}$ is the county-level population density (in 1,000 people per square mile); ϵ^D_{imy} represents unobserved errors; and all other variables are defined in the same way as in Eq.(1). Similarly to the heterogeneity test on policy stringency and benefit generosity, if the coefficient on the interaction term is statistically significant, then the estimated effects of SNAP disbursement on the agency-level monthly crime incidence varies by the population density in the local community.

Similarly to Carr and Packham (2019), I do not have detailed information on SNAP beneficiaries. Therefore, all coefficient estimates that are presented in the following subsections of results for the main analysis and robustness checks reflect the intent-to-treat effect, which provides a lower bound for the true effects of interest.

4.2 Main Results

This subsection reports the empirical results for variations in crime incidence under different SNAP disbursement schemes. I begin by reporting the results of the event study and the linear estimations. Following the interpretation of the baseline results, I also discuss whether the average effect of staggering SNAP benefit disbursement varies across states with different levels of SNAP policy stringency, benefit generosity, and population density of the local communities.

4.2.1 Event Study: SNAP Schedule Change and Crime Incidence

Prior to the main analysis, I conduct a set of event studies to examine crime incidence before and after any change to the state-level SNAP disbursement schedule. The event study result based on the full sample is presented in Figure 2. In general, I do not find a statistically significant pre-trend for the four types of crime under study, including theft, robbery, burglary and property destruction. In addition, there is no consistent pattern

for changes to crime incidence after the introduction of state-level policy changes to the SNAP disbursement schedule. Results based on the two subsamples (stagger-increase and stagger-decrease states), as shown in Appendix Figures A1 and A2, are generally consistent with my main findings. The pre-trend and post-trend for both subsamples are almost always statistically insignificant (except the incidence of property destruction crimes in the two stagger-decrease states).[32]

There are two main takeaways from the event study results. First, the statistical insignificance during the pre-event period provides strong evidence for validity of the parallel trend assumption, which substantiates the exogeneity of the state-level policy change in SNAP disbursement schedules. Second, the null change in crime incidence during the post-event period suggests that the policy change itself does not have a significant impact on crime. Thus, it is necessary to explore in further detail whether and how the timing of state-level SNAP disbursement affects crime incidence.

4.2.2 Staggering Benefit Issuance and Crime Incidence

The baseline results for the estimated impact on crime incidence of staggering SNAP benefit issuance are presented in Panels A through C of Table 4. First, Panel A shows that crime rates in the areas with staggered SNAP disbursement are on average not significantly different from those with non-staggered benefit distribution. Then, I explore the impact of increasing the number of distribution days and lengthening the staggering period. I find that increasing the number of distribution days does not reduce crime rates (see Panel B), while lengthening the staggering period does (see Panel C). When the staggering period is extended by one day, the agency-level robbery rate and burglary rate are reduced by 0.0020 and 0.0733 incidents per 100,000 people. There is no significant change on average in the incidence of theft and property destruction when a new SNAP staggering period is adopted.

It is likely that the impact on crime incidence of the number of distribution days and the staggering period is not linear. Therefore, I group these two measures of benefit staggering into weekly bins. Table 5 presents the corresponding results. The benchmark group

[32]The exception probably arises from low statistical power, since there are only two stagger-decrease states.

is crime rate in the areas that implement a non-staggered, single-day SNAP disbursement. For the number of distribution days, I have three treatment groups: (i) between 2 and 7 days, (ii) between 8 and 14 days, and (iii) 15 days and above (see Panel A). Generally, choosing a longer period of distribution does not reduce the rates of theft and property destruction. However, the robbery rate is reduced by 0.022, 0.024 and 0.036 incidents per 100,000 people when the monthly SNAP benefit is issued on 2 to 7 days, 8 to 14 days, and 15 or more days, respectively, compared with the baseline group (single-day/non-staggered benefit distribution). In addition, a SNAP disbursement schedule consisting of 2-7 distribution days or more than 15 distribution days is conducive to a reduction of 1.52 to 1.88 burglary incidents per 100,000 people.

For the length of the SNAP staggering period, I also have three treatment groups: (i) staggered within 7 days, (ii) staggered across 8 to 14 days, and (iii) staggered across 15 or more days (see Panel B). First, staggering SNAP disbursement within 7 days or across 8 to 14 days does not yield a significant change in the monthly rates of robbery, theft, burglary or property destruction. When the staggering period is extended to 15 or more days, monthly robbery cases drop by approximately 0.02 incidents per 100,000 people (significant at 5% level).

In summary, the empirical results based on agency-level crime incident reports covering 36 states suggest that staggering benefit disbursement reduces certain types of crime. Lengthening the staggering period of SNAP benefit disbursement potentially leads to a reduction in the incidence of robbery and burglary, and the effect is largely linear. On the other hand , adding the number of distribution days does not impose a linear impact on crime incidence. Instead, regressions based on categorical bins of distribution days suggest that a policy of 15 or more distribution days is potentially the most effective in reducing robbery and burglary incidents. I find no significant decrease in the incidence of theft and property destruction cases in response to changes to the timing of state-level SNAP disbursement.

4.2.3 Effect Heterogeneity

After obtaining the estimated average effects of staggering SNAP benefit disbursement, I further explore whether this effect varies by policy stringency, benefit generosity and population density. Results for the three heterogeneity tests are reported in Appendix Tables B1 through B3. In general, the estimated impact on crime incidence of adding more distribution days or lengthening the staggering period of SNAP benefit disbursement is consistent with the baseline results presented in Table 4. Adding more distribution days does not seem to reduce crime incidence, but lengthening the staggering period significantly decreases the rate of robbery and burglary. Next, I discuss the implications for the results for the three heterogeneity tests.

First, results for the heterogeneity test on policy stringency are reported in Table B1. The effect of increasing the number of distribution days on crime incidence is not affected by policy stringency (see Panel A of Table B1). On the other hand, the effect of lengthening the staggering period on the reduction in robberies is mostly observed in the regions where less stringent SNAP policies are implemented, although this effect heterogeneity is relatively small in magnitude (see Panel B of Table B1). For theft, burglary and property destruction offenses, the impact of lengthening the staggering period on crime incidence does not seem to interact with SNAP policy stringency.

Second, results presented in Table B2 suggest that the effect heterogeneity by benefit generosity is not statistically significant for most of the crime types that I study. The only exception is robbery. Increasing the number of distribution days contributes to a reduction in robbery incidents when the per capita benefit is above the national average, but the effect is economically very small (see Panel A of Table B2). The effect of lengthening the staggering period on crime incidence is not affected by benefit generosity for any of the four types of crime under study (see Panel B of Table B2).

