HOW DOES EXPANDED SNAP (FOOD STAMP) ELIGIBILITY AFFECT THE INCOME VOLATILITY OF VULNERABLE POPULATIONS?

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HOW DOES EXPANDED SNAP (FOOD STAMP) ELIGIBILITY AFFECT THE INCOME VOLATILITY OF VULNERABLE POPULATIONS?

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I examine how the SNAP program (formerly the Food Stamp Program) affects the income volatility of vulnerable populations. Monthly income fluctuates by about 20 percent on average from the annual mean for households below the poverty line and the concern is that these households face considerable consumption volatility as a result. The first two chapters study how state level expansions in SNAP eligibility between 1996 and 2011 have affected household income volatility using the Survey of Income and Program Participation (SIPP). I use a reduced form simulated instrument approach to isolate the impact of household eligibility gain on overall and non-SNAP income volatility (the latter captures the household behavioral response). My simulated instrument captures eligibility changes induced by state level changes to vehicle, asset and permanent resident eligibility rules. I further investigate household behavioral changes that are likely to be affected by the program, including hours worked and participation in other social safety net programs. I find that SNAP eligibility reduces total household income volatility of single mothers by a non-statistically significant 11 percent. The stabilizing nature of the SNAP benefit formula contributes to about a quarter of this reduction.

BIOGRAPHICAL SKETCH

Michiel Paris is an empirical micro-economist. Prior to Cornell, he completed a bachelors in Economics at the London School of Economics and Political Science and a masters degree in Economics at the University of Oxford. He has also worked at the International Food Policy Research Institute and at the World Bank.

This document is dedicated to Malu, Ria, Tom, and Bas.

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CHAPTER 1

INTRODUCTION, PROGRAM BACKGROUND, AND POLICY VARIATION

1.1 Introduction

Households in the US face a remarkable degree of income volatility within a given year and this is mostly hidden when examining annual income data. Hannagan and Morduch (2015) find that households experience income deviations of over 25 percent from the mean in 5 months of any given year on average. They find that income volatility remains high for households up to 300 percent of the poverty line but is particularly pronounced for households below the poverty line. A concern is that this income volatility is symptomatic of high consumption volatility, especially for poor households with low savings, and has negative welfare impacts. From a policy perspective, it important to know what the drivers are behind income volatility and how it is affected by the present US social safety net system.

This study examines the extent to which eligibility for the Supplemental Nutrition Assistance Program (SNAP), formerly known as the Food Stamp Program, affected the monthly income volatility of vulnerable groups that are more likely to be poor — single mothers, households without college education, and African American and Hispanic households — between 1996 and 2011. I look at the overall effect of eligibility on the volatility of total household income (including SNAP benefits). Benefits supplement income and benefits rise as household income falls, hence a negative income shock is mitigated by higher SNAP benefits for participating households. Moreover, non participating households may choose to apply when faced with an adverse economic shock. I further examine how the volatility of total non-SNAP household income is affected, which cap-

tures the household's overall behavioral response. Becoming eligible for SNAP is likely to impact other household decisions such as hours worked and participation in other social safety net programs, decisions which independently affect income volatility. I also look at the impact of state eligibility expansions on these other variables.

Of the programs in the US social safety net that target the poor, SNAP is arguably the most important. During the Great Recession, SNAP coverage increased from 9 percent to over 15 percent of the US population. In contrast, participation in Temporary Assistance for Needy Families (TANF), the other main assistance program (this program includes cash welfare), barely increased. SNAP distinguishes itself from other programs in the US social safety net by being (almost) universally available to households below the poverty line regardless of age, family structure, disability status or work history. Eligibility is determined by a household's income over the previous month only[1], and benefits can be received within two weeks of application. These features make the program an important means by which households can guard themselves against negative economic shocks. In fiscal year 2016, $70 billion worth of benefits were disbursed by the SNAP program, covering 44 million people (14 percent of the population). [2][3]

Broadly speaking, households are eligible for the SNAP program if their household income (after deductions) falls below the US federal poverty line and if household assets do not exceed $2000. A more detailed description of SNAP eligibility rules follows in the

[1] subject passing income and asset tests

[2] Some groups are ineligible for much of the sample period such as students, permanent residents and able bodied adults without dependents. For details see Section 2.

[3] The main alternative programs that I could study are the EITC (Earned Income Tax Credit) and TANF. The EITC provides tax credits annually to working families and primarily targets households further up in the income distribution. The TANF program is difficult to study because of a myriad of cash and non-cash sub programs. TANF cash receipt is also limited to five years over person's lifetime and this time limit is not observable in the data.

next section.

My identification strategy exploits plausibly exogenous state level policy variation in how vehicles count towards the asset test, how the overall asset test is applied, and whether non-citizen permanent residents are eligible. SNAP eligibility cannot be directly observed in the SIPP, except through participation, hence I first calculate household eligibility from detailed household level data. I then use a reduced form instrumental variable approach to estimate the impact of eligibility on income volatility, where I instrument for state level SNAP eligibility using a simulated instrument. The simulated instrument isolates the changes in eligibility brought about by these exogenous policy changes and addresses potential biases arising from reverse causality, unobserved contemporaneous economic and demographic shocks, as well as certain types of measurement error.

As my primary data source, I use the Survey of Income and Program Participation (SIPP): a nationally representative panel survey designed to track household participation in social programs. The SIPP collects detailed income and household information on a monthly basis and this allows me to study monthly income volatility over four month periods. I do not study consumption volatility directly because my identifying variation is at the state level and national consumption datasets do not lend themselves to my identification strategy. The Consumption Expenditures Survey only identifies regions of residence, and the Nielsen Scanner data lacks sufficient data on household characteristics to determine household eligibility.

This study makes two contributions to the literature. First, it uses plausibly exogenous variation in state policies to identify the degree to which SNAP eligibility affects income volatility. Second, it uses high frequency monthly data to measure income volatility for a particular household instead of relying on cross-sectional volatility of annual income

across different households.

I find that, for single mothers, a 10 percentage point increase in the state eligibility (approximately the increase in SNAP eligibility observed between the early 2000s and 2011) decreases the percentage monthly deviations by which income differs from the mean by approximately 2.1 percentage points (or an 11 percent decrease in average deviations). Roughly 1.6 percentage points of this reduction is attributed to behavioral changes and the rest to the direct effect — from receiving SNAP benefits. These results are, however, not significantly different from zero. The previous literature surveyed below finds a non-causal overall reduction of 12-18 percent. Additionally, I find that hours worked at a single mother's own business increases by 1.1 hour a week in response to a 10 percentage point increase in SNAP eligibility and this is significant at the 10 percent level. This increase could be indicative that becoming SNAP eligible increases a person's willingness to engage in higher risk income generating activities, although the effect appears to be localized during the post-2008 recession period.

I also find that the eligibility expansions had very little effect on the participation of the two other groups with historically high SNAP participation that I study — households with at most high school education and African American/Hispanic households.

My simulated instrument is a strong predictor of changes in state eligibility for all the studied groups but a fairly weak predictor of observed changes in SNAP participation, suggesting poor uptake amongst those that gain eligibility because of the policy changes. Participation is strongest amongst single mothers, although the relevant F statistic of the first stage that regresses household participation on the simulated instrument is 4.5, below the ballpark figure for a strong instrument of 10. This could explain the lack of significance of my income volatility results. The strength of the first stage could be understated,

however, since previous papers have found that SNAP participation is underreported in the SIPP by 10-20 percent (Mabli et al. (2014), Ratcliffe, McKernan, Wheaton, et al. (2016)). The policy variation is fairly weak, but it is the main variation that is available. A general drawback of the SNAP program is that it is administered at the Federal level and that there are relatively few sources of policy variation to exploit. The simulated instrument allows me to aggregate the variation from the sources of state level eligibility variation that are available.

There are several descriptive papers that document how income volatility is affected by the US social safety net. Hardy (2017) uses annual Current Population Survey (CPS) data to compare cross-sectional household income instability (defined as the standard deviation of the percentage change in annual income) with and without SNAP, TANF and EITC benefits. He finds a 18 percent reduction in this measure across all US families since the early 1980's. Gundersen and Ziliak (2003) perform a similar exercise but focus exclusively on the Food Stamp Program using annual Panel Study of Income Dynamics (PSID) data. After controlling for household characteristics and year fixed effects, they find that Food Stamp participation reduces volatility in disposable income by 12 percent. They additionally decompose the volatility of food consumption into that arising from non Food Stamp income and Food Stamp benefit volatility, and find that food consumption volatility is reduced by 14 percent.

Cross-sectional household volatility hides important within-year income changes. Morduch and Siwicki (2017) use the 2012/13 US Financial Diaries data set to look at intra-household income volatility using the coefficient of variation measure (the standard deviation divided by the mean). Specifically to SNAP, they find that conditional on receiving SNAP benefits, the coefficient of variation of household income falls from 0.42 to 0.37 when SNAP benefits are included. Bania and Leete (2009) compare the intra-household

coefficients of variation of income in 1992/93 and 2001/03 using the SIPP. They find that for households with income below the poverty line, the median coefficient of variation of income of Food Stamp recipients in 2001/03 is 0.34 compared to 0.44 for households that do not participate in the program.

Another related paper is Blundell and Pistaferri (2003) who use a structural approach to examine the extent to which the Food Stamp Program reduces the impact of permanent income shocks on food consumption. They find that participation reduces the response of food consumption to permanent shocks by a third.

The state policy variation employed in this study has also been used to study various other outcome variables. Immigrant eligibility had been used to study the impact of SNAP on food insecurity by Borjas (2004), Yen et al. (2008), and Ratcliffe, McKernan, and Zhang (2011). Schmeiser (2012) has used state level variation in vehicle rules to study the effect of SNAP on child obesity. Schmidt, Shore-Sheppard, and Watson (2013) use a simulated instrument to study the effect of SNAP, amongst other programs, on food insecurity but this instrument does not use any of the exogenous state level variation used in this study.

The importance of using an instrumental variable approach because of the potential of reverse causality is highlighted by Moffitt and Ribar (2008) who examine whether periods of high income volatility are followed by increased months of Food Stamp participation. Using a longitudinal fixed effect approach, they find that higher income variability (both short and long term) is associated with reduced SNAP participation.

Hoynes and Schanzenbach (2012) study the impact of food stamps on the labor supply. Using county level variation from the initial roll out of the food stamp program in the

1960's and 70's, they find no significant effect in hours worked for their general sample but they do find a significant reduction in the employment rate of single mothers with a treatment-on-the-treated estimate of 24 to 27 percentage points,

Ratcliffe, McKernan, Wheaton, et al. (2016) examine the effect of SNAP state asset limits on asset holdings. Using SIPP data from 1997 to 2011 and focusing on households below 200 percent of the poverty line, they find that living in a state without an asset limit is associated with an 8 percent increase in the probability of having over $500 in a bank account and find no effect for bank accounts over $2000.

The study is organized as follows: Section 1.2 outlines SNAP eligibility and benefit rules; Section 1.3 describes the policy variation exploited; Section 2.1-2.7 describes the data; Section 3.1 details the methods used; Section 3.2 presents the results and robustness checks; and Section 3.3 concludes.

1.2 Benefit formula and eligibility rules

This section outlines SNAP eligibility and benefit rules in some detail. I encode these rules to calculate the eligibility of households in my data set and the eligibility coding is also key to creating my simulated instrument. Broadly speaking, eligibility rules are set at the Federal level by the US Department of Agriculture (USDA). States have some power to relax eligibility rules by applying for waivers to these rules. The primary state level variation that I exploit alters the asset test, the treatment of vehicles thereunder, and the eligibility of permanent residents.

Eligibility to the SNAP program has been traditionally determined using three eligibility tests: i) the gross income test, ii) the net income test, and iii) the asset test. A household has to pass all three tests in order to qualify for SNAP benefits. Recipients of TANF and Supplemental Security Income (SSI) programs qualify automatically (although these programs have comparable eligibility tests of their own). These recipients are actively encouraged to apply for SNAP benefits.

The gross income test depends on a household's gross cash, pre-tax income over the previous month (which excludes in-kind transfers like housing assistance and tax credits like the EITC). This income must fall below 130 percent of the federal poverty level for the household to qualify. To pass the net income test, the household is allowed deductions for child support, excess shelter expenses (which includes rent and utility bills), excess medical costs for elderly and disabled persons, costs of child care that are necessarily to keep a household member employed, as well as a standard deduction (8.3 percent of poverty line in most years) and a 20 percent deduction of earned income. After applying these deductions, the resultant net income must not exceed 100 percent of the federal poverty level.

To pass the asset test, a household's countable assets may not exceed $2000 (during the sample period). Only liquid assets are counted and these include checking accounts, interest earning accounts, bonds, stocks and mutual funds. Home value, lot value and most retirement plans are excluded. Vehicles above a certain value also count towards the asset test. Specifically, for any vehicle with net value (Kelly Blue Book value minus loans) over $1500, the gross value above $4650 counts towards the asset test.

Once a household passes all three tests, household benefits are determined by the follow-

ing formula:

$$Benefits_t = Max\ Benefit_t - 0.3\ (Net\ Income_t), \tag{1.1}$$

where $Max\ Benefit_t$ is the largest benefit that a household can receive and is set at the cost of the USDA's Thrifty Food Plan. For most household sizes, the cost of the Thrifty Food Plan is approximately 30 percent of the federal poverty line level, hence benefits are approximately zero when net income reaches 100 percent of the federal poverty line. The maximum benefit has in practice been below 30 percent of the federal poverty line for households with one or two eligible members (and marginally so in some years for households with 3 eligible members). Therefore it is in principal possible for a household just below the federal poverty line to be eligible for SNAP yet receive zero dollars in SNAP benefits. The USDA, however, sets a minimum benefit for households of size one or two of $10 before June 2008 and of 8 percent of the maximum benefit thereafter.

Households with a person aged over 60 or with a disabled household member face less stringent eligibility requirements. Their countable assets may not exceed $3000 and in determining income eligibility, an elderly individual may qualify as a separate household. These households are also exempt from the gross income test, although they still have to pass the net income test.