Third, the heterogeneity test on population density yields different results for the two measures of benefit staggering, including the number of distribution days and the length of the staggering period. Corresponding results are presented in Appendix Table B3. The statistical insignificance of all the interaction terms suggests that population density does not affect how the number of distribution days affects crime incidence (see

Panel A of Table B3). On the contrary, heterogeneity from population density is substantiated when evaluating the impact of lengthening the benefit staggering period on crime incidence, especially for robbery and property destruction offenses. Specifically, I find a slight decrease in the incidence of robbery by 0.0027 cases per 100,000 people (significant at the 10% level) and a more substantial decrease in the incidence of property destruction by 0.1357 cases per 100,000 people (significant at the 5% level) when population density increases by 1000 people per square mile (see Panel B of Table B3). Taken together, this result is informative in understanding the difference between the two features of staggering SNAP benefit disbursement.

4.3 Robustness Checks

To examine the robustness of my main results, I conduct three sets of sensitivity checks, with an alternative identification strategy, as well as alternative measures for the SNAP disbursement schedule (explanatory variable) and crime incidence (outcome variable).

4.3.1 SNAP Disbursement and Crime Incidence at the State Borders

As a supplement to my main analysis based on the national-level framework, I also examine the impact of SNAP disbursement on crime based on evidence from reporting agencies located in counties at state borders. Inspired by Dube et al. (2010), I allow for the border-specific time effects with the state-border agency sample. The corresponding specification can be characterized as:

$$Crime_{ibmy} = \alpha + \beta \cdot Stagger_{smy} + \rho X_{sy} + \delta Z_{cy} + \mu_i + \theta_{bmy} + w_{ibmy}, \tag{6}$$

where b denotes a unique state-border region; θ_{bmy} represents the border-specific month-by-year fixed effect; w_{ibmy} represents unobserved errors; and all other variables are defined in the same way as in Eq.(2). The parameter of interest is still β. The empirical result based on the local-level approach denoted by Eq.(6) can be compared with the main result based on the national-level framework denoted by Eq.(2). The parameter of interest is β.

The null hypothesis is still $\beta = 0$ – that is, neither more distribution days nor a longer staggering period reduces the crimes under study.

Corresponding results are reported in Appendix Table C1 and C2. In general, I do not find significant evidence for the impact of staggering SNAP benefit disbursement on crime incidence at the state borders. Compared with the significantly negative impact identified in the main analysis, it is reasonable to infer that such an effect mostly comes from the non-border cities and counties.

4.3.2 Choice of Calendar Days in the SNAP Disbursement Schedule

My main analysis focuses on the number of distribution days and total length of the benefit staggering period in a SNAP disbursement schedule. As a robustness check, I explore whether the choice of specific calendar days in the disbursement schedule might also have an impact on crime. The possible mechanism is that issuing SNAP benefits to some or all recipients on the first day of each month may collide with the delivery of their paychecks from work. The positive income shock from double sources stimulates immediate expenditure, which makes consumption smoothing rather challenging. This can bring about financial stress before the end of each month, thus providing an incentive for committing crimes. On the other hand, issuing benefits on consecutive days may be less conducive to crime reduction than having some gaps in the disbursement schedule. The proposed story is very similar to the argument for choosing a longer staggered disbursement period in total. Avoiding disbursement on consecutive days helps prevent continuous spikes in food purchases, which helps ensure sufficient time for local grocery stores to restock and reduces the likelihood of food shortages. To empirically test these hypotheses, I run the following regression:

$$Crime_{imy} = \alpha + \zeta \cdot First_{smy} + \xi \cdot Cont_{smy} + \rho X_{sy} + \delta Z_{cy} + \mu_i + \theta_{my} + \eta_{imy}, \quad (7)$$

where $First_{smy}$ is an indicator for whether SNAP disbursement starts on the first day of month m of year y in state s (1=yes); $Cont_{smy}$ is an indicator for whether SNAP benefits are issued on consecutive calendar days in month m of year y in state s; η_{imy} represents unobserved errors; and all other variables are defined as in Eq.(1). The parameters of

interest here are ζ and ξ. The null hypothesis is $\zeta = 0$ and $\xi = 0$, which means that neither of these two features of the SNAP disbursement schedule affects crime. If rejected, then either the first day of the disbursement schedule or the continuity of issuing dates makes a difference to crime occurrence.

Corresponding results are reported in Appendix Table C3. I do not find significant evidence for a calendar-day-based analog for the so-called "first of the month effect" on crime incidence discussed in the existing literature, which characterizes a peak in household food expenditure in the first week of a SNAP month, followed by a sharp decrease in household food expenditure driven by reductions in quantity thereafter (Hastings and Washington, 2010; Goldin et al., 2019). Another theory, as discussed above, is that the collision of SNAP disbursement with paycheck delivery stimulates immediate food purchases, making it difficult to smooth consumption; households may run short on food later in the month, which could spur more crimes. Along with the monthly disbursement start date, I also explore whether issuing SNAP benefits on consecutive days affects crime incidence. But I do not find supporting evidence for this theory, either. In summary, the empirical results presented in this study suggest that the number of distribution days and the staggering period are the two most critical features in the SNAP disbursement schedule that affect crime incidence.

4.3.3 Alternative Measure for Crime Incidence

For this part of the robustness check, I use an alternative measure for crime incidence. I replace the crime rate measure used in the main analysis (crime count per 100,000 population) with the log crime count as the outcome variable. The regression equation is the same as that for the main analysis, which is shown above in Eq.(2).

Using log crime count as the outcome measure, I first find a null effect of staggering monthly SNAP benefit distribution on crime incidence (see Panel A of Appendix Table C4). Similarly, the linear effect on crime incidence of increasing the number of distribution days is statistically insignificant for all crime types except burglary, which witnesses a 0.23 percent decline (see Panel B of Appendix Table C4). As in the main analysis, I find evidence that lengthening the staggering period reduces crime(see Panel C of Appendix

Table C4). Lengthening the staggering period results in a 0.35 percent decrease in total burglary incidents on average (significant at the 1% level). There is also a marginally significant decrease in the total count of robbery and property destruction incidents when the staggering period is longer.

I also explore the potential nonlinearity in the impact of adding the number of distribution days and lengthening the staggering period. I find a significantly lower incidence of robbery and burglary when SNAP benefits are not distributed on a single day. Robbery incidents drop by approximately 0.30 percent to 0.66 percent, and burglary cases decrease by approximately 1.92 percent to 5.97 percent (see Panel A of Appendix Table C5). For the impact of lengthening the staggering period, I find no change in the incidence of the instrumental offenses (robbery, theft and burglary). However, expressive violence, such as property destruction cases, witness a decline by approximately 5.66 percent to 8.79 percent when the staggering period is 8 days or above (see Panel B of Appendix Table C5).

In general, results using the alternative outcome measure, presented in Appendix Tables C4 through C5, are generally consistent with my main findings shown in Tables 4 and 5. Lengthening the staggering period decreases the incidence of robbery and burglary in a linear pattern. On the contrary, the impact of increasing the number of distribution days is very likely nonlinear. Either way, a SNAP disbursement schedule that consists of more distribution days over a longer staggering period is preferred for the purpose of crime control.

5 Possible Mechanism: Impact through the Prevalence of Food Insecurity

The reduced-form analysis above shows that the timing of SNAP benefit disbursement does not affect emotion-driven incidents, but imposes a significant impact on the incidence of financially motivated crimes. In this study, I focus on the latter and explore the potential mechanism for such an impact. Previous studies have discussed two strands of possible mechanisms: (i) impact on the retailers accepting SNAP payment, such as

the "congestion effect" resulting from a non-staggered benefit distribution (Gordin et al., 2019), and (ii) influence on the SNAP recipients, such as the increased stress cycle frequency and reduced maximum level of stress for SNAP beneficiaries under a staggered benefit issuance scheme (Sims et al., 2021). In this section, I skip the intermediate steps and explore changes directly relevant to food insecurity as potentially the key mechanism for the estimated impact on crime incidence of staggering SNAP benefit disbursement. Specifically, I examine the connections between the staggering period of SNAP benefit disbursement and the prevalence of food insecurity, and between food insecurity and crime incidence.[33] Two sets of estimations are implemented separately using the constructed county-level yearly panel dataset during 2001-2016, as described in Section 3.[34] Along with the empirical specifications, I report the corresponding results that are relevant for testing the proposed mechanism.

5.1 Timing of SNAP Disbursement and Food Insecurity

After establishing the causal linkage between food insecurity and crime incidence, I continue to explore the potential connection between the timing of food assistance distribution and the prevalence of food insecurity. Empirically, I estimate the following equation:

$$FI_{cy} = \alpha^F + \phi^F \cdot Stagger_{sy} + \rho X_{sy} + \delta Z_{cy} + \mu_c + \theta_y + \varepsilon^F_{cy}, \tag{8}$$

where FI_{cy} represents the numerical measure of county-level food insecurity, which is either the food insecurity rate or the food insecurity index; $Stagger_{sy}$ is either the average number of distribution days or the average length of the SNAP staggering period in state s across all months of year y; ε^F_{cy} represents unobserved errors; X_{sy} and Z_{cy} represent a set of state- and county-level controls, which are defined in the same way as above (see Section 4); and μ_c and θ_y are county and year fixed effects. The coefficient of interest is ϕ^F.

[33] The reduced-form analysis above suggests that the average impact of the number of distribution days on crime incidence is statistically insignificant. Therefore, for this part of the study, I focus on the impact of the staggering period.

[34] The yearly summary of UCR data does not report statistics for property destruction offenses. For this section, I check the total crime rate for the property crimes of interest and the separate incidences of robbery, theft and burglary.

The results are reported in Table 6. Results for the food insecurity rate are presented in the first two columns, and results for the food insecurity index are shown in the last two columns. My first finding is that staggering SNAP disbursement across recipients does not lower the county-level food insecurity rate (see Columns 1-2). On the other hand, the county-level food insecurity index drops by 0.03 when the average length of the monthly SNAP staggering period is extended for an additional day (see Column 4). This result suggests that staggering SNAP disbursement has no significant impact on the prevalence of food insecurity, but may help relieve the severity of food insecurity at the county level.

5.2 Food Insecurity and Crime

The previous subsection finds a connection between staggering SNAP benefits and the severity of food insecurity at the county level. To explore the potential connection between food insecurity and crime incidence, I estimate the following equation:

$$Crime_{cy} = \alpha^C + \phi^C \cdot FI_{cy} + \rho X_{sy} + \delta Z_{cy} + \mu_c + \theta_y + \varepsilon^C_{cy}, \tag{9}$$

where $Crime_{cy}$ is the crime rate (crime count per 100,000 people) of county c in year y; FI_{cy} is the county-level food insecurity index; X_{sy}, Z_{cy}, μ_c and θ_y are defined as in Eq.(8); and ε^C_{cy} represents unobserved errors. The coefficient of interest is ϕ^C.

I estimate Eq.(9) for all crime incidents combined, as well as for specific crime categories, including robbery, theft and burglary. Considering that the main explanatory variable, county-level food insecurity index, may be endogenous, I use the one-year lagged county-level value ($FI_{c,y-1}$) to replace the original same-period index and run another set of OLS regressions. The results are presented in Table 7. The two sets of results are in general consistent. Using either measure of the county-level severity of food insecurity, I find that a one-point increase in the county-level food insecurity index is associated with an increase of 48.50 to 52.29 incidents in the total crime count per 100,000 people, along with 19.23 to 22.72 more theft incidents and 11.35 to 11.45 more burglary incidents per 100,000 people. There is potentially an increase of 1.88 robbery incidents, but it is not robust when the one-year lagged measure for county-level severity of food insecurity is exploited. In general, the results indicate a positive and significant correlation between

food insecurity and the increase in crime incidence.

Overall, the results presented in Tables 6 and 7 suggest that staggering SNAP distribution across recipients can help relieve the severity of food insecurity at the local level, which may in turn reduce the incidence of financially motivated crimes. The discussion in this section lays the groundwork for the reduced-form estimation of how benefit issuance of food assistance programs can have an impact on the incidence of criminal activity.

6 Conclusion and Discussion

This study explores the connection between the timing of a welfare payment and crime incidence, based on evidence from the SNAP program. I begin with a reduced-form analysis. Using agency-level crime data from 36 states between 2000 and 2017, together with SNAP benefit disbursement data in corresponding states, I find that a more dispersed schedule of SNAP benefit disbursement reduces the incidence of certain crimes. Specifically, increasing the number of distribution days probably affects crime incidence in a nonlinear way. Compared with a single-day (non-staggered) benefit distribution, a disbursement schedule that consists of 15 or more distribution days is associated with a decline of 0.036 robbery incidents and 1.876 burglary incidents per 100,000 people. On the other hand, the impact on crime incidence of lengthening the staggering period is very likely linear. A one-day extension in the staggering period results in a reduction of 0.002 robbery incidents and 0.073 burglary incidents per 100,000 people on average (reductions of approximately 0.02% and 0.35%, respectively). This result is generally consistent with findings in Foley (2011) as well as Carr and Packham (2019) based on evidence from several selected states or large cities, but the magnitude of the estimated impact is much smaller. In addition to the average effect, I also explore the potential effect heterogeneity by policy stringency, benefit generosity and population density. I find evidence for effect heterogeneity by policy stringency and population density. Staggering SNAP disbursement across recipients has a greater contribution to crime reduction in places where the SNAP policy is less stringent and the population density is higher.

Then, I explore changes to the prevalence of food insecurity as the potential mecha-

nism for the estimated impact of adopting a certain SNAP benefit disbursement schedule across recipients on crime incidence, with a special focus on financially motivated crimes. Evidence on the county-level prevalence of food insecurity during 2001 and 2016, based on household-level CPS-FSS data, suggests that staggering SNAP disbursement may not change the food insecurity rate at the local level, but may reduce the severity of food insecurity and thereby reduce crime.