A SNAP household is defined as a group of persons that purchases and prepares meals together. Certain types of household members are ineligible and are excluded from the SNAP household that is used to determine the amount of SNAP benefits disbursed. All migrants who are not permanent residents are ineligible, as well as some permanent residents for part of the sample period. Able-bodied adults without dependents (ABAWDs) who work less than 80 hours per month are only eligible for 3 months of SNAP benefits every 36 months. Students who are enrolled at least half-time in an institution of higher education and work less than 20 hours a week are also ineligible for SNAP. However, the

income and assets of ineligible members may still affect eligibility of other potentially eligible members in the household. The income of ineligible ABAWDs and ineligible aliens counts towards household income on a pro-rated basis. The assets of these two groups are also included within household assets. The income and assets of ineligible students are not counted. States can apply to waive the ABAWD eligibility restriction when state unemployment is high. In addition, since 1997, states are allowed to exempt 15 percent of their ABAWD applicants from the work requirement. In 2009 the ABAWD eligibility rule was suspended until beyond 2011.

The SNAP administration only asks about the migration status of those members of the household that apply to the program. In theory, this should allow families with citizen children but with parents that lack a legal residency status to apply. However, in practice the USDA reports low uptake among such households.

Once a household qualifies for SNAP, it is required to re-certify at set intervals (which can be up 3, 6 or over 12 months depending on the state). Any changes to income or household composition that would affect SNAP benefits have to be reported as they happen.

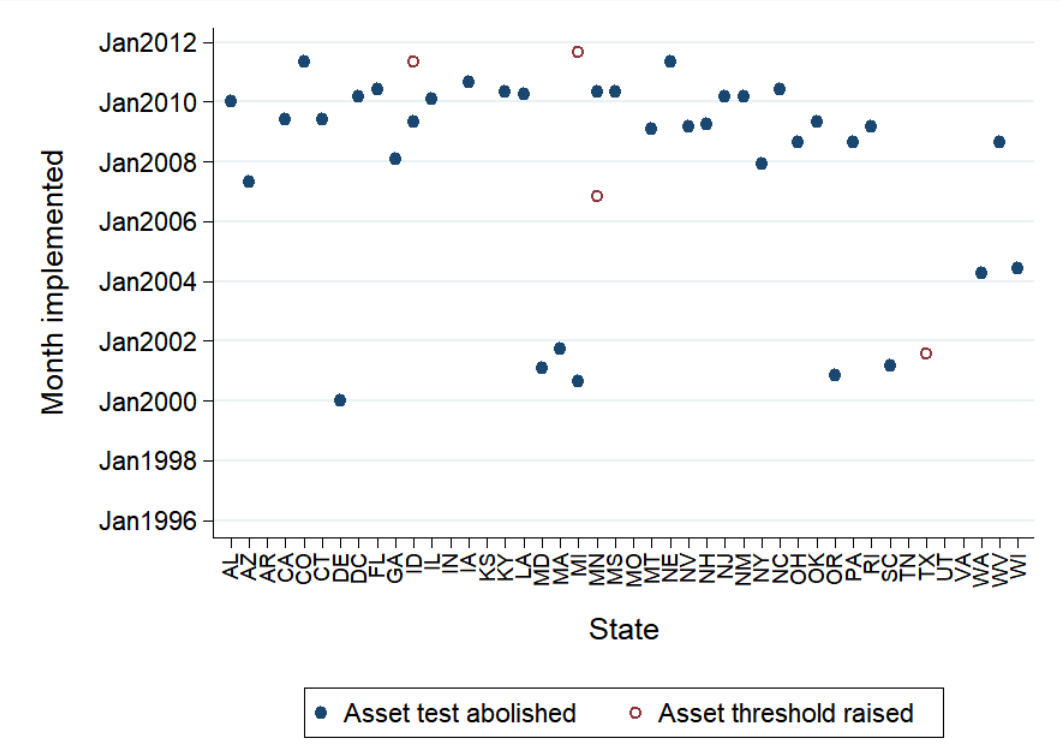
1.3 Policy variation

My identification strategy relies on three sources of state level policy variation: 1) increases in, or elimination of, the asset limit, 2) easing of vehicle policy rules, and 3) easing of eligibility rules for permanent residents. It is important to note that SNAP benefits are paid for by the federal government. States are responsible for half of the administrative costs of administering the program in each respective state. Hence, from a political

economy perspective, expanding SNAP eligibility is relatively inexpensive from a state's perspective. The Food Stamp program was renamed the Supplemental Nutrition Assistance Program in 2008 but for ease of exposition I will refer to the program as the SNAP program for the pre-2008 period as well.

1.3.1 Asset limit

Figure 1.1: Asset policy rules changes by state



Source: calculated from USDA ERS SNAP policy database. Increased asset thresholds for Idaho, Michigan, Minnesota, and Texas were $5000, $5000, $7000, and $5000 dollars respectively. Kansas, Tennessee, Virginia, Indiana, Missouri, Arkansas and Utah did not pass any asset policy rule changes (this does not include vehicle rule changes).

States were given control of asset test limits through an expansion of categorical eligibility rules — automatic eligibility because of participation in another program. Before the

Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (PRWORA), categorical eligibility for SNAP was restricted to recipients of Aid to Families with Dependent Children (AFDC) cash assistance (which became part of the TANF program as a result of PRWORA), the SSI program and of some state general assistance programs, effectively exempting these groups from both the federal level SNAP income and asset tests[4].

The transformation of AFDC into TANF in 1996 was followed by a marked decline in the number of people enrolled in cash welfare. There was a general trend where households that left the TANF program would also leave the SNAP program despite still being SNAP eligible through the income and asset tests. Possibly households were unaware that they could gain access to the SNAP program through regular channels instead of through categorical eligibility, although applications the SNAP program do involve a time-commitment and hence are not costless. Concerned by a drop in SNAP participation from 74 percent in 1994 to 54 percent in 2001, the USDA issued a series of guidelines on the implementation of categorical eligibility in 1999 and 2000 (Ganong and Liebman, 2013). These guidelines have effectively created three types of categorical eligibility policies for states to choose from. The first, Traditional Pure Cash Public Assistance, as before, confers eligibility to recipients of SSI, cash TANF benefit and, in some states, General Assistance. The second policy, Narrow Categorical Eligibility, extends categorical eligibility to some narrowly targeted TANF/MOE-funded cash and non-cash services. These include child care, transportation, work support and other short term assistance. In practice these services are only provided to a small number of people (Mathematica 2013). The third policy, Broad-Based Categorical Eligibility (BBCE), allows states to confer SNAP eligibility to recipients of simple TANF/MOE-funded non-cash services[5]. This third option was used in

[4]It should be noted that these exemptions did not guarantee the receipt of SNAP benefits since these could still turn out to be zero if household income was too high.

[5]The TANF maintenance of effort (MOE) requirement is a requirement that a state must spend at least

some form by 41 states by the end of the sample period in 2011. The TANF/MOE-funded non-cash services that conferred eligibility could be as simple as receiving informational brochures about TANF programs. States could set their own eligibility criteria for these services and in practice have used BBCE to eliminate the net income test, raise the limit of the gross income test to between 130 to 200 percent of the federal poverty level, eliminate the asset test or raise the asset test limit. Elimination of the asset test using BBCE has gradually expanded across states as can be seen in Figure 1.1. By mid 2008, 13 states had altered the asset test using BBCE. Many states adopted BBCE during the Great Recession period. I discuss the implications of this fact on my identification strategy in the methods section.

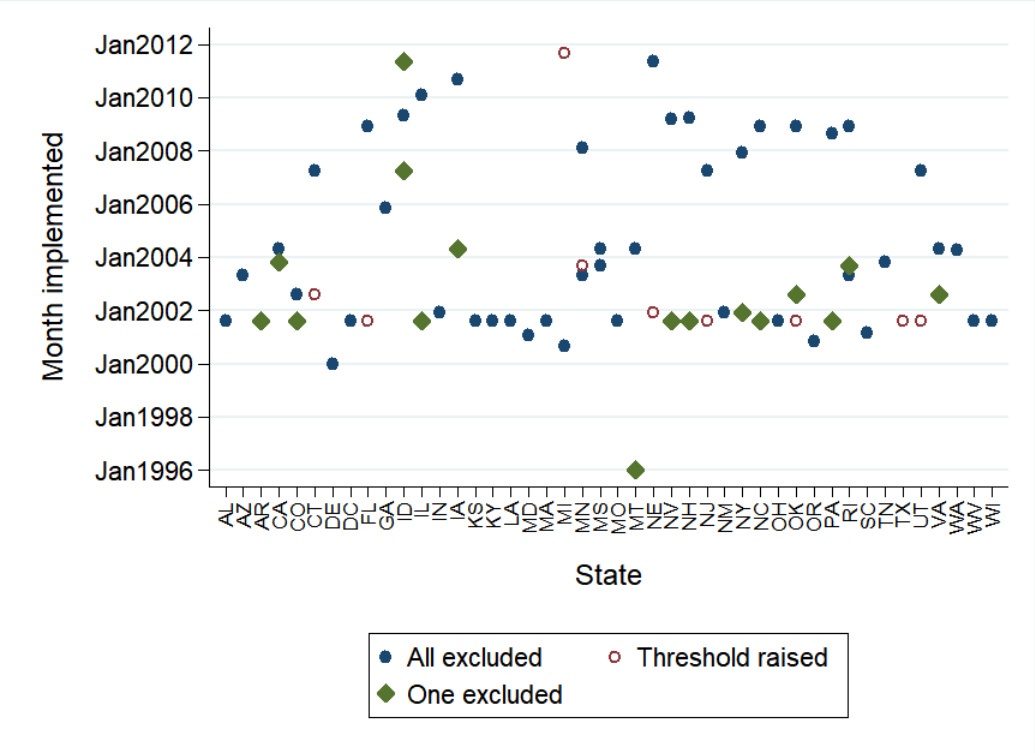
A policy document from the Center on Budget and Policy Priorities analyzing the asset changes in 2002 expected that the removal of asset limits would make the application process less daunting and cumbersome for households but noted that relatively few households would gain eligibility since most poor households have relatively low levels of assets (Dean et al., 2002).

Raising the gross income limit through BBCE has been found to have only a small effect on eligibility. An analysis of SNAP Quality Control data from FY2011 by Laird and Trippe (2014) found that reverting from BBCE back to the federal gross income test of 130 percent of the poverty level would make 3.1 percent of SNAP households ineligible in the 43 States that had implemented BBCE. In my analysis, I do adjust the gross income limits in accordance with state BBCE adoption but this is a relatively unimportant source of policy variation.

a specified amount of state funds for benefits and services for members of needy families each year.

1.3.2 Vehicle asset rules

Figure 1.2: Vehicle policy rules by state

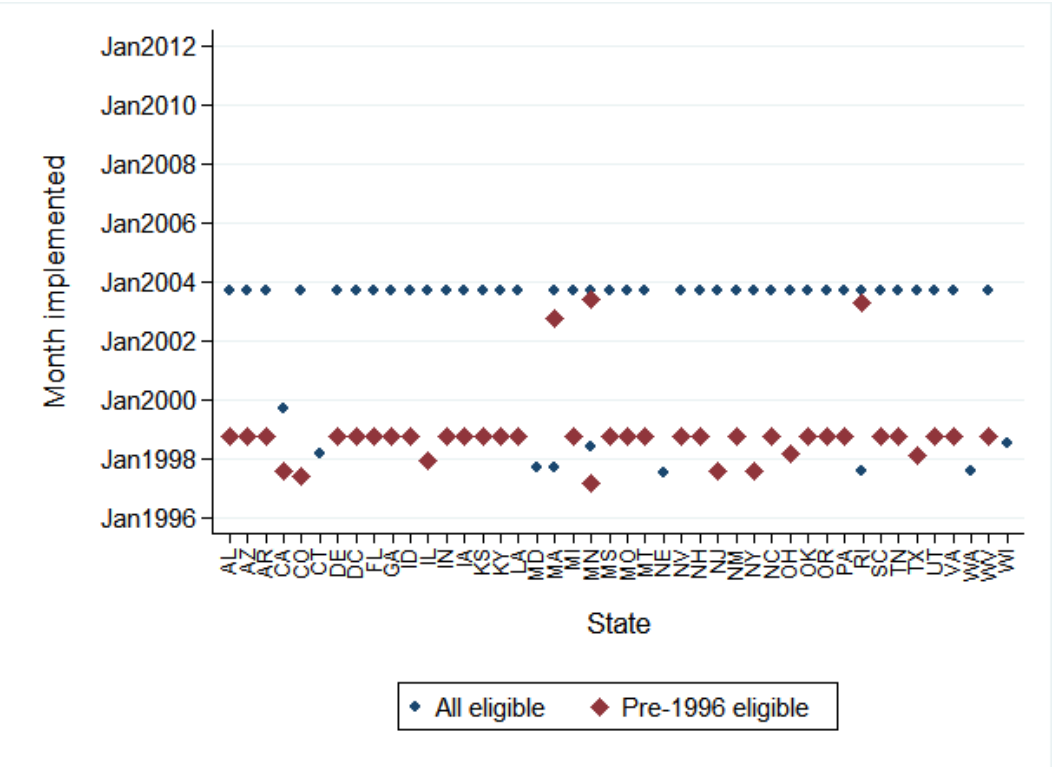


Source: calculated from USDA ERS SNAP policy database.

In 2000, the SNAP vehicle rules were changed to allow states to substitute SNAP vehicle rules for their TANF vehicle rules, where doing so would expand eligibility. State uptake of this option is summarized in Figure 1.2. In practice states have used this option to either increase the vehicle value that is exempt from the asset test, completely exempt the value of some vehicles, or exempt the value of all vehicles in the household. Almost all states adopted some alternative vehicle policy rules well before the 2009 economic crisis. Since excess vehicle value falls under the asset test, the adoption of BBCE by states also shows up in this figure as all vehicles being excluded from the asset test.