Based on all the above findings, the policy implication of this study is to choose an extended SNAP disbursement schedule to reduce the incidence of financially motivated crimes, which is consistent with previous studies (Foley, 2011; Carr and Packham, 2019). Policymakers are advised to stagger SNAP benefit distribution among recipients across 15 or more days, during which time more distribution days should be incorporated in the disbursement schedule. In addition, a less stringent set of SNAP policies is preferred to encourage enrollment (Shiferaw, 2019), alleviate food insecurity, and deter crimes. Carefully designed timing of SNAP disbursement is likely to reduce the incidence of food insecurity and in turn contribute to crime reduction in the local communities.

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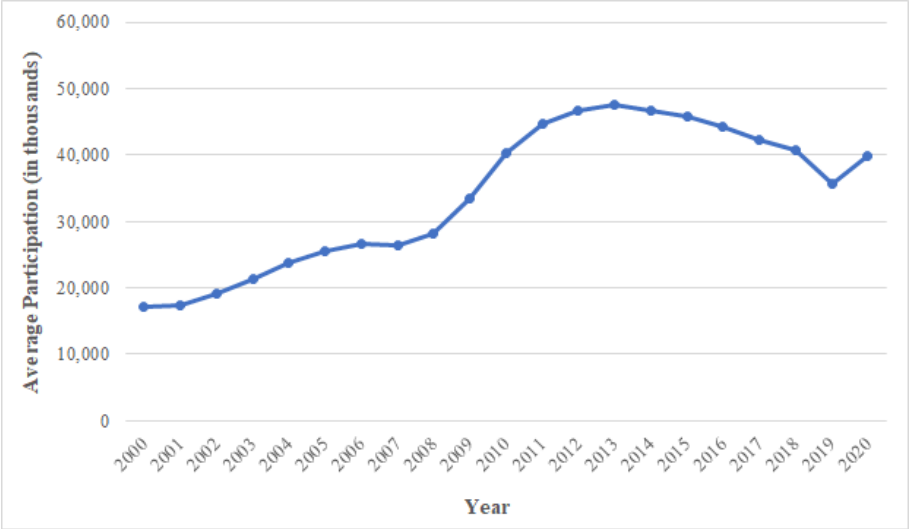
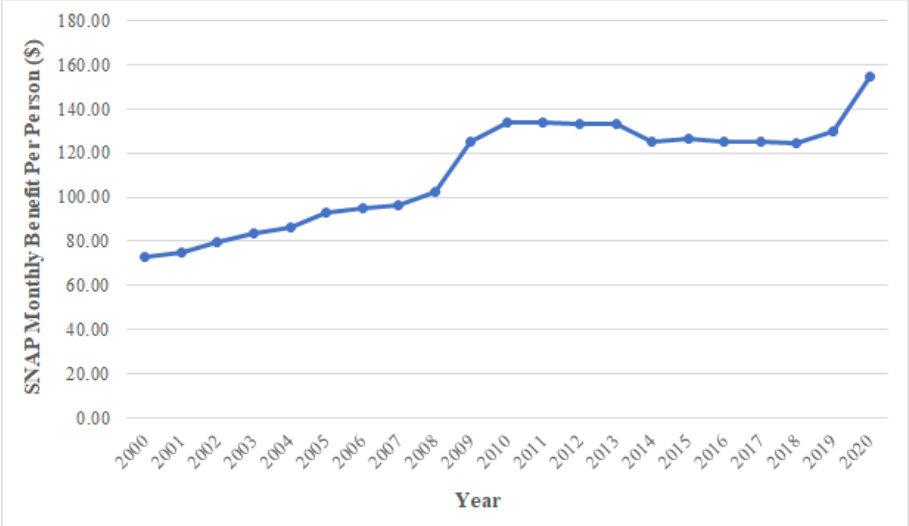
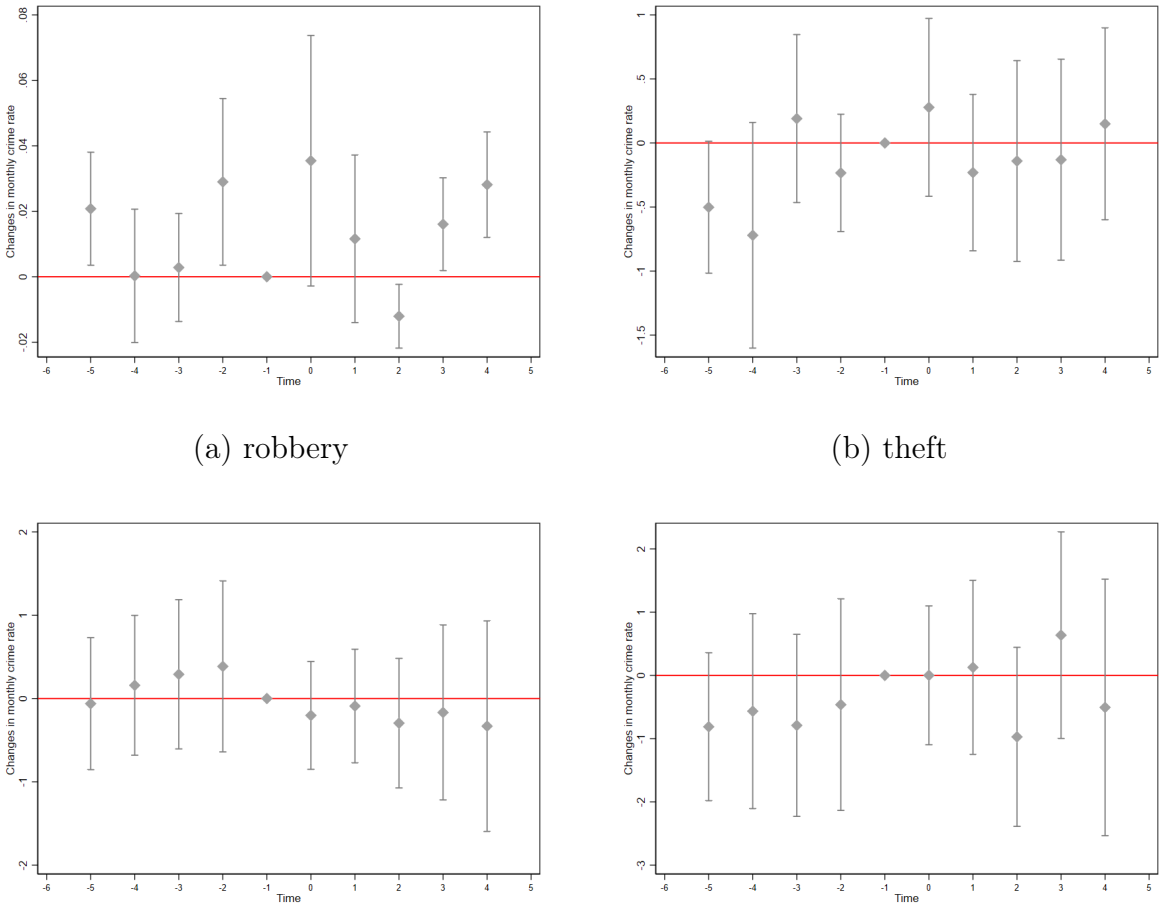


(a) Average enrollment



(b) Average monthly benefit per recipient

Figure 1: SNAP average enrollment and monthly benefit amount (2000-2020)



(a) robbery

(b) theft

(c) burglary

(d) destruction

Figure 2: Event study — Full sample

Note: In this set of event studies, I define event month as the first month that changes are made to state-level SNAP disbursement schedule between 2000 and 2017. The result presented in all four panels generally validates the parallel trend assumption. On the other hand, no significant changes to crime incidence are observed during the post-event period.

Table 1: Summary statistics — Reduced-form analysis

	Mean	Std. Dev.	Obs.
Panel A: Monthly agency-level crime count by category			
Robbery	0.03	1.69	347,349
Theft	1.21	10.12	347,349
Burglary	1.80	17.34	347,349
Destruction	4.61	29.77	347,349
Panel B: Demographics and SNAP disbursement policy			
County-level population density ($\times$ 1000 people / square mile)	0.60	0.96	347,349
State-level SNAP policy stringency index	6.75	1.79	316,089
State average monthly benefit per person ($)	108.86	22.30	347,349
National average monthly benefit per person ($)	113.05	21.00	347,349
Disbursement starts from Day 1 of a month (1=yes)	0.75	0.43	347,349
Benefit issued on consecutive calendar days (1=yes)	0.61	0.49	320,263
Length of staggering period (days)	9.11	4.95	320,263
Number of distribution days	7.57	4.39	320,263

Source: (a) NIBRS, 2000-2017; (b) USDA (FNS & ERS), 2000-2017.

Note: (1) For Panel A, only county and city police agencies with a population coverage greater than 10,000 people enter the sample for analysis.
(2) For Panel B, the state-level average monthly SNAP benefit per person during my study period (2000-2017) do not have the same mean as the national average because the combined dataset from the NIBRS program only covered 36 states by the end of 2017. SNAP policy stringency index is not available in 2017.
(3) In Panel B, the variables "benefit issued on consecutive calendar days (1=yes)", "length of staggering period (days)" and "number of distribution days" have a smaller total number of observations, as information on SNAP disbursement in West Virginia is not available until May 2003, when EBT was fully implemented.

Table 2: SNAP disbursement schedule by state (2018)

Type of schedule	States
Panel A: Distribution days	
One day only	AK, ND, NV, NH, RI, SD, VT
Between 2 and 7 days	CT, HI, ME, MT, NE, NJ, **OK**, OR, UT, **VA**, WY
Between 8 and 14 days	**AR**, AZ, CA, CO, DC, **GA**, IA, **ID, IL, IN**, KS, **KY**, LA, MA, **MI**, MN, **NC**, NY, **OH, PA**, TX, WA, WI, WV
15 days and above	**AL, DE, FL, MD**, MO, MS, NM, **SC**, **TN**
Panel B: Staggering period	
Non-staggered	AK, ND, NV, NH, RI, SD, VT
Staggered within 7 days	CT, HI, ME, MT, NE, NJ, WY
Staggered across 8 to 14 days	**AR**, AZ, CA, CO, DC, IA, **ID**, KS, LA, MA, MN, NY, **OK**, OR, **PA, SC**, UT, **VA**, WA, WI, WV
Staggered across 15 to 21 days	**GA, IL, IN, KY, MD, MI**, MO, MS, **NC**, NM, **OH, TN**, TX
Staggered across 22 or more days	**AL, DE, FL**

Source: SNAP policy database, administered by the Economic Research Service under USDA.

Note: States marked in bold are where SNAP disbursement schedule changed at least once between 2000 and 2017. Among these states, FL and MD are not included in the NIBRS database during the study period 2000-2017.

Table 3: Timeline of state-level SNAP schedule change (2000-2017)

Source: SNAP policy database, administered by the Economic Research Service under USDA. The number in bracket after each state denotes the month of schedule change. See Table 2 for a detailed categorization of the distribution schedules by the staggering period and the total number of distribution days.

Table 4: Timing of SNAP benefit disbursement and crime incidence

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Staggered distribution (dummy)				
Staggered distribution across recipients	-0.0036	-0.4784	0.6893	-0.5301
	(0.0085)	(0.8766)	(0.4230)	(1.1866)
Panel B: Distribution days				
Number of distribution days	-0.0013	0.1022	-0.0798	0.0802
	(0.0011)	(0.0827)	(0.0616)	(0.1222)
Panel C: Staggering period				
Length of staggering period	-0.0020***	0.0381	-0.0733**	-0.0461
	(0.0007)	(0.0508)	(0.0344)	(0.0862)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	320212	320212	320212	320212

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a NIBRS participating agency in a certain month divided by the population of 100,000. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table 5: Staggering SNAP benefit disbursement and crime incidence

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Distribution days				
Between 2 and 7 days	-0.0222*	0.6781	-1.5161***	-1.5738
	(0.0128)	(0.4133)	(0.3265)	(1.0624)
Between 8 and 14 days	-0.0241***	0.4353**	-0.4673	-0.5592
	(0.0079)	(0.2118)	(0.3754)	(0.5456)
15 days and above	-0.0355*	1.5334	-1.8764***	1.3475
	(0.0194)	(1.2816)	(0.4528)	(1.4808)
Panel B: Staggering period				
Staggered within 7 days	-0.0058	-0.3277	0.6656	-0.1055
	(0.0145)	(3.5793)	(0.7607)	(3.8525)
Staggered across 8 to 14 days	0.0011	-0.6352	0.4831	-1.2018
	(0.0133)	(1.9432)	(0.8422)	(1.4626)
Staggered across 15 or more days	-0.0222**	-0.0038	-0.5345	-1.4337
	(0.0086)	(0.8421)	(0.3414)	(1.1498)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	320212	320212	320212	320212

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a NIBRS participating agency in a certain month divided by the population of 100,000. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table 6: SNAP benefit disbursement and county-level prevalence of food insecurity

	Food insecurity rate		*Food insecurity index*	
	(1)	(2)	(3)	(4)
Average number of distribution days	0.0326		-0.0163	
	(0.0763)		(0.0177)	
Average length of the monthly staggering period		0.0291		-0.0315**
		(0.0557)		(0.0129)
state-level controls	Yes	Yes	Yes	Yes
county-level controls	Yes	Yes	Yes	Yes
county FE	Yes	Yes	Yes	Yes
year FE	Yes	Yes	Yes	Yes
Observations	4318	4318	4167	4167

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The average number of distribution days and the average length of the monthly staggering period are defined as the mean of the corresponding monthly measures across 12 months of a year. County-level controls include the size of total population, unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores) in a county in a given year. State-level controls include per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