1.3.3 Permanent residents

Figure 1.3: Child migrant policy changes by state

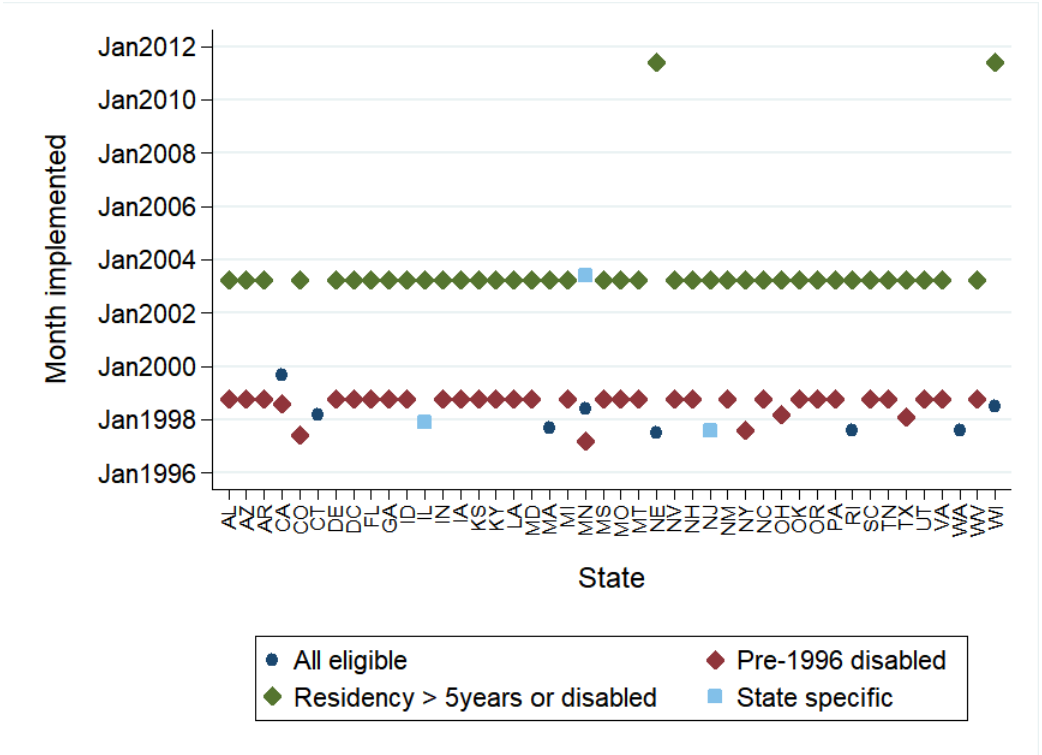


Source: calculated from USDA ERS SNAP policy database.

Before PRWORA, all permanent residents could receive SNAP if they passed the other eligibility tests. The passing of PRWORA removed eligibility of any permanent resident adult household member who had worked for less than 40 quarters in the United States. The eligibility of children was based upon the work history of their parents. Eligibility rules for refugees, battered spouses and immigrants from certain specific origins were more generous, although I cannot observe these groups in my data. Subsequently, two federal laws were passed that restored eligibility for some permanent residents.

In June of 1998, the Agriculture Research, Extension, and Education Reform Act was passed, which restored federal eligibility to those permanent residents who had been

Figure 1.4: Adult migrant policy changes by state

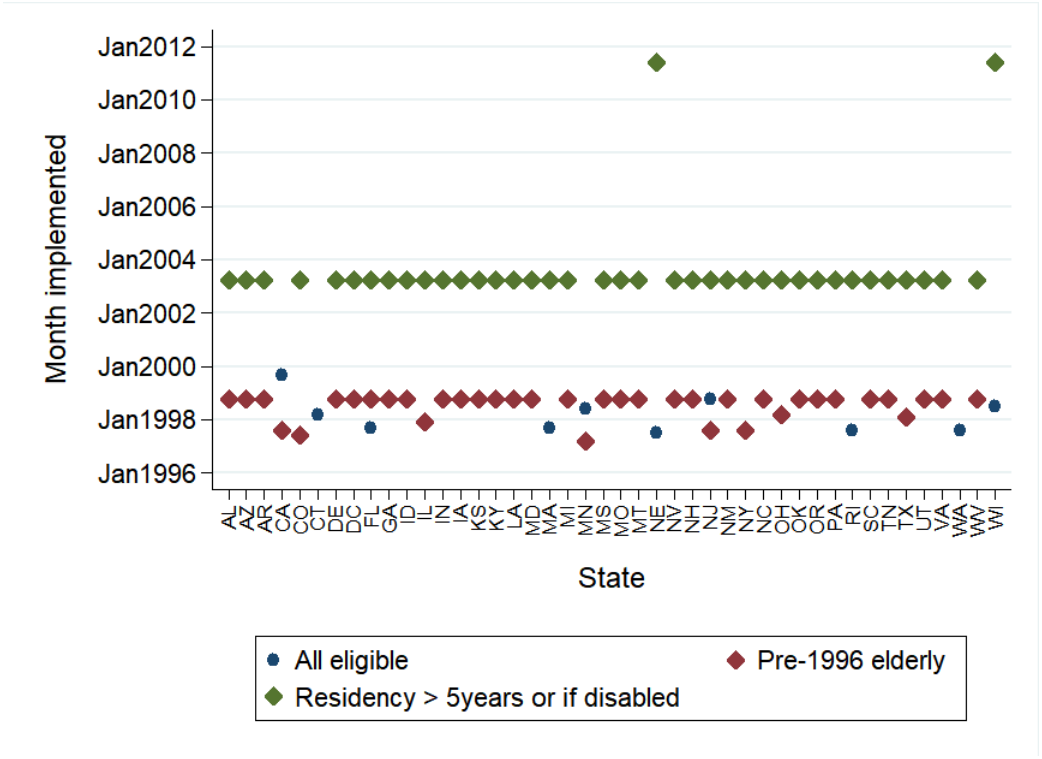


Source: calculated from USDA ERS SNAP policy database. Illinois and New Jersey extended eligibility to adult parents. Minnesota gives full coverage to adults over 50.

under 18, above 65 or disabled at the passing of PRWORA and had been present in the US at that time. In May of 2002, the Farm Security and Rural Investment Act extended eligibility to all permanent residents who were children, disabled or had lived continuously in the US for 5 years. This law came into effect in October 2002 for disabled adults, April 2003 for adults qualified under the 5 year rule, and in January 2004 for children.

State level eligibility of permanent residents is shown in Figure 1.3, 1.4, and 1.5. The effect of both federal acts are visible in 1998 and 2002/4. After the passage of PRWORA, some states funded their own replacement food assistance programs for the permanent residents that had become ineligible. Many of these programs ended after the passage of the 1998 and 2002 Federal Acts. Some states provided support to permanent residents

Figure 1.5: Elderly migrant policy changes by state



Source: calculated from USDA ERS SNAP policy database.

that had been resident pre-PRWORA, much like the changes implemented in the 1998 Act. Others gave full eligibility to certain groups. The details of these programs are documented in Zimmermann and Tumlin (1999). The continual use of state programs after 2001 can be followed in the annual state option documentation of the USDA.

CHAPTER 2

DATA

2.1 Data sources

This study combines data from the SIPP, data on state characteristics from the University of Kentucky Center for Poverty Research national welfare database, and data on state SNAP policy changes from the USDA Economic Research Service SNAP Policy Database.

The SIPP is a nationally representative household survey designed to provide panel data over a period of 3-4 years. Every 3-4 years a new sample of households is interviewed at 4 month intervals about their income, demographics and program participation over the previous months, providing monthly data. These rich monthly data are the primary attraction of this dataset. To match the availability of state policy data, the 1996, 2001, 2004 and 2008 panels are combined to form a data set that covers the period from 1996 to 2011. Since some of these panels were not collected back to back, there are two gaps in this data set from March 2000 to February 2001 and from January 2008 to September 2008. Additionally, I drop the first three and last three months of observations of each panel because of the interview structure of the SIPP. Data are collected every 4 months from each household and each interview is called a wave. The SIPP splits up each wave into 4 rotation groups that are interviewed in consecutive months. This means that in practice the first and last month in each panel only contains a quarter of interviewed households. The division of waves into rotation groups does not appear to be random, so I drop months that don't contain all 4 rotation groups. At the start of each panel between 40,000 and 52,000 households are interviewed.

Since the SIPP follows households over time, inevitably some households are lost to attrition. All the analyses in this study use monthly household probability weights provided by the SIPP, which adjust for household non-response. There is additionally a substantial drop in the number of households interviewed in 2006 and 2007, where sample size approximately halved, because of budgetary issues experienced by the Census at the time.

A limitation of the SIPP data is that the 1996 and 2001 panels (and prior panels) are not designed to be representative at the state level, whereas the 2004 and 2008 panels are (SIPP User Guide Chapter 10). I include state-panel fixed effects in all regressions to account for level differences in the explanatory variables that may be introduced by the lack of representativeness of the earlier panels. This is not the first study using state level variation as a source of identifying variation from the pre-2004 panels. Examples of other papers include Card and Shore-Sheppard (2004) and Yang (2017).

Another limitation of SIPP data is seam bias. It is well documented that monthly variables for a household tend to be more similar within the four months covered by an interview (or wave) than to adjacent months that were covered by separate interviews. The variation introduced by the seams should be uncorrelated with the treatment and so is unlikely to bias any estimates. I also ensure that the household volatility measures that I use in the analysis contain the same number of seams on average.

The USDA policy data set contains state level policy information at monthly intervals and covers vehicle policy, broad based categorical eligibility and migration policy. These data cover the period from 1996 to 2011, with the exception of some vehicle policy variables that are missing for most of 2011. I have manually updated these missing values using USDA reports on policy options and technical documentation of the SNAP Quality Control data. This data set also contains information covering state policies on factors that

affect participation costs such as SNAP re-certification lengths, availability of electronic applications, and whether the state maintains call centers for SNAP.

2.2 Sample construction

I focus on three groups that have historically made up a substantial proportion of SNAP recipients. These groups are households with a high school education or less, single mothers with children, and African American and Hispanic households. Low education households are defined as households where all members have up to, and including, a high school diploma. African American or Hispanic households are defined as households where any member identifies themselves as African American or Hispanic. Single mother households are those that are classified as female headed family households by the SIPP. The characteristics of the groups examined in the final sample are presented in Table 2.1.

In comparison to all SIPP households, all three groups have lower earned and total income, less assets and are less likely to own a house. As result they are significantly more likely to be SNAP eligible: more than 30 percent for each group compared to 17 percent for the entire weighted SIPP sample.

Of the three vulnerable groups studied, the high school educated or less group is on average the oldest, has the lowest income and works the least number of hours, but is the most likely to own a house and has more liquid assets (consistent with an older age profile). It is closest to the national population in terms of racial composition and citizenship, with 19 percent of this group being non-white (in the aggregate sample it was 17 percent).

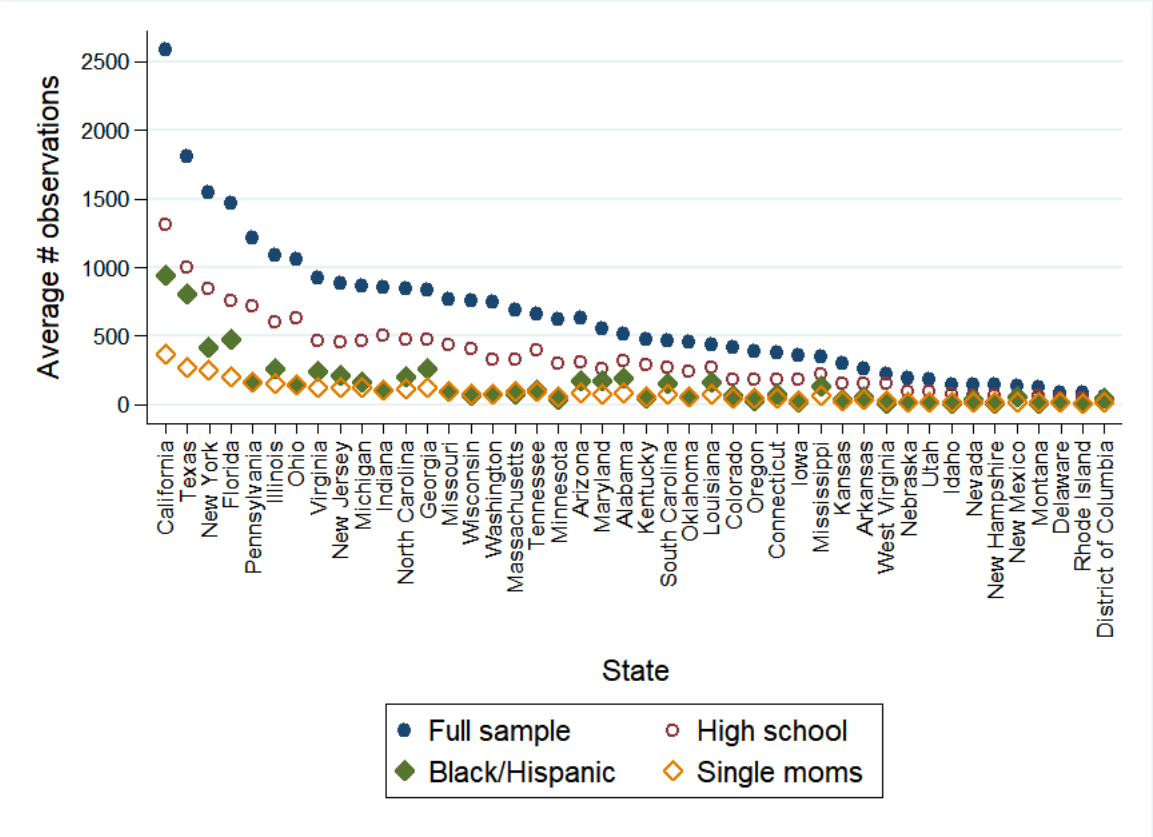
The African American and Hispanic group has the highest income, works the most and is most likely to live in urban areas, although it has the lowest liquid assets. Single mother households on average are the least likely to own a house (49 percent versus 69 percent overall), have the largest household size (3.06 persons versus 2.54 persons overall), and are the youngest (average age of the reference person averaged 45.2 versus 50.2 overall). Single mothers are the most likely to be eligible for food stamps at 39 percent and report receiving $73 in SNAP benefits on average per month compared to $18 among the overall population.

The definition of a SNAP household does not perfectly align with the definition of a household or a family in the SIPP. SNAP benefits are allocated to groups that purchase and prepare meals together. In the SIPP individuals are organized either into households — a group of persons from a sample unit that live at the same address — or further divided into families — people related by birth marriage or adoption that reside together. The main analysis uses the SIPP household as the unit of measure instead of the SIPP family. Doing the same analysis using the SIPP family definition gives qualitatively similar results.

The sample is trimmed using the following procedure. Households that are classified as living in group quarters are dropped since these are unlikely to be applying for SNAP as a group. I also drop data from Maine, Vermont, North Dakota, South Dakota, and Wyoming because in some panels identifiers for these states are merged for confidentiality reasons. Alaska and Hawaii are also dropped because these states have separate poverty levels and have relatively small SIPP sample sizes.

For the main regressions presented in this study, relevant data are first aggregated up to the state level and the regressions are then estimated using aggregated state weights.