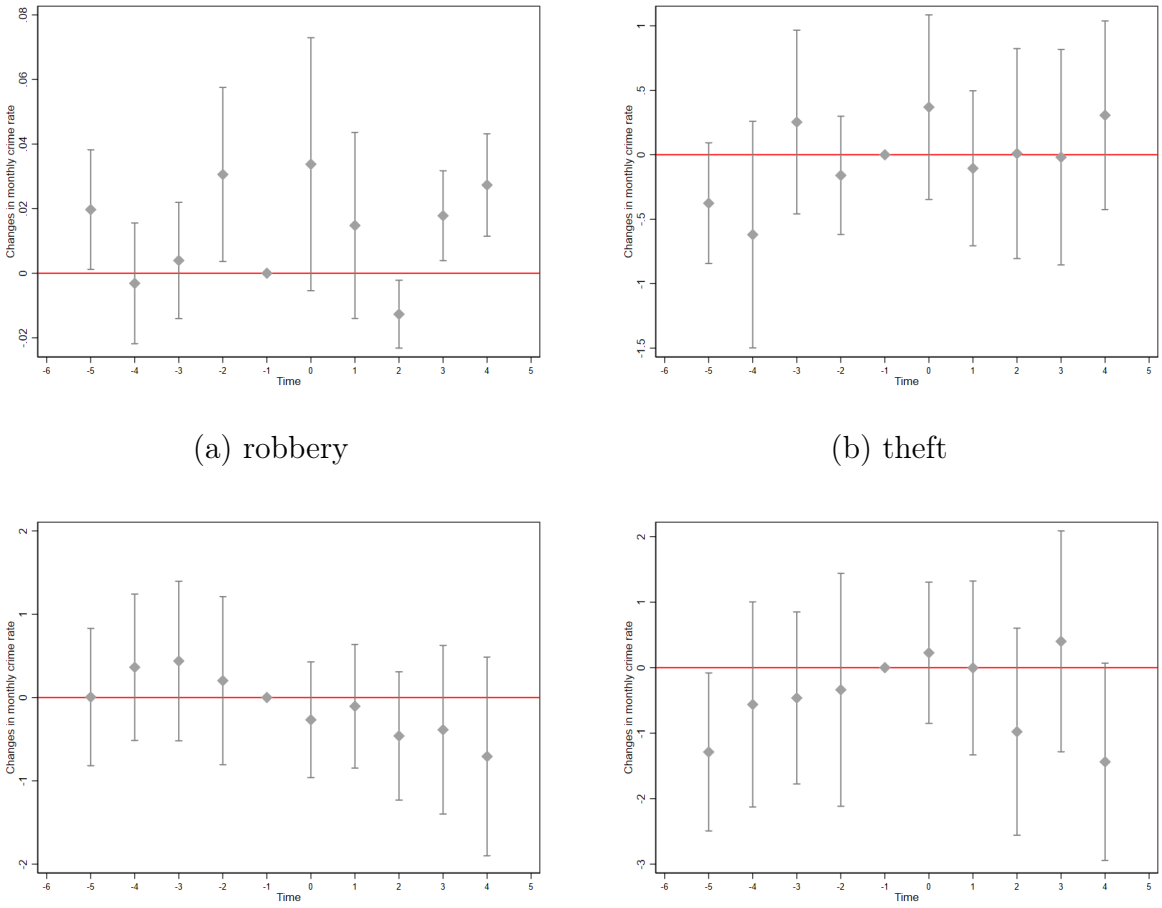
Table 7: County-level prevalence of food insecurity and crime incidence

	(1) Total	(2) Robbery	(3) Theft	(4) Burglary
Panel A: OLS - Same period				
County-level food insecurity index	48.501***	1.878**	19.233***	11.450***
	(12.777)	(0.853)	(6.480)	(2.472)
state-level controls	Yes	Yes	Yes	Yes
county-level controls	Yes	Yes	Yes	Yes
county FE	Yes	Yes	Yes	Yes
year FE	Yes	Yes	Yes	Yes
Observations	4167	4167	4167	4167
Panel B: OLS - One year lagged				
County-level food insecurity index (lagged)	52.286***	1.421	22.720***	11.350***
	(13.053)	(0.871)	(6.636)	(2.563)
state-level controls	Yes	Yes	Yes	Yes
county-level controls	Yes	Yes	Yes	Yes
county FE	Yes	Yes	Yes	Yes
year FE	Yes	Yes	Yes	Yes
Observations	3906	3906	3906	3906

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a participating county of the UCR program in a certain month divided by the population of 100,000. County-level controls include the size of total population, unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores) in a county in a given year. State-level controls include per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

A Supplemental Figures and Tables



(a) robbery

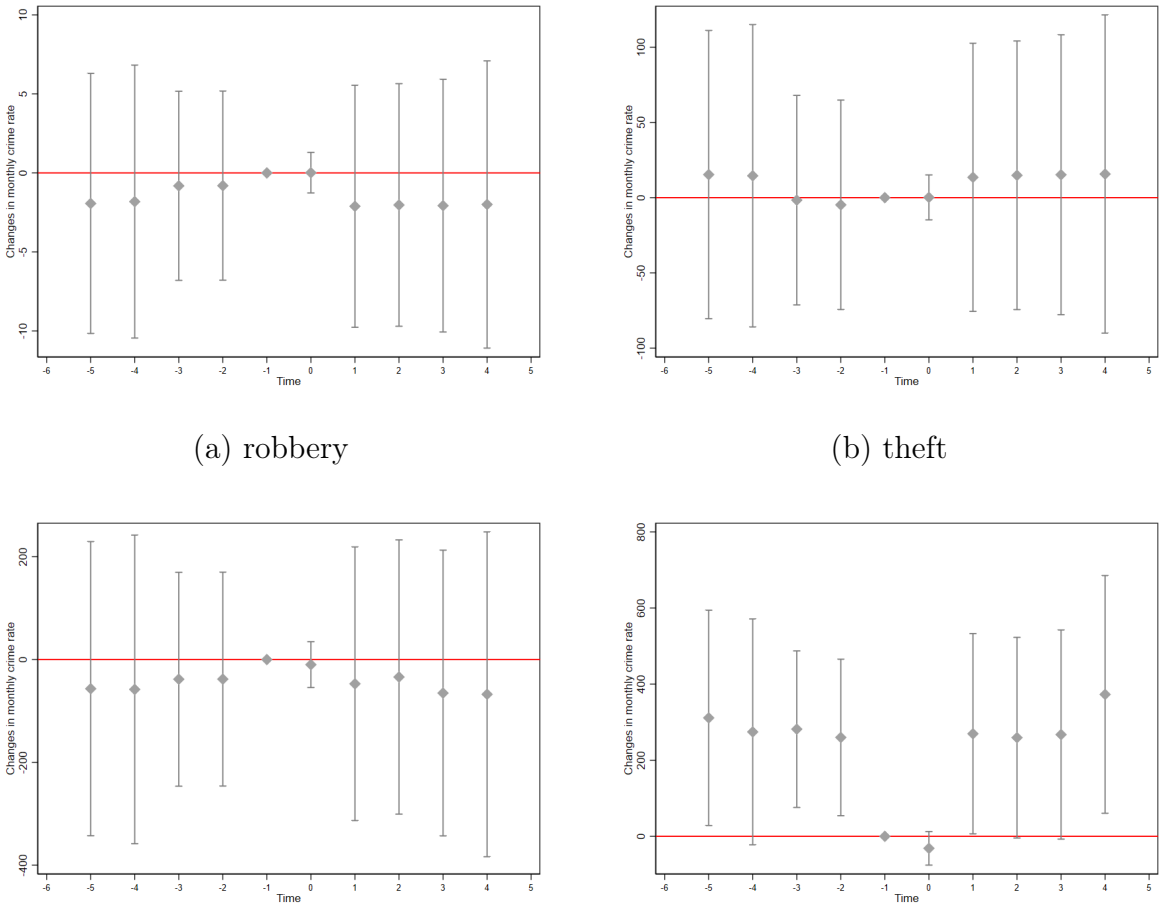
(b) theft

(c) burglary

(d) destruction

Figure A1: Event study — Stagger-increase states

Note: In this set of event studies, I define event month as the first month that changes are made to state-level SNAP disbursement schedule between 2000 and 2017. The result presented in all four panels generally validates the parallel trend assumption. On the other hand, no significant changes to crime incidence are observed during the post-event period.



(a) robbery

(b) theft

(c) burglary

(d) destruction

Figure A2: Event study — Stagger-decrease states

Note: In this set of event studies, I define event month as the first month that changes are made to state-level SNAP disbursement schedule between 2000 and 2017. The result presented in all four panels generally validates the parallel trend assumption. On the other hand, no significant changes to crime incidence are observed during the post-event period.

Table A1: SNAP policy variables and the policy stringency index

	Contribution to the Index	Value range
Panel A: Eligibility		
Broad-based categorical eligibility (BBCE)	+	0, 1
Exempts at least one but not all vehicles from SNAP asset test	+	0, 1
Exempts all vehicles from SNAP asset test	+	0, 1
All legal noncitizen adults has full eligibility	+	0, 1
Panel B: Transaction costs		
Proportion of working households with short recertification periods (1-3 months)	–	[0, 0.38]
Simplified reporting	+	0, 1
Online application availability	+	0, 1
Panel C: Stigma		
Mean proportion of State benefits issued via electronic benefits transfer (EBT)	+	[0, 1]
Fingerprinting required during application	–	0, 1
Panel D: Outreach		
Federally funded radio or TV advertisement	+	0, 1

Source: USDA, Economic Research Service, SNAP Policy Database.

Note: Policy weight introduced in Stacy et al. (2018) is not applied here. The policy stringency index in this study is computed each month during 2000-2016 by an unweighted sum of the value indicator for all the "positive" policies (1 or the actual proportion) subtracted by the value indicator of the two "negative" policies (1 or the actual proportion). I added a value of 2 to the calculated sum to ensure the index falls in the range of 0 to 10.

Table A2: Summary statistics — Mechanism analysis

	Mean	Std. Dev.	Obs.
Panel A: yearly county-level crime count by category			
Total	5621.22	18240.32	39,377
Robbery	167.71	1068.38	39,377
Theft	2664.65	8506.71	39,377
Burglary	837.65	2619.92	39,377
Panel B: food security scale and grocer establishments			
County-level food insecurity rate	9.69	7.43	4,340
County-level food insecurity index	4.02	1.52	4,189
Club store establishments	1.63	3.60	39,372
Supermarket establishments	2.84	25.32	39,372
Convenience store establishments	7.28	32.44	39,372

Source: (a) Uniform Crime Reporting (UCR) by FBI, 2001-2016; (b) Current Population Survey, Food Security Supplement (CPS-FSS) and County-level Business Pattern (CBP) by Census Bureau, 2001-2016.

Note: (1) Crime statistics for UCR and NIBRS are not directly comparable, because UCR has a much higher population coverage than the NIBRS program. Besides, the reporting unit of crime incidents and the data period are also different. Only county and city police agencies with a population coverage greater than 10,000 people enter the sample for analysis.
(2) The observations for county-level food insecurity rate and food insecurity index are significantly lower. This is caused by the fact that the county of residence is not identified for a considerable proportion of surveyed households in the CPS-FSS. The transition from the household-level food security scale to the county-level prevalence of food insecurity is complete for fewer than 300 counties each year during my study period.

Table A3: Key statistics of the NIBRS program (2000-2017)

	No. of states	No. of agencies	Population coverage (%)
2000	21	3572	16.61
2001	22	3781	17.85
2002	23	4034	18.65
2003	25	4514	20.38
2004	29	4804	21.68
2005	30	4970	23.12
2006	34	5136	23.79
2007	34	5271	24.45
2008	35	5548	25.31
2009	35	5903	26.30
2010	35	5954	27.04
2011	35	6069	27.73
2012	35	6330	28.51
2013	37	6468	28.75
2014	37	6672	29.04
2015	37	6804	29.82
2016	37	7059	31.34
2017	37	7098	32.01

Source: NIBRS manuals, 2000-2017.

Note: The count of participating states in the NIBRS program includes Washington D.C. However, after restricting the type of agencies to city and county police, all D.C. agencies are gone and 36 states remain in the sample for analysis.

B Effect Heterogeneity

Table B1: Staggering SNAP benefit disbursement and crime incidence (heterogeneity by policy stringency)

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Distribution days				
Number of distribution days	0.00211	0.04440	-0.06884	0.13994
	(0.0038)	(0.0737)	(0.0955)	(0.1828)
Number of distribution days × policy stringency index	-0.00045	0.00789	-0.00085	-0.00702
	(0.0004)	(0.0084)	(0.0082)	(0.0209)
Panel B: Staggering period				
Length of staggering period	0.00328*	0.06670	-0.13865*	-0.10069
	(0.0020)	(0.0758)	(0.0718)	(0.1673)
Length of staggering period period × policy stringency index	-0.00068***	-0.00354	0.00863	0.00611
	(0.0003)	(0.0070)	(0.0068)	(0.0182)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	314083	314083	314083	314083

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a NIBRS participating agency in a certain month divided by the population of 100,000. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table B2: Staggering SNAP benefit disbursement and crime incidence (heterogeneity by benefit generosity)

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Distribution days				
Number of distribution days	-0.00140	0.10185	-0.08142	0.07747
	(0.0011)	(0.0774)	(0.0509)	(0.1270)
Number of distribution days × Δ benefit per capita	-0.00011**	-0.00075	-0.00321	-0.00526
	(0.0000)	(0.0016)	(0.0020)	(0.0043)
Panel B: Staggering period				
Length of staggering period	-0.00201***	0.03813	-0.07311**	-0.05404
	(0.0008)	(0.0523)	(0.0352)	(0.0781)
Length of staggering period × Δ benefit per capita	-0.00005	-0.00008	-0.00187	-0.00316
	(0.0001)	(0.0018)	(0.0019)	(0.0033)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	320212	320212	320212	320212