Figure 2.1: Average number of observations by state



Notes: Alaska, Hawaii, Maine, North Dakota, South Dakota, Vermont, and Wyoming are excluded from the graph.

Especially for the single mother, and African American and Hispanic sub samples, cell sizes can become small. Figure 2.1 shows average monthly observations per state in all sub samples. In my robustness checks, I estimate regressions for each group using only states with more than 50 observations on average.

2.3 Calculating eligibility

Household SNAP eligibility is not directly observed in the SIPP and needs to be constructed from household level data. The SNAP eligibility determination plays a crucial role in the simulated instrument construction, since this is a measure of the state level eligibility of an artificial state population that is nationally representative. SNAP participation is indirectly observed through household reporting of positive SNAP benefits received in a particular month. However, other authors have found under-reporting of both SNAP participation and benefits of between 10 and 20 percent in the SIPP (Mabli et al. (2014), Ratcliffe, McKernan, Wheaton, et al. (2016)). The SIPP contains most of the information required to calculate SNAP eligibility of each household. In some cases necessary data are missing and I have made imputations where possible as discussed in the following paragraphs.

The first hurdle is to identify which household members are ineligible for SNAP either because they are students, able bodied adults without dependents (ABAWDs), or disqualified non-citizens. I adjust household incomes and assets appropriately according to the rules pertaining to each group. I take care to avoid double counting of individuals who are ineligible across multiple dimensions.

Students are identified as those that report being enrolled either half time or full time in an institution of higher education and also report working less than 20 hours for an employer. Any income and assets of this group are excluded from the household.

Before 2009, I exclude any ABAWDs from SNAP eligibility despite the fact that ABAWDs were technically eligible for 3 months every 3 years because I do not observe individual

SNAP participation histories. This will understate eligibility to a degree. The eligibility time limit was suspended beyond 2011 by the 2009 American Recovery and Reinvestment Act. The income of ABAWDs is counted on a pro-rated basis. For example, for a household of 3 containing one ineligible member, that person's income is counted on a pro-rated basis by including two-thirds of this income as part of eligible household income (the presumption is that this income is equally shared among household members). An ABAWDs assets are fully counted towards household assets.

The eligibility of permanent residents varies over the sample period and is described in detail in the policy variation section. The SIPP contains information on citizen status, permanent residency, information on year of entry into the US, and the year of permanent residency in the US. This information is collected once per panel during the second wave of interviews, although only individuals above 15 years of age are interviewed.

The migration status of children is important, however, since households with ineligible non-citizen adults may yet be part eligible through the citizenship of their children. I impute the citizenship of under 15 year olds using the following procedure. Children are assigned US citizenship if they have at least one parent who is a US citizen. In addition, children are also assigned US citizenship if their mother entered the US before their date of birth since children born on US soil can claim US citizenship. The remaining non-citizen children are assigned permanent residence if any of their parents is a permanent resident. This procedure is only performed for children with parents, which comprise 96.6 percent of my sample. The 2004 and 2008 core surveys additionally ask all respondents, including children under 15, about their citizen status in each interview, which allows me to test the quality of this imputation in these panels. Less than 1 percent of children who are citizens are incorrectly labeled as non citizens (13,578 observations out of 1.4 million child citizen observations). However, 24 percent of non-citizen children are incorrectly

labeled citizens (7,399 observations out of 30,696 child non-citizen observations). Part of this second error is accounted for by children gaining citizenship after the second wave of interviews — looking only at the month in which the migration survey was conducted, 21 percent of non-citizen children are incorrectly labeled citizens (160 observations out of 775 child non-citizen observations). I use the constructed citizenship variables in all panels to keep the measure consistent over time.

The SIPP topical migration modules provide a detailed account of an individuals migration history. Since the SNAP eligibility of permanent residents often depends on the length of time that a person has been a permanent resident, a measure of this variable is required. The SIPP asks respondents in which year they moved to the US and their residency status at the time of entry. In addition, respondents who were not permanent residents when they arrived in the US are asked in which year they changed their status to permanent resident. In many cases, both the arrival year and change of status year variables are given as a range of years (for example 1980-1985), most likely for confidentiality reasons. The ranges mostly cover years far removed from the survey date. Whenever an arrival date or change of status date falls within a range, I have set the variable at the midpoint of the range. The eligibility rules that are time dependent either grant eligibility to permanent residents after a 5-year period, after 10 years of work history, or grant eligibility to those who have been permanent residents since before 1996. In most cases where this approximation could make a difference, the error introduced is at most of 1 year. I proxy for a permanent resident's years worked in the US with years of presence in the US.

Permanent residents are determined as those individuals that at the time at which the migration topical module interviews were conducted 1) did not have US citizenship, and 2) who report to have entered the US as a permanent resident or to have changed their

status to permanent resident. No further migration data are observable after the second wave, so any subsequent change of status in later waves (for example becoming a US citizen or losing permanent residency status) is unobserved. This is likely to introduce the following errors. First, some permanent residents will have become citizens at some later point in the survey. Second, some non-permanent residents will have gained permanent residency. Third, some permanent residents will have lost permanent residency, though since this is likely to be accompanied by a loss of permission to stay in the US, this group is likely to drop out of the survey.

Similarly to ABAWDs, I count the income of ineligible permanent residents towards considered household income on a pro-rated basis. SNAP regulations stipulate that states have discretion to either count ineligible household income on a pro-rated basis or fully exclude that person's income (as is done with students). I do not observe which of these policies states implement in practice so I have chosen to use the more conservative measure (that will tend to understate eligibility to a degree).

For both income tests, I use total household income excluding in-kind transfers in accordance with SNAP eligibility rules (SNAP benefits are categorized as an in-kind transfer, as are housing vouchers). The SIPP definition of total income is similar to that used to calculate SNAP eligibility. Rebates (including EITC credits), refunds, loans, and capital gain or loss amounts from the sale of assets, and inter-household transfers of cash such as allowances are not included in SIPP income variables. Benefits received from other safety net programs do count as part of total income and these are included in the household income measures.

For the net income test, I use information on possible deductions that could be claimed by households. Households can claim deductions for child support in some states, for

medical expenses in excess of $35 a month if elderly or disabled, for costs of child care that are necessary to maintain the employment of a household member, and for shelter costs that are in excess of 50 percent of their income after all other deductions. No information at all is collected on child care costs or on child support payments. While excluding child care and child support deductions in the net income calculations is not ideal, this would understate true eligibility and benefits received. Households are, at an annual frequency only, asked about the size of rent or mortgage payment, and about their medical costs in excess of health insurance premiums. This information was not collected in 2006 and 2007 because of budget shortfalls at the Census Bureau. Some households also fail to respond to these annual interviews in some years. Where possible, I linearly impute from adjacent observations for any missing years of information.

The SIPP tracks household rent or the size of mortgage payments annually in an aggregated household level variable. To assign this variable to individual families within the household, I divide the amount proportionally by family size. Since individual contribution to rent or mortgage payment is not tracked, a more precise family level variable cannot be constructed.

Excess medical costs for the elderly and disabled in excess of $35 can be deducted from gross income under SNAP eligibility regulations. A measure of these excess medical costs is constructed from annual individual medical cost data reported in the SIPP topical modules. These are then aggregated to the household and family level provided that the elderly or disabled person is SNAP eligible.

The SIPP collects sufficiently detailed information on assets to identify the value of household liquid assets that count towards the asset test. This information includes the value of checking accounts, interest earning accounts, bonds, stocks and mutual funds, various

pension accounts, and the value of up to three vehicles per household. I linearly impute any missing data from adjacent asset observations. Asset information was also not collected in the last two years of the 2004 panel (2006 and 2007). Vehicle value above certain excluded amounts (detailed in the eligibility rule section) is additionally added to liquid assets and the sum is compared to asset test thresholds. Some households do not have any asset data, affecting approximately 6.3 percent of households. These households are dropped. Characteristics of these dropped households are presented in Table 2.2. On average, the dropped households are younger, have lower income and receive more SNAP benefits.

When calculating household liquid asset variables, individual level assets observed in the SIPP topical asset modules are summed to the household level. In the case of jointly held accounts, the SIPP divides the account value by the number of account holders to arrive at an individual account value of the joint account. Before 2008, IRA and KEOGH[1] accounts were included under liquid assets (minus 10 percent of the account value that would be lost to the withdrawal penalty). These accounts were made exempt from the asset test in June 2008.

The SIPP keeps track of the gross and net value of three cars per household, as well as which member of the household owns the vehicle. When calculating the contribution of excess car value to SNAP countable assets, only these first three car values are considered. In practice, less than 2 percent of households that pass the net income test own a third car. When constructing vehicle value at the family level, the three household vehicles are assigned to the family to which the owner belongs. Because of the censored nature

[1] An IRA is an account set up at a financial institution that allows an individual to save for retirement with tax-free growth or on a tax-deferred basis. A KEOGH plan is an employer-funded, tax-deferred retirement plan designed for unincorporated businesses or self-employed persons.

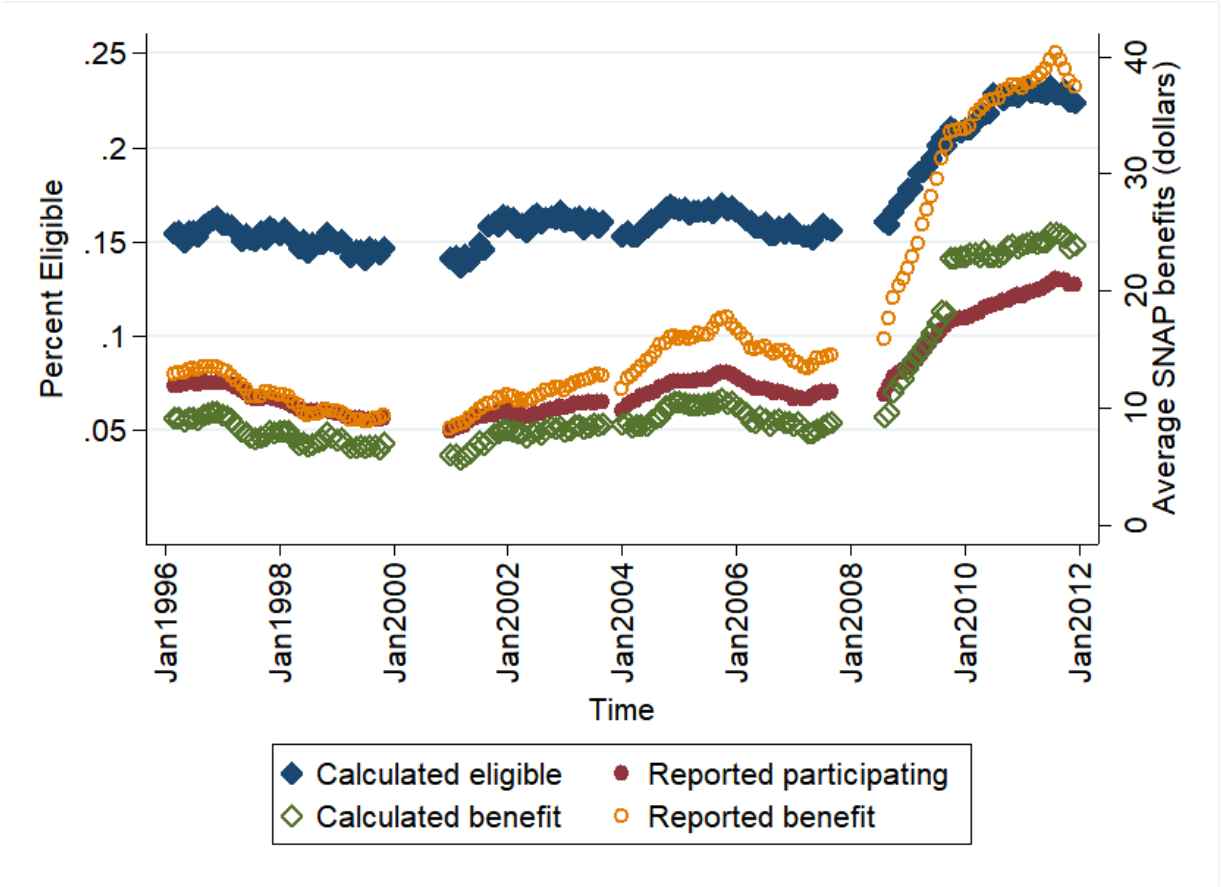
of household vehicle value, family level vehicle value is censored to an unknown degree depending on how many separate families are present in the household. The direction of the bias that this censoring may introduce is unknown.

Given the information above, I can calculate SNAP eligibility of each household after first excluding ineligible household members and their income and assets where applicable. I apply the gross income test by determining whether the income of eligible household members fell below 130 percent of the federal poverty line for a household of that size (or whatever higher threshold was set by any state under BBCE rules). I then compute household net income by subtracting a standard deduction of 8.3 percent of the poverty limit, a 20 percent deduction of earned income, excess medical costs and excess shelter costs from gross income. The household passes the net income test if net income falls below 100 percent of the federal poverty level. Next, I apply the asset test by determining whether countable household assets were below the $2000 threshold for households without elderly or disabled members ($3000 for households with elderly and disabled members). A household is determined to be SNAP eligible if it passes the gross income test, the net income test, and the asset test. Given household net income, I can calculate SNAP benefits from the benefit formula.

When states adopt BBCE, they regularly raise the gross income test threshold in addition to abolishing the asset test. The USDA ERS policy database does not contain information on the details of the individual state BBCE programs. I gathered this information from the technical documentation of the annual SNAP Quality Control exercise. Every year a random administrative dataset is gathered and published with the aim of documenting whether the benefits are disbursed in accordance with the SNAP eligibility rules. The documentation of this data set offers a state by state breakdown of the new thresholds and additional criteria that the states have set for their BBCE eligibility rules.

The federal poverty line measures vary from year to year and by household size. I use the poverty lines reported in the SNAP Characteristics documentation of the USDA that is published annually. This documentation also contains information on the thresholds above which rent and mortgage costs become deductible, as well as the size of the standard deduction. Both these thresholds are set annually by the USDA. The excess shelter cost threshold is set irrespective of household size and thus larger families are more likely to benefit from this deduction.

Figure 2.2: National fraction SNAP eligible and participating

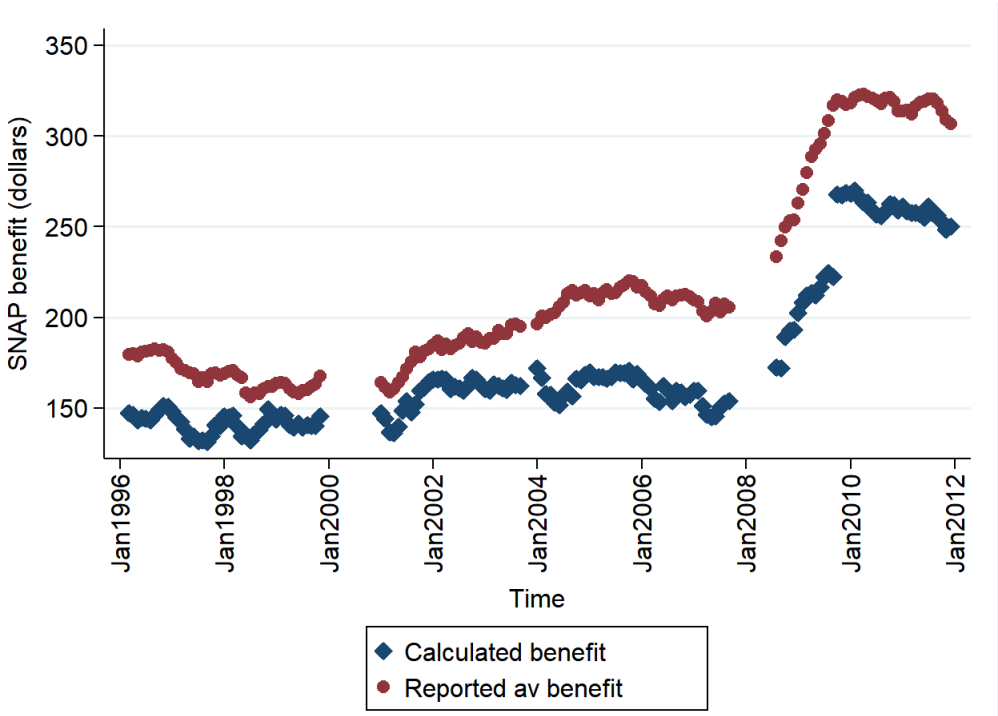


Notes: Series are weighted averages of households (using SIPP monthly household weights).

National averages of calculated eligibility and benefits are plotted next to observed SNAP participation and reported benefits received in Figure 2.2. As can be observed in the figure, rises and falls in observed participation and calculated eligibility mirror each other.

Unsurprisingly, eligibility exceeds participation. The SNAP participation ratio implied by these series is in line with those found in other studies. Reported benefits exceed calculated benefits throughout, even though calculated benefits include households that are eligible but do not report participating. Around 38 percent of those eligible in my data report participating during the sample period on average, while government figures report an average participation rate of around 64 percent for the same period.

Figure 2.3: Reported and calculated benefits conditional on reporting positive SNAP benefits



Notes: Series are weighted averages of households (using SIPP monthly household weights).

Figure 2.3 shows average calculated benefits compared to reported benefits for households who are calculated to be eligible and who also report positive SNAP benefits in the SIPP. Calculated benefits are around 20 percent lower than reported benefits for these household, suggesting that calculated net income for these households is higher than that reported to the SNAP administration on average. This could be because I miss two poten-

tial deductions: cost of child care and child support payments. Another possibility is that households under-report their income to the SNAP administration relative to what they report in the SIPP. Chetty, Friedman, and Saez (2013) find that among EITC recipients, which is a slightly higher income and a working population, households tend to selectively report income to the EITC administration, especially from quasi informal sources (in the case of EITC, reporting additional income can raise EITC benefits for certain income ranges). A third possibility is that errors in the net income calculation systematically overstate household income or understate deductions.

Among those who report positive benefits, approximately 20 percent are calculated to be ineligible for SNAP. The primary reason for this is that these households do not pass the net income test (around 88 percent of this group). The remainder does not pass the asset test in my data. This is further evidence of either under-reporting of income to the SNAP administration or an over estimation of net-income in my calculations. I am unable to distinguish which reason is more important.

2.4 Data cleaning and assumptions

Around 7.3 percent of individuals in 13.5 percent of households either did not have migration data or did not have enough migration data from which to determine citizenship and permanent residency. Although part of the reason for this is household non-response, another part is due to these household members not appearing in the second wave of interviews in each panel (for example if the household member joined the household at a later date). In the 2004 and 2008 panels, I find that 89.5 percent of individuals that are missing migration data are citizens (a monthly citizenship question is included in the core

survey of these panels). Given the relatively large number of households affected by this issue, I treat them as citizens. An alternate method is to treat individuals who are missing migration data as students are treated: by not counting them towards the number of people eligible in the household and excluding their income and assets from the rest of the household. Doing this does not qualitatively change the final results.

Another group of households display ID problems. About 3.2 percent of individuals in the SIPP have their birth year changed over time, sometimes by decades. These individuals are part of 6.2 percent of households. In some cases IDs appear to switch between members within the household, however, in others it seems to be simple measurement error. For a third group, when merging the core data with individual migration history data, approximately 0.7 percent of individuals have age changes between the core data and migration data in the month of merging. These individuals are part of 1.3 percent of households. I include the last two groups in the final sample. Dropping these groups does not substantially change the results. I find that all three groups are also not remarkably different on average from the full sample in terms of average household characteristics.

There are two situations where monthly income is negative for some households. Some households report negative property income in all panels. It is not clear what the source of this negative income is but it could be mortgage payments. Additionally, some households report negative earned income as well in the 2008 panel. The first group appears to consist predominantly of households higher up in the income distribution that are unlikely to participate in SNAP. The second group appear to be not as advantaged as the first group, although they have assets well above average and with over 75 percent of household reference persons with at least some college education. I adjust for the negative income problems as follows: any negative property income or earned income is recoded to 0 at the individual level because the SIPP does not consider loan repayments

as deductible from income.

2.5 Outcome measures

The outcome variables studied are 1) the volatility of total household income including SNAP, 2) the volatility of total household income excluding SNAP, 3) the volatility of household earned income, 4) monthly hours worked by the household reference person for their primary employer, 5) monthly hours worked by the household reference person for their primary own business, 6) a dummy for participation in the TANF program, and 7) a dummy for participation in the SSI program.

There are several ways of measuring income volatility. The measure used in this study is the average absolute deviations divided by the mean (AAD/mean):

$$AAD/mean = \frac{\frac{\sum |x_i - \bar{x}|}{t}}{\bar{x}} \tag{2.1}$$

The main advantage of this measure is its easy interpretation: it shows the magnitude of the average percentage deviations of income from the mean. An alternative and popular measure is the coefficient of variation (CV), which is the standard deviation divided by the mean. The interpretation of the CV is less clear because it gives more weight to deviations that are further away from the mean. Both measures normalize by the mean to facilitate comparison across households from different parts of the income distribution.

Income volatility is measured for a household for a period of time, instead of cross-sectionally (as many previous papers have done). The periods of time used are 4, 8 and 12 months. Shorter time spans suffer more from the lack of variability within waves of in-

terviews, although offer larger sample sizes. Since the data are structured as panels that follow individual households for 3-4 years (and with gaps between panels), 12 month volatility measures provide limited coverage of the sample period. In the main analysis I use 4 month period for all my income volatility measures. Results for 8 and 12 month measures are presented in Appendix 1.

Income volatility calculated over a 4 month segment dated t refers to the average deviations from the mean for month t, $t+1$, $t+2$, and $t+3$. All income deviation measures are calculated using real income to facilitate comparison across time. Income is deflated using the monthly CPI index for Urban Consumers. Using 8 and 12 month segments does not change the results substantially though lowers precision since the number of data points falls as segment length increases.

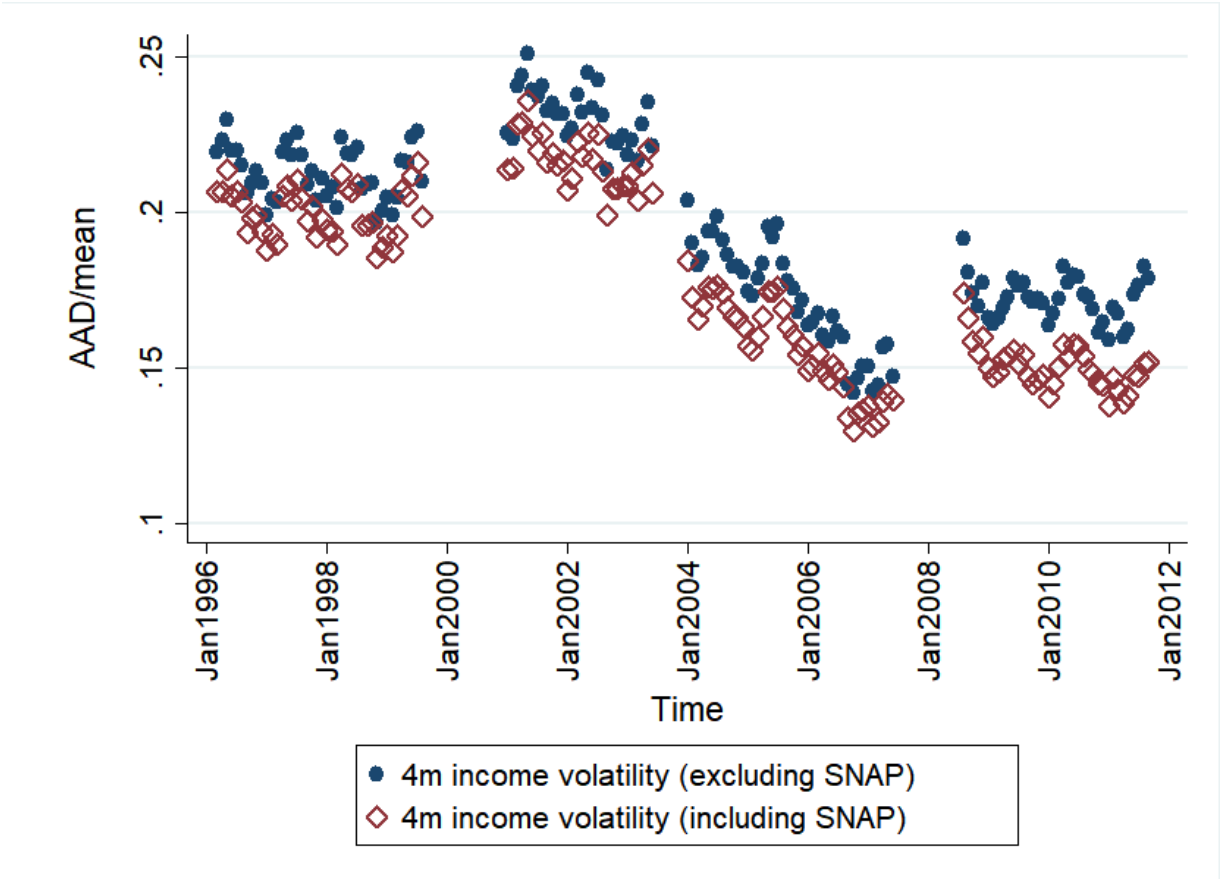
All income volatility regressions are based on households with uninterrupted income series. The presence of seam bias means that any segments with missing data points will have less seams on average, thereby artificially lowering income volatility. Characteristics of households with interrupted income series are reported in Table 2.2, and these appear to be very close to that of the full sample. The dropped households tend have slightly higher earned and total income, although both these measures exhibit considerable variability. These household are somewhat less likely to have a reference person that is a US citizen (80 percent vs 91 percent) and are marginally more likely to be non-white (21 percent vs 17 percent).

An individual household income volatility data point is calculated from at most 12 income observations. Like the sample variance, the AAD/mean suffers from a fixed small sample bias that originates from the fact that an estimate of the mean is required in order to calculate the measure. I correct for the bias by adjusting all income volatility measures

by a factor of $\frac{n}{n-1}$.

Income volatility of the various sub samples studied are presented in Table 2.1. In a given year, households experience deviations of around 15-18 percentage points in total household income, although there is considerable variation across households. This is in line with what Hannagan and Morduch (2015) find using the US Financial Diaries data set. Deviations in earned income are higher by a few percentage points for each subgroup. Across sub samples, income deviations rise as groups get poorer on average, with single mothers experiencing deviations of 18 percent in total household income (although these deviations are smaller in absolute terms).

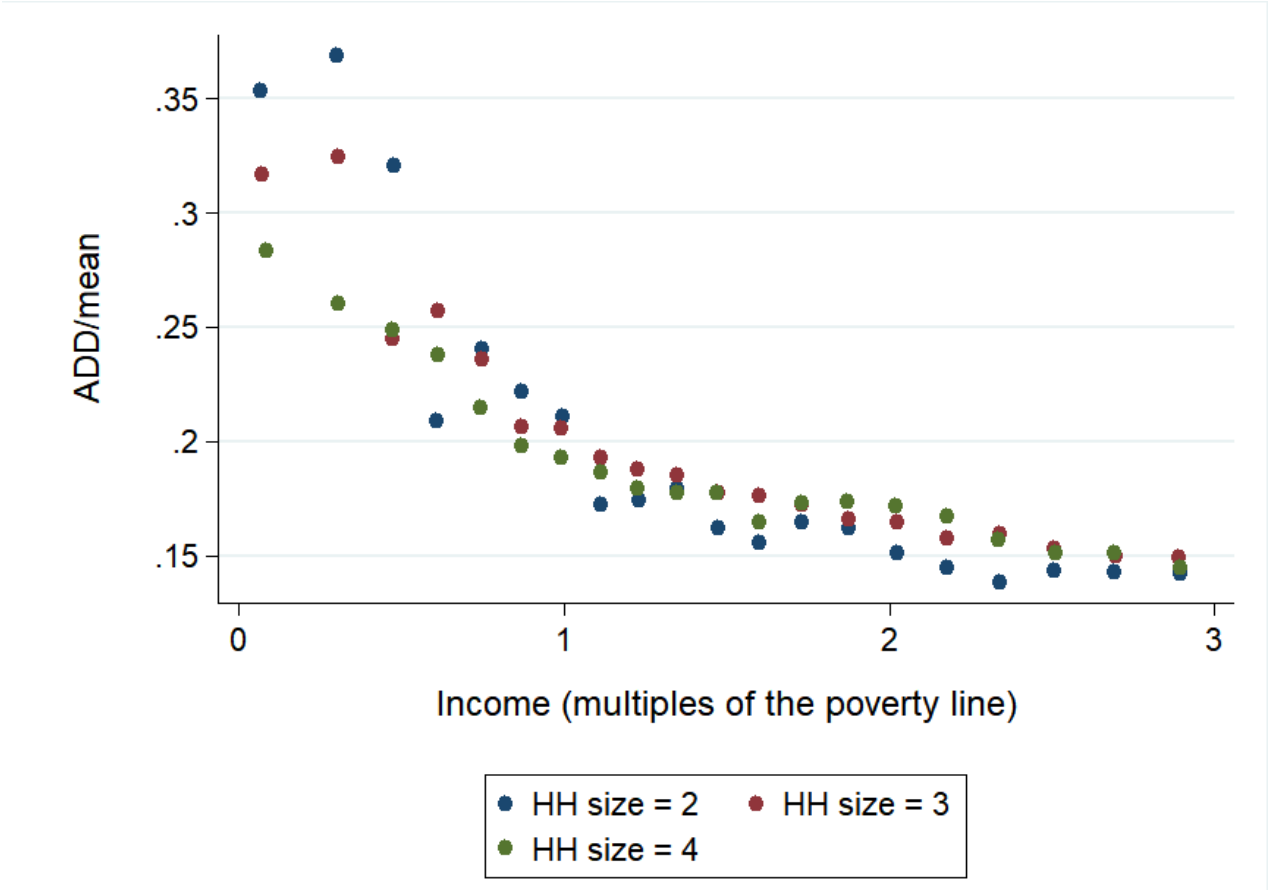
Figure 2.4: 4 month income volatility of single mothers over time



Notes: Weighted averages of single mother households (using SIPP monthly household weights).

Figure 2.4 shows the evolution of 4 month income volatility over the sample period. Income volatility is higher on average during the first two panels of data (between 1996 and 2003) than in the last two panels. This could be partly due to the non-representativeness at the national level of the first two panels. In all my regressions I include state and time effects to account for these level differences. Including SNAP benefits in income lowers income volatility as expected (for more discussion see the conceptual framework section).

Figure 2.5: 4 month income volatility (including SNAP) of single mothers by household size



Notes: Weighted averages of single mother households (using SIPP monthly household weights). Only households with uninterrupted income data were included.

Figure 2.5 displays the income volatility (including SNAP benefits) of single mothers by income and household size. The figure shows that income volatility increases as house-

holds become poorer. Also, for low income single mothers, income volatility increases as household size decreases, although that is likely due to mothers with more children having weaker attachment to the labor market.

I use income volatility as a proxy for consumption volatility for data reasons. My identification strategy relies on state level policy variation and this is not compatible with potential national data sources on consumption data. The CES divides the US into regions and does not identify states. The Nielssen scanner data lack sufficient demographic and income data to determine a household's SNAP eligibility.

Income volatility is invariably a rough measure of consumption volatility because there are many other dimensions along which households can adjust to obtaining SNAP eligibility. For this reason, I will also characterize the impact of my variation in SNAP policies on other relevant potential outcome variables. Using income is less than ideal, as is pointed out by Meyer and Sullivan (2008), who argue that consumption is a better measure of welfare at the bottom of the income distribution because they find that for single mothers, over the 1993-2003 period, incomes in the bottom decile fell by around 10 percent (probably due to under-reporting of transfer income) while consumption rose moderately by a little under 10 percent. However, this is the best that can be done with present national survey data.

2.6 Simulated Instrument

Using the encoded eligibility criteria described above, I construct a simulated instrument of SNAP eligibility. I follow the approach used by Currie and Gruber (1996) and Cutler

and Gruber (1996) by taking a random sub-sample from the national SIPP data in each month and replacing all state samples with this sub-sample. I then compute household level SNAP eligibility and benefits for this artificial sample using the state's eligibility rules that were enforced in each particular month. These calculated household SNAP eligibility and benefits are then aggregated to form simulated state level average eligibility. In practice, I used the entire national sample instead of a random sub-sample in each month to avoid sampling issues from a probability weighted sample. For each vulnerable group studied (single mothers, high school educated, and African American and Hispanic households) the base sample from which the simulated instrument is calculated is first limited to the SIPP population of that vulnerable group.

After controlling for month fixed effects (thereby parsing out average national level eligibility), the simulated instrument will pick up changes in eligibility brought about by the policy changes. Table 2.3 gives an idea of the fraction of households that could potentially be affected by each of the type of policy change. Over 20 percent of households in each sub population who pass the net income test would fail the federal asset test if it was applied in their state. Around half of these would still fail the asset test if it was just based upon liquid assets (ie. if all vehicles were excluded from the asset test). Between 0.5 and 1 percent of each vulnerable population would pass all the SNAP eligibility tests but would be disqualified because of their permanent residency status if the rules implemented in 1996 under PRWORA persisted over the sample period.

A second method of constructing the simulated instrument instead takes the March 1996 SIPP sample and then constructs extrapolated household data for each subsequent month by state. This is done by adjusting income, rent, health costs and assets of the sampled households according to national trends in these variables. All income variables are inflated according to the evolution of national wages captured by the BLS series "Employed

full time: Median usual weekly real earnings: Wage and salary workers: 16 years and over, Non seasonally adjusted". In a similar vein, all asset values, rent or mortgage payments and medical costs are constructed by setting their growth rate at that of CPI inflation using the BLS series "Consumer Price Index for All Urban Consumers: All Items". Household SNAP eligibility and benefits are then determined for the extrapolated state populations in each month according to the eligibility rules enforced at that point in time. Note that in contrast to the previous method, the state populations are not replaced by the entire sample. The base month was chosen to obtain as large a sample as possible. March 1996 was chosen as the base month since this is the month in which all 4 rotation groups of the first wave of interviews of the 1996 panel have data, and this is the wave of the 1996 panel that is least affected by attrition. This method yields weaker first stages than the first method, although this is expected given that it relies on stronger assumptions on the evolution of incomes and assets.

2.7 Participation and Eligibility

Participation in the SNAP program is in general higher for the three groups studied, with single mothers being the group with the highest participation rates at 68 percent. The households most likely to be affected by the SNAP policy reforms (households that have at least 1 permanent resident member and households with countable assets over $2000) have lower participation rates of just over 40 percent.

Table 2.1: Sample characteristics

	Full Sample	HS educated or less	Black or Hispanic	Single Mothers
HH characteristics:				
Own house	0.69	0.60	0.50	0.49
Live in metro area	0.80	0.74	0.87	0.82
% SNAP eligible	0.17	0.31	0.31	0.38
% Pass gross inc test	0.19	0.34	0.31	0.37
% Pass net inc test	0.19	0.33	0.30	0.35
% Pass asset test	0.54	0.66	0.70	0.73
Household size	2.54	2.34	2.98	3.06
o.w. SNAP eligible	2.38	2.19	2.67	2.81
HH Income (monthly) and Assets:				
Total income	4,608	2,548	3,601	3,073
	(4,844)	(2,430)	(3,690)	(2,977)
Earned income	3,747	1,726	3,029	2,379
	(4,905)	(2,500)	(3,684)	(2,896)
SNAP benefits	18	32	43	73
	(83)	(107)	(125)	(155)
Liquid assets	59,016	23,548	13,962	16,166
	(850,332)	(529,038)	(402,908)	(274,885)
Excess vehicle value	4,059	2,246	2520	2,080
	(6,442)	(4,524)	(4,871)	(4,389)
4m Income volatility (AAD/mean):				
Total income w/ SNAP	0.154	0.151	0.166	0.178
	(0.257)	(0.261)	(0.267)	(0.261)
Total income w/o SNAP	0.158	0.157	0.173	0.195
	(0.266)	(0.279)	(0.289)	(0.301)
Earned income	0.173	0.167	0.19	0.233
	(0.340)	(0.356)	(0.36)	(0.416)
Reference person characteristics:				
Age	50.2	54.0	45.7	45.2
Married	0.54	0.42	0.46	0.04
Female	0.50	0.53	0.55	1
Hispanic	0.10	0.16	0.43	0.15
Non-white	0.17	0.19	0.54	0.35
High school or under	0.27	1	0.27	0.3
US Citizen	0.91	0.88	0.81	0.88
Hrs worked at 1st job	23.1	17.3	24.6	23.4
Hrs worked at 1st business	3.2	2.2	2.0	1.5
# of households	4,738,231	1,543,751	1,089,789	632,415

Notes: Full sample excludes dropped states and households that reside in group quarters, and those missing asset information. All averages are calculated using household weights. Values in brackets are standard deviations. AAD stands for absolute average deviations from the mean. The asset distribution has a very high variance because it is characterized by fat right tales.

Table 2.2: Characteristics of excluded groups

	Full Sample	Missing asset data	Interrupted income series
HH characteristics:			
Own house	0.69	.38	0.71
Live in metro area	0.80	.78	0.81
% SNAP eligible	0.17		0.16
% Pass gross inc test	0.19		0.20
% Pass net inc test	0.19		0.19
% Pass asset test	0.54		0.58
Household size	2.54	2.53	2.69
o.w. SNAP eligible	2.38		2.50
HH Income (monthly) and Assets:			
Total income	4,608	3,980	4,975
	(4,844)	(4,575)	(5,464)
Earned income	3,747	3,457	4,201
	(4,905)	(4,555)	(5,496)
SNAP benefits	18	30	19
	(83)	(108)	(86)
Liquid assets	59,016		51,554
	(850,332)		(825,525)
Excess vehicle value	4,059		4,349
	(6,442)		(6,533)
Reference person characteristics:			
Age	50.2	41.0	49.1
Married	0.54	.41	0.56
Female	0.50	.52	0.50
Hispanic	0.10	.13	0.12
Non-white	0.17	.21	0.21
High school or under	0.27	.27	0.28
US citizen	0.91	.73	0.80
Hrs worked at 1st job	23.1	26.1	24.1
Hrs worked at 1st business	3.2	2.3	3.3
# of households	4,738,231	339,629	589,798

Notes: Full sample excludes dropped states and households that are group quarters, and those missing asset information. All averages are calculated using household weights. Values in brackets are standard deviations.

Table 2.3: Fraction of households likely to be affected by policy changes (1996-2011)

	Full Sample	HS educated or less	Black or Hispanic	Single Mothers
% *Pass income tests*	*18.66*	*32.51*	*29.07*	*34.56*
Vehicle and Asset tests				
% Pass income tests & fail Federal asset test	6.28	7.96	5.64	5.98
% Pass income tests & fail liquid asset test	4.05	4.76	2.24	2.80
Permanent residents				
% pass all SNAP tests but ineligible under PRWORA rules	0.39	0.75	1.03	0.55

Notes: Averages are weighted using household weights.

Table 2.4: Participation and eligibility of selected groups

	Percent Participating	Percent Eligible	Participation Rate
Full sample	0.077	0.17	0.453
Single mothers	0.261	0.382	0.683
Black or hispanic	0.173	0.309	0.560
High school	0.145	0.311	0.466
HH w/ countable assets over $2000	0.0156	0.038	0.411
HH w/ 1+ permanent resident	0.106	0.253	0.419

Notes: Weighted SIPP monthly household weights.

CHAPTER 3

METHODS, RESULTS, AND CONCLUSION

3.1 Methods

3.1.1 Conceptual framework

The following model illustrates the relevant household optimization problem:

$$\max_{C_t, L_t, A_{t+1}, P_t} \sum_t u(L_t, C_t, \phi) \tag{3.1}$$

$$s.t. \quad A_{t+1} - R_t A_t + p_t C_t = \bar{Y}_t + w_t L_t + E_t P_t B_t \tag{3.2}$$

In this model a household makes intertemporal choices in each time period over how much to consume, C_t, how many hours to work, L_t, the level of assets it wishes to hold in the next period, A_{t+1}, and which social programs to participate in, P_t. Saving, $A_{t+1} - R_t A_t$, and consumption, C_t, is financed out of labor income, $w_t L_t$, benefits from social programs, $E_t P_t B_t$, and other income, $\bar{Y}_t$. Assets earn a rate of return R_t and hours worked are remunerated at an hourly wage rate, w_t. The wage rate is likely to be endogenous in practice if a household's ability to search for suitable job matches depends on how much non-earned income a household receives while searching. Participating in a social program comes at a utility cost of ϕ, which could capture social stigma and application costs. Benefits from social programs depend on eligibility, E_t, participation, P_t, and monetary benefits, B_t. In

the case of SNAP, the monetary benefit level, B_t, depends on household income since the benefit formula deducts 30 cents on every dollar earned below the poverty line.

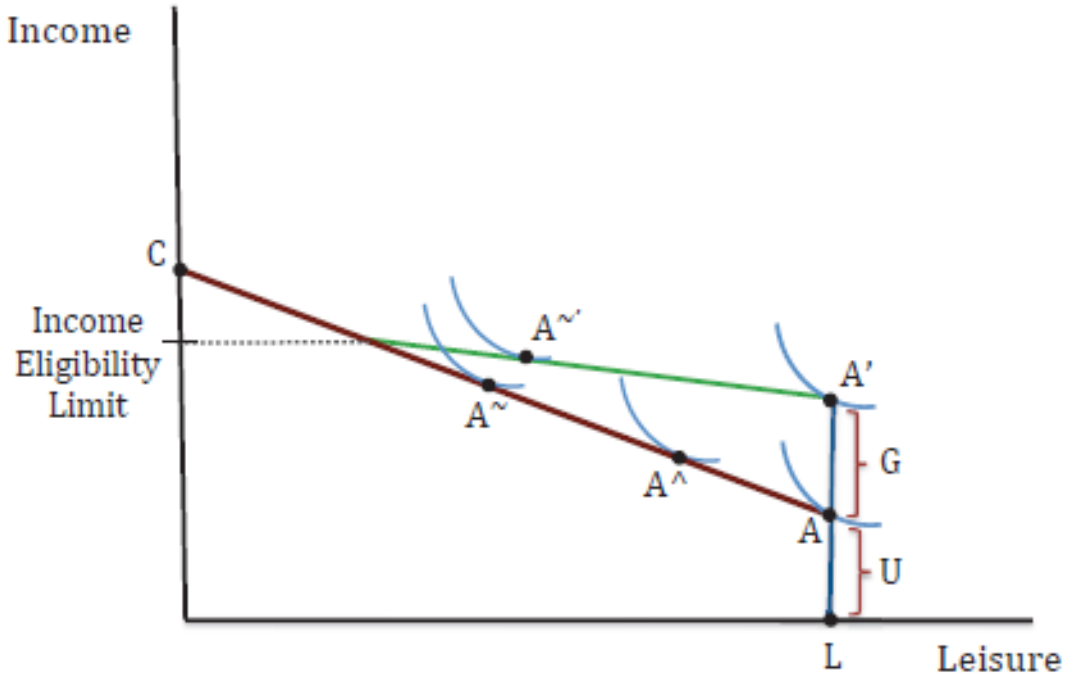
Eligibility to the SNAP program may either be exogenously imposed, such as the ineligibility of some permanent residents and students, or depend on endogenous household choices such as how much the household works, participation in other social programs that make a household categorically eligible, and asset levels.

Households face a complicated multi period optimization problem where they trade off the dis-utility of working against the need to consume. Households may also smooth consumption over time by borrowing and saving. A household participating in SNAP, will mechanically have lower income volatility because the benefit schedule has a stabilizing effect on total income: for each dollar of marginal income earned, SNAP benefits fall by 30 cents, so negative income shocks are partly offset by a rise in benefits. A negative income shock (such as a decrease in the wage rate) may also induce non-participating, but eligible, households to join the SNAP program, since marginal utility of an extra dollar in benefits rises, while the cost of participating, ϕ, is unaffected. This increasing likelihood of joining the program as other income falls will also have an income stabilizing effect. These two sources of income volatility smoothing is measured by comparing the difference in household income volatility that includes SNAP benefits and that excludes SNAP benefits.

In addition, however, there could be changes in income volatility brought about by behavioral changes. Households could respond by changing hours worked, applying to riskier jobs, changing their savings behavior, and changing their participation in other social safety net programs. The change due to behavioral responses is captured by the change in non-SNAP income volatility, although because of the complexity of the house-

hold problem, I will not be able to identify the underlying mechanisms through which the response operates.

Figure 3.1: Income leisure trade-off of becoming SNAP eligible



Source: Hoynes and Schanzenbach (2012)

To give a flavor of the other relevant behavioral impacts, I look at the household reference person's hours worked for an employer and at their own business, as well as the household's participation in the TANF and SSI program. Theoretically, becoming SNAP eligible would expand the household's budget set as displayed in Figure 3.1. Households would face a disincentive to work both from the income effect of being granted a lump sum benefit and from the marginal disincentive of the loss of benefits for every dollar earned, which acts as an effective extra 30 percent income tax. This effect would affect both hours worked for an employer and for an own business. A decrease in hours worked for an employer can in principle have an ambiguous effect on income volatility: workers may decide to work less overtime (which is likely to decrease income volatility) or switch from

full-time employment to part time employment (which is likely increase income volatility). Having access to SNAP may also enable workers to spend more time searching for better employment matches. Participation in the TANF and SSI programs is likely to be associated with decreased income volatility since in both these programs benefits are also phased out gradually as income rises.

3.1.2 Estimation

I estimate the following instrumental variable setup:

Second stage:

$$y_{st} = \beta_1 SNAP_{st} + \beta_2 X_{st} + \beta_3 Z_{st} + \gamma_s + \delta_t + \epsilon_{st} \tag{3.3}$$

First stage:

$$SNAP_{st} = \alpha_1 \tilde{SNAP}_{st} + \alpha_2 X_{st} + \alpha_3 Z_{st} + \gamma_s + \delta_t + \epsilon_{st} \tag{3.4}$$

The analysis is done at the state level. Here s identifies a state and t a month of interest. y_{st} can be a number of different outcome variables, which are discussed below. $SNAP_{st}$ is the independent variable of interest and refers to the state fraction eligible and/or participating in SNAP. X_{st} is a vector of average household characteristics and Z_{st} is a vector of state characteristics. γ_s and δ_t are state and month fixed effects. $\tilde{SNAP}_{st}$ is a simulated instrument of average state SNAP eligibility in the state.

To provide a comprehensive picture of the impact of increased SNAP eligibility on volatility measures, the dependent variable, y_{st}, includes 1) the volatility of total household income including SNAP (this shows the overall effect), 2) the volatility of total household income excluding SNAP (this captures the behavioral effect), 3) the volatility of household earned income, 4) monthly hours worked by the household reference person for their primary employer, 5) monthly hours worked by the household reference person for their primary own business, 6) a dummy for participation in the TANF program, and 7) a dummy for participation in the SSI program.

Estimating the second stage of the above IV model by OLS would be problematic for at least 2 reasons. First, the model is likely to suffer from endogeneity bias. Eligibility depends mechanically on household income, household composition, asset values and shocks to these variables are likely to be correlated with outcomes y_{st} as well, either directly in the case of income volatility measures or indirectly for measures like hours worked. Second, there is likely to be some measurement error in the constructed eligibility measures due to the imperfect nature of the data from which the eligibility measure is constructed.

A potential solution to these problems is to find an instrument that is correlated with $SNAP_{st}$ but is uncorrelated with outcomes y_{st} except through SNAP. One way to do this is to construct an instrument that captures state level variation in eligibility due to the SNAP policy changes but that is independent of state level income and demographic shocks except through SNAP. The simulated instrument described in the data section fits this description. The instrument deals with the bias resulting from measurement error provided that the bias creating measurement error in the eligibility measure (that which is correlated with outcome variables) is uncorrelated with the simulated instrument. This is separate from attenuation bias that could still occur from random measurement error

in both measures.

A further complication is that eligibility does not guarantee that a household is aware of its eligibility or is willing to use the SNAP program if it was aware. If awareness or willingness to participate is correlated with the outcome variables, then the coefficient in the instrumented regression may still be biased.

Validity of the simulated instrument requires that the timings of the state level SNAP eligibility policy changes are exogenous to any characteristics that could affect outcome variables. This is tested in Table 3.1. These linear regressions measure the correlation between the probability that a particular policy is implemented and key state level characteristics. Since my data on state level characteristics is annual, all regressions use annual state level data: the dependent variable is a dummy that is 1 in any year where a policy under consideration is implemented in a state. The F test of a joint zero on all coefficients is rejected for all policy changes but the coefficients are small and often in the opposite direction that I would expect. For example a one percentage point increase in the state unemployment rate is associated with 5 percent reduction in the probability that any policy change is implemented. Similarly, a one percent increase in the gross state product per capita growth rate is associated with a non-significant 2 percent increase in the probability that any policy change is implemented. The political variables also have unexpected signs. The only coefficients that are statistically significantly different from zero are whether the state had a democratic governor and are negative.

The assumption of the exogeneity of policy timings is most problematic for the elimination of the asset test through BBCE because around half of states adopted BBCE after the start of the 2009 recession. Controls for state economic characteristics can partially correct for this but biases could arise if the relationship between the outcome variables and the

Table 3.1: Policy timings – dependent variable is 1 in year of policy change

	Any BBCE change	Any vehc change	Any mig. child change	Any mig. adult change	Any mig. elderly change	Any policy change
GSP/capita gr rate	-0.007*	-0.009**	0.015***	0.009*	0.010*	0.018
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.012)
Unemployment rate	0.035*	-0.027**	-0.017*	-0.024***	-0.024***	-0.058*
	(0.013)	(0.009)	(0.006)	(0.006)	(0.007)	(0.023)
Governor Democrat	0.012	-0.014	-0.021	-0.044**	-0.036*	-0.104*
	(0.015)	(0.020)	(0.017)	(0.015)	(0.016)	(0.044)
% House Democrat	0.003	-0.034	0.018	-0.056	-0.027	-0.095
	(0.065)	(0.077)	(0.086)	(0.074)	(0.072)	(0.217)
% Senate Democrat	0.050	0.029	-0.063	0.102	0.062	0.180
	(0.070)	(0.085)	(0.076)	(0.068)	(0.064)	(0.232)
Constant	-0.053	0.215***	0.149***	0.105**	0.106**	0.522***
	(0.045)	(0.041)	(0.031)	(0.032)	(0.033)	(0.099)
Observations	672	672	672	672	672	672
R^2	0.045	0.012	0.033	0.039	0.039	0.018
F	5.746	2.797	15.714	18.094	19.815	5.332
p	0.000	0.029	0.000	0.000	0.000	0.001

Notes: SE in parentheses. All rates and percentages range from 0 to 100. SE are clustered at the state level.

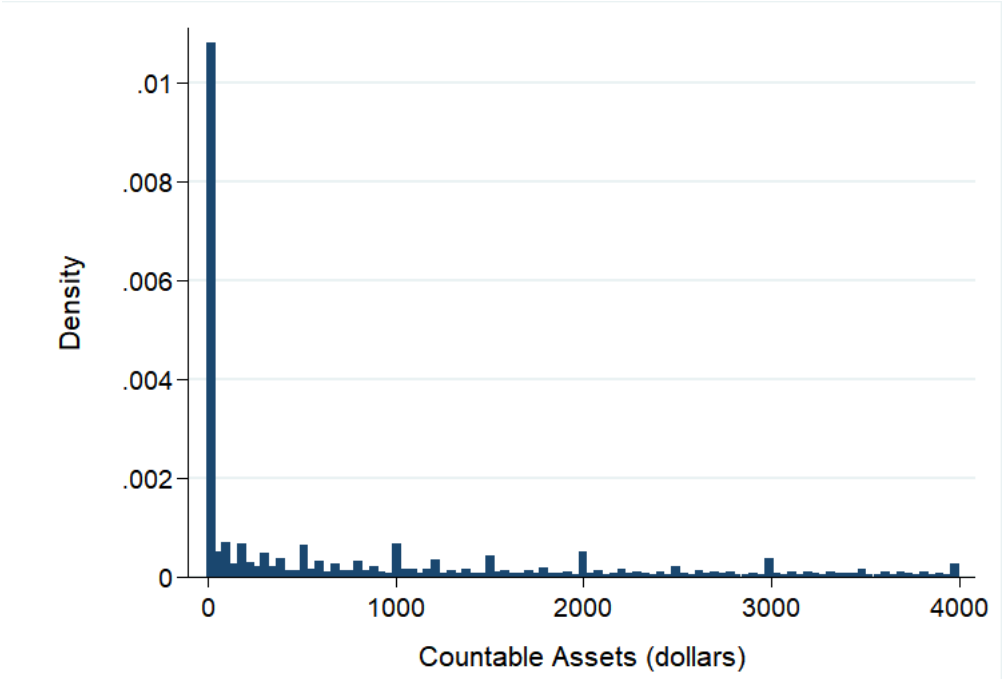
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

characteristics affecting policy timings is non linear and from the annual measurement of these characteristics. As a robustness check, I exclude all recession period data.

Another threat to my identification strategy could result from households responding to the loosening of SNAP asset rules by increasing their holdings of various assets. Some households may be constrained to hold their asset levels below the SNAP asset test levels in order to stay eligible for SNAP benefits. If these households increase their asset levels after the elimination of the asset test and this impacts the outcome variables (if for example income volatility decreases) then a bias would arise. The change in that outcome would be wrongly attributed to those that marginally became eligible because of the asset test elimination. The asset test is based upon countable assets, which is the sum of excess vehicle value and liquid assets. Households keeping their vehicle value below the threshold to maintain SNAP eligibility is unlikely to bias my results unless owning a more expensive vehicle is likely substantially increase income volatility. There is evidence of a weak response in liquid assets to the elimination of the asset limit. Ratcliffe, McKernan, Wheaton, et al. (2016) find that living in a state without an asset limit is correlated with a 2 percentage point increase in the probability of individuals having over $500 in a bank account and find no effect for bank accounts over $2000.

Figure 3.2 shows a histogram of household asset values for households who live in state-months where the state had not yet adopted BBCE, ie. the federal asset limit was still in place. Vehicle value rule changes are possibly included and are factored in in the calculation of excess vehicle value. If households were able to successfully constrain their assets to stay below the asset limit, bunching would be expected just under $2000 and $3000, which are the asset thresholds for regular and for elderly or disabled households respectively. There is minor bunching at these values but since similar bunching is also observed at $1000 and $4000, values that are not relevant in the SNAP asset test and to

Figure 3.2: Countable assets of households living in state-months where BBCE had not yet been implemented



Notes: Density of households with countable assets under $4000. Calculated from SIPP data using only HH observations from state-months where BBCE had not yet been adopted. Observations are weighted using SIPP weights.

my knowledge are not relevant in the asset test of other programs, this bunching is likely due to rounding done by households when they report their assets to the SIPP. Overall, this presents weak evidence of bunching, and hence of asset constraining, at best.

Table 3.2 shows how the assets of single mothers are related to BBCE adoption in the state that they live in. The first column shows that countable assets are $4219 lower on average in states that had adopted BBCE before 2008, after controlling for the other factors listed. After January 2008, living in a state that has adopted BBCE is associated with a $6047 drop in countable assets. Most of this fall in assets occurs in liquid assets as can be seen in the third column. The adoption of BBCE is associated with an increase in excess vehicle value of $123 before 2008 and by $898 after 2008, although since I do

Table 3.2: Asset response of single mothers to states adopting BBCE

	Countable Assets	Excess vehicle Value	Liquid Assets	Probability Assets over $2000
BBCE adopted	-4,219***	123**	-2,763***	-0.07***
	(676)	(38)	(674)	(0.00)
Post-2007	-3,252***	501***	-2,553**	-0.04***
	(859)	(36)	(859)	(0.00)
BBCE adopted*Post-2007	1424*	274***	134	0.06***
	(591)	(46)	(589)	(0.00)
GSP/capita gr rate	-223***	36***	-259***	-0.00
	(46)	(2)	(46)	(0.00)
Unemployment rate	-160	-276***	224	-0.03***
	(381)	(15)	(381)	(0.00)
HH in metro area	10,345***	189***	10,312***	0.05***
	(469)	(20)	(469)	(0.00)
HH owns house	24,997***	2,112***	23,895***	0.30***
	(830)	(16)	(829)	(0.00)
Ref pers non white	-14,996***	-803***	-14,525***	-0.14***
	(597)	(17)	(596)	(0.00)
Ref pers hispanic	-14,679***	-370***	-14,277***	-0.14***
	(337)	(24)	(336)	(0.00)
Ref pers married	-1,611	588***	-1,880*	-0.00
	(894)	(46)	(892)	(0.00)
Ref pers high school	8,977***	478***	8,630***	0.07***
	(1,277)	(19)	(1,277)	(0.00)
Ref pers college	5,810***	969***	5,274***	0.15***
	(270)	(19)	(268)	(0.00)
Ref pers grad	33,954***	2,416***	32,807***	0.37***
	(863)	(63)	(859)	(0.00)
Constant	2,565*	1,276***	653	0.27***
	(1,066)	(50)	(1,065)	(0.00)
Observations	618,740	618,740	618,740	618,740
R^2	0.006	0.081	0.005	0.227

Notes: All rates range from 0 to 100. Regressions include state fixed effects.

SE given in brackets.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

not adjust asset values for inflation, this may simply reflect that cars of equal quality are becoming more expensive over time (and the vehicle excess value threshold becoming increasingly binding). It should be noted that the asset distribution displays fat right tails, even for single mothers, and that much of the changes are happening at the right end of the distribution (where households are unlikely to be eligible for SNAP). The signs on gross state product per capita growth are unexpectedly negative, though small. This could also be driven by changes high up the in asset distribution.

In the fourth column, I run a linear probability model with a dummy that is equal to one when household countable assets exceed $2000 as the dependent variable. I find that, both before and after 2008, single mothers in BBCE adopting states are less likely to have countable assets above $2000.

3.2 Results

3.2.1 First stage

Table 3.3 shows the first stage underlying all the income volatility regressions where the four month average fraction of the state population eligible is regressed on the simulated instrument and controls. The F test of whether the coefficient on the simulated instrument is significantly different from zero is above the ballpark figure of 10 (taken to indicate a strong instrument in the instrumental variable literature) and the coefficients are close to 1 for all sub populations. This shows that simulated eligibility is a strong predictor of the increase in eligibility observed at the state level. State unemployment rates and house

Table 3.3: First stage - 4 month average fraction of state population eligible

	(1)	(2)	(3)
	High school	Black/Hispanic	Single mom
4m Simulated fraction eligible	.89***	.82***	.84***
	(.10)	(.2)	(.22)
GSP/capita growth rate	.08	.036	.19*
	(.071)	(.067)	(.085)
Population growth rate	-.23	-.16	-1.2**
	(.39)	(.35)	(.34)
Unemployment rate	1.2*	2.1**	2.3***
	(.52)	(.62)	(.53)
Minimum wage	-.009	-.019**	-.007
	(.008)	(.006)	(.008)
Max EITC credit 2 dep	.000*	.000	.000
	(.000)	(.000)	(.000)
HH: in metro area	-.007	-.022	-.001
	(.014)	(.019)	(.019)
HH: owns house	-.24***	-.13***	-.24***
	(.064)	(.035)	(.044)
HH: number of persons	.044**	-.003	.037*
	(.015)	(.013)	(.014)
N	1892	1892	1892
R squared	0.879	0.788	0.753
F stat on sim fraction eligible	87.6	16.6	14.5

Notes: Standard errors in parentheses and are clustered at the state level. All state level rates and fractions range from 0 to 1. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.4: First stage - 4 month average fraction of state population participating

	HS educated or less	Black or Hispanic	Single Mothers
4m Simulated fraction eligible	.12	.13	.42*
	(.13)	(.14)	(.2)
GSP/capita growth rate	.075	.082	.27***
	(.053)	(.047)	(.07)
Population growth rate	.23	.34	.49
	(.38)	(.33)	(.47)
Unemployment rate	-.27	-.24	1.3*
	(.48)	(.56)	(.51)
Minimum wage	-.013*	-.013*	-.015
	(.006)	(.005)	(.010)
Max EITC credit 2 dep	.000	.000	-.000
	(.000)	(.000)	(.000)
HH: in metro area	-.041	-.046	-.04
	(.022)	(.034)	(.023)
HH: owns house	-.24***	-.23***	-.23***
	(.057)	(.062)	(.058)
HH: number of persons	.048**	.021	.064***
	(.014)	(.014)	(.017)
N	1892	1892	1892
R squared	0.821	0.819	0.774
F stat on sim fraction eligible	0.9	0.9	4.6

Notes: Standard errors in parentheses and are clustered at the state level. All state level rates and fractions range from 0 to 1. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

ownership are also highly correlated with household SNAP eligibility.

Eligibility does not necessarily imply participation, however. Table 3.4 shows the first stage where observed participation is the dependent variable instead. The coefficients on the simulated instrument in this regression are much smaller and have low statistical significance: a 1 percent increase in the simulated state fraction eligible is associated with a 0.1 percent increase in observed participation ceteris paribus for high school graduates and African American and Hispanic households. For single mothers participation increases by 0.4 percent. The low statistical significance implies low F statistics, which are all below 10. The strongest first stage is for single mothers with an F stat of 4.6, while for the other two groups it is below 1.

As mentioned above, there is known underreporting of SNAP participation in the SIPP survey of approximately 10-20 percentage points. Nevertheless, this first stage suggests that SNAP uptake among those who have become newly eligible because of the policy changes is low. Using lags in participation does not substantively change the results.

3.2.2 Main results

The main results are shown in Table 3.5. This table summarizes a different regression in each row. The coefficient shown is that of the simulated state SNAP fraction eligible after instrumenting for the state fraction eligible. The simulated instrument base population matches that of the national sub population studied. The first three rows show the results of the impact of eligibility on income volatility in total income including SNAP, total income without SNAP, and on earned income. All the coefficients for income volatility

Table 3.5: Results - Each line shows a separate regression. The coefficient is that of simulated state fraction eligible

	HS educated or less	Black or Hispanic	Single Mothers
Income volatility (4 month AAD/mean)			
Total income w/ SNAP	0.01	-0.17	-0.21
	(0.06)	(0.26)	(0.17)
Total income w/o SNAP	0.00	-0.15	-0.16
	(0.07)	(0.24)	(0.13)
Earned Income	-0.03	-0.18	-0.08
	(0.08)	(0.29)	(0.14)
Levels			
Hrs worked at 1st job	-3.52	-15.28	-7.14
	(4.93)	(9.49)	(11.11)
Hrs worked at 1st business	3.02	13.32	11.22
	(2.23)	(7.97)	(6.16)
TANF participation	0.08	0.17	0.24
	(0.04)	(0.09)	(0.14)
SSI participation	-0.03	-0.21	-0.03
	(0.06)	(0.19)	(0.14)
N	1892	1892	1892
F stat first stage	87.6	16.6	14.5

Notes: Standard errors in parentheses and are clustered at the state level. AAD stands for absolute average deviations from the mean. All income variables are in 1996 dollars. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student, state growth rate per capita, state population growth rate, state unemployment rate, state minimum wage, maximum state EITC benefit for a HH of 2, HH lives in metro area, HH owns a house, and average HH size. Number of observations and F stat are reported for income volatility regressions.

are statistically insignificant from zero due to large standard errors. For single mothers, the group that most strongly increases participation in response eligibility changes, both actual and simulated SNAP eligibility increased by approximately 10 percentage points from the early 2000s to the end of the sample period. To give an idea of magnitude of the coefficients: the coefficient for total income including SNAP benefits implies that a 10 percentage point increase in state SNAP eligibility reduces average household deviations from the mean by 2.1 percentage points for single mothers (the AAD/mean for this group is 18 percentage points — implying an 11 percent decrease in income volatility). About 1.6 percentage points of this change is due to the behavioral response and the rest is due to the direct effect. These magnitudes are smaller than the 18 percent reduction due to the direct response found by Hardy (2017) and the 12 percent reduction found by Gundersen and Ziliak (2003), although the estimates of these studies were not causal.

On the labor supply side, a 10 percentage point increase in state SNAP eligibility reduces hours worked in paid employment by a statistically insignificant 0.7 hours per week, the direction predicted by theory. A similar change, however, increases hours worked at a single mother's own business by 1.1 hours per week and is significant at the 10 percent level (although robustness checks using pre-2008 data are suggestive that this is due to economic shocks rather than policy changes). This increase in hours worked on own business ventures could be explained by single mothers using the security provided by SNAP benefits to explore riskier income generating activities (where larger prospective uncertain future business returns outweigh the marginal disincentive to work arising from the benefit schedule).

Participation in the TANF program rises by 2.4 percent (statistically significantly different from zero at the 10 percent level) as a result of the 10 percent increase in SNAP eligibility, whereas SSI participation is effectively unchanged.

3.2.3 Robustness checks

One threat to my identification strategy is that the policy changes implemented during the 2009 economic crisis were in response to local economic conditions, and that therefore any income volatility response attributed to the policy changes should be attributed to these economic shocks instead. As a robustness check, I exclude the 2008 SIPP panel and the results of this exercise are presented in Table 3.6. Data used in these regressions cover the period from March 1996 to September 2007. The first stage regressions weaken as a result of the decrease in observations with a fall of the F stat on simulated eligibility to 7.5 from 14.5 in the first stage (using eligibility as the dependent variable). For single mothers the impact of eligibility on income volatility approximately halves for both total income with and without SNAP benefits, although the coefficients are again statistically insignificant from zero. The increase in hours worked at a single mother's own business disappears, which suggests that this effect is localized within the recession period. In so far as the policy changes were implemented because of the 2009 economic crisis, this increase in hours may not be well identified. Hours worked for an employer now have a positive coefficient.

Another concern is that some of the state month cells used in the main results contain very few observations, especially for the African American and Hispanic, and the single mother sub groups. As a robustness test, I only include states that have at least 50 observations of each group on average. These results are presented in Table 3.7. The magnitudes of the income volatility measures for single mothers remain statistically insignificant and decrease slightly. The increase in hours worked at their own business remains of a similar magnitude and significance level as in the main regressions.

Table 3.6: Robustness pre-2008 - Each line shows a separate regression. The coefficient is that of simulated state fraction eligible

	HS educated or less	Black or Hispanic	Single Mothers
Income volatility (4 month AAD/mean)			
Total income w/ SNAP	.03	.05	-.12
	(.06)	(.16)	(.19)
Total income w/o SNAP	.03	.06	-.06
	(.05)	(.16)	(.18)
Earned Income	-.01	.17	.13
	(.09)	(.18)	(.22)
Levels			
Hrs worked at 1st job	-11.8	-20.04	5.68
	(4.74)	(10.14)	(12.65)
Hrs worked at 1st business	.42	10.24	.81
	(2.25)	(7.26)	(5.73)
TANF participation	0.07	0.13	0.12
	(0.06)	(0.12)	(0.22)
SSI participation	0.1	-0.22	0.03
	(0.06)	(0.21)	(0.11)
N	1452	1452	1452
F stat first stage	60.2	11.6	7.5

Notes: Standard errors in parentheses and are clustered at the state level. AAD stands for absolute average deviations from the mean. All income variables are in 1996 dollars. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student, state growth rate per capita, state population growth rate, state unemployment rate, state minimum wage, maximum state EITC benefit for a HH of 2, HH lives in metro area, HH owns a house, and average HH size. Number of observations and F stat are reported for income volatility regressions.

Table 3.7: Robustness high observations - Each line shows a separate regression. The coefficient is that of simulated state fraction eligible

	HS educated or less	Black or Hispanic	Single Mothers
Income volatility (4 month AAD/mean)			
Total income w/ SNAP	0.00	-.16	-.15
	(.05)	(.17)	(.14)
Total income w/o SNAP	0.01	-.15	-.13
	(.05)	(.18)	(.12)
Earned Income	-.03	-.13	-.02
	(.07)	(.19)	(.16)
Levels			
Hrs worked at 1st job	-2.28	-12.5	-1.33
	(4.58)	(7.61)	(10.42)
Hrs worked at 1st business	3.03	14.28	11.63
	(2.2)	(5.6)	(4.88)
TANF participation	0.08	0.11	0.23
	(0.04)	(0.08)	(0.17)
SSI participation	-0.03	-0.22	-0.19
	(0.06)	(0.19)	(0.15)
N	1806	1247	1161
F stat first stage	86.7	20.4	11.1

Notes: Standard errors in parentheses and are clustered at the state level. AAD stands for absolute average deviations from the mean. All income variables are in 1996 dollars. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student, state growth rate per capita, state population growth rate, state unemployment rate, state minimum wage, maximum state EITC benefit for a HH of 2, HH lives in metro area, HH owns a house, and average HH size. Number of observations and F stat are reported for income volatility regressions.

3.3 Conclusion

In this study, I look at how expansions in SNAP eligibility after 1996 affected household income volatility. I use a simulated instrument approach to isolate eligibility changes arising from state level easing of vehicle, asset, and permanent resident eligibility rules.

For single mothers, a 10 percentage point increase in the state eligibility (approximately the increase in SNAP eligibility observed between the early 2000s and 2011) decreases the percentage deviations by which income differs from the mean by approximately 11 percent, of which around three quarters is attributed to behavioral changes and the rest to the direct effect. These results are, however, not significantly different from zero. Hours worked at a single mother's own business increases by 1.1 hour a week in response to a 10 percentage point increase in SNAP eligibility and this is significant at the 10 percent level, although the effect appears to be localized during the post-2008 recession period.

My simulated instrument makes full use of the three sources of state level policy variation available for SNAP. However, the lack of significance of my income volatility results is likely due to a low propensity of SNAP participation amongst those households made eligible by the policy changes. My strong first stage using state eligibility shows that these policies do explain a substantial part of the increase in eligibility observed. However, only single mothers show a relatively strong tendency to participate when made eligible, where a 1 percent increase in eligibility is associated with a 0.4 percent increase in participation. This is only significant at the 10 percent level, however.

The first policy recommendation of this study is to encourage high asset groups and permanent residents to apply for the program, either by informational campaigns designed

to reduce stigma or provide information about SNAP registration policies for migrants. In the current policy environment families that contain several members without a legal residency status are unlikely to participate regardless, however.

Secondly, recertification of participating households can be streamlined by further automating the process. At present it is common for households to miss several months of benefits because they fail re-certify immediately, a phenomenon known as SNAP churn.

Ultimately, the extent to which the program affects income volatility is a function of the level of benefits. To substantially reduce income volatility, SNAP benefits would have to be raised, although at present this is not politically viable.

A potentially promising direction for future research is to further investigate the increase of entrepreneurial activity of households below the poverty and the relationship of the social safety net to this trend. This may well be symptomatic of the broader societal shift towards less permanent employment, which in itself would increase the income and consumption volatility of the poor. Furthermore, it is important to determine why high asset groups and permanent resident have such low participation rates in the SNAP program.

Another promising pursuit would be to study how mental well-being and anxiety levels are affected by participation in the social safety-net. These outcome variables would provide insight on the impact that reduced income volatility can have on households.

APPENDIX A

8 AND 12 MONTH INCOME VOLATILITY

Table A.1: First stage - 8 month average fraction of state population eligible

	(1) High school	(2) Black/Hispanic	(3) Single mom
8m sim state frac elig