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a NIBRS participating agency in a certain month divided by the population of 100,000. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population,a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table B3: Staggering SNAP benefit disbursement and crime incidence (heterogeneity by population density)

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Distribution days				
Number of distribution days	0.00006	0.11161	-0.09660	0.12340
	(0.0012)	(0.0801)	(0.0619)	(0.1591)
Number of distribution days × population density	-0.00237	0.01605	0.01937	-0.12604
	(0.0026)	(0.0432)	(0.0510)	(0.1865)
Panel B: Staggering period				
Length of staggering period	-0.0004	0.0497	-0.0986***	0.0289
	(0.0007)	(0.0469)	(0.0369)	(0.0788)
Length of staggering period × population density	-0.0027*	-0.0072	0.0294	-0.1357**
	(0.0014)	(0.0336)	(0.0247)	(0.0598)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	345237	345237	345237	345237

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a NIBRS participating agency in a certain month divided by the population of 100,000. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. Population density is defined as the population (in 1,000 people) per square mile. Population data come from the intercensal population estimates and the county-level area data come from the 2010 Census. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

C Testing for Robustness

Table C1: Timing of SNAP benefit disbursement and crime incidence at the state borders

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Staggered distribution (dummy)				
Staggered distribution across recipients	-0.0127	-1.6759	1.5838	-1.2734
	(0.0707)	(1.8835)	(1.7238)	(6.7582)
Panel B: Distribution days				
Number of distribution days	-0.0030	-0.0098	-0.0680	0.0718
	(0.0121)	(0.5229)	(0.4417)	(0.8775)
Panel C: Staggering period				
Length of staggering period	-0.0003	-0.0023	0.0297	-0.0858
	(0.0106)	(0.3140)	(0.2640)	(0.5701)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	129723	129723	129723	129723

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a NIBRS participating agency in a certain month divided by the population of 100,000. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table C2: Staggering SNAP benefit disbursement and crime incidence at the state borders

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Distribution days				
Between 2 and 7 days	-0.0612	-0.2458	-1.3976	-1.0215
	(0.0602)	(2.7983)	(2.1373)	(3.2955)
Between 8 and 14 days	-0.0484	-0.6904	-1.0483	0.4340
	(0.0542)	(1.5803)	(1.5697)	(1.9383)
15 days and above	-0.1059	-0.0005	-2.3051	0.9219
	(0.0836)	(2.4125)	(3.0512)	(3.7228)
Panel B: Staggering period				
Staggered within 7 days	0.1079**	-0.0608	-0.0115	4.1191
	(0.0439)	(1.6139)	(1.7446)	(2.8228)
Staggered across 8 to 14 days	-0.0279	-1.7789	1.7906	-2.1903
	(0.0533)	(1.4668)	(1.9338)	(3.9960)
Staggered across 15 or more days	-0.0286	-1.5508	1.8150	-2.7904
	(0.0877)	(3.2654)	(3.2021)	(5.2861)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	129723	129723	129723	129723

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by crime rate, which is computed as the total crime count reported by a NIBRS participating agency in a certain month divided by the population of 100,000. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table C3: Choice of calendar days in the SNAP disbursement and crime incidence

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Crime count per 100,000 population				
Disbursement starts from Day 1 of a month (1=yes)	0.0270	-0.0097	0.3846	1.8744
	(0.0179)	(0.6802)	(0.8899)	(1.6732)
Benefit issued on consecutive calendar days (1=yes)	0.0065	0.5484	0.2086	0.1651
	(0.0087)	(0.6040)	(0.7099)	(0.9183)
Panel B: Log crime count				
Disbursement starts from Day 1 of a month (1=yes)	0.0009	0.0013	0.0170	0.0625
	(0.0021)	(0.0092)	(0.0308)	(0.0462)
Benefit issued on consecutive calendar days (1=yes)	0.0004	0.0085	0.0238	0.0173
	(0.0016)	(0.0102)	(0.0217)	(0.0291)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	345237	345237	345237	345237

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table C4: Timing of SNAP disbursement and crime incidence (log monthly count)

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Staggered distribution (dummy)				
Staggered distribution across recipients	-0.0008	-0.0086	0.0045	-0.0304
	(0.0015)	(0.0223)	(0.0335)	(0.0367)
Panel B: Distribution days				
Number of distribution days	-0.0002	0.0013	-0.0023**	-0.0002
	(0.0001)	(0.0017)	(0.0011)	(0.0027)
Panel C: Staggering period				
Length of staggering period	-0.0002*	0.0006	-0.0035***	-0.0038*
	(0.0001)	(0.0010)	(0.0010)	(0.0020)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	345237	345237	345237	345237

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by the logarithm of the actual crime count reported by a NIBRS participating agency in a certain month. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).

Table C5: SNAP benefit disbursement staggering and crime incidence (log monthly count)

	(1)	(2)	(3)	(4)
	Robbery	Theft	Burglary	Destruction
Panel A: Distribution days				
Between 2 and 7 days	-0.0066***	-0.0048	-0.0418***	-0.0716
	(0.0010)	(0.0334)	(0.0114)	(0.0635)
Between 8 and 14 days	-0.0030***	-0.0036	-0.0192*	-0.0156
	(0.0008)	(0.0046)	(0.0111)	(0.0123)
15 days and above	-0.0047***	0.0156	-0.0597***	0.0410
	(0.0013)	(0.0238)	(0.0187)	(0.0423)
Panel B: Staggering period				
Staggered within 7 days	-0.0011	-0.0029	0.0181	0.0314
	(0.0019)	(0.0656)	(0.0324)	(0.0367)
Staggered across 8 to 14 days	-0.0009	-0.0100	-0.0042	-0.0566**
	(0.0021)	(0.0359)	(0.0317)	(0.0229)
Staggered across 15 or more days	-0.0030	-0.0014	-0.0460	-0.0879***
	(0.0025)	(0.0382)	(0.0337)	(0.0332)
county-level controls	Yes	Yes	Yes	Yes
state-level controls	Yes	Yes	Yes	Yes
agency FE	Yes	Yes	Yes	Yes
month-by-year FE	Yes	Yes	Yes	Yes
Observations	345237	345237	345237	345237

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the outcome variables, crime incidence is measured by the logarithm of the actual crime count reported by a NIBRS participating agency in a certain month. In order for a more accurate computation of crime rate and avoid the influence of a small population, only agencies with a population coverage greater than 10,000 people remain in my sample of analysis. County-level controls include the size of total population (in 100 thousands), unemployment rate, poverty rate, average weekly wage and the total number of grocer establishments (club stores, supermarkets and convenience stores). State-level controls include: per capita Gross State Product, real minimum wage, unemployment rate, poverty rate, SNAP and Medicaid recipients as a percentage of total state population, a binary indicator for Medicaid expansion (1=yes), and a binary indicator for whether the state governor is a Democrat (1=yes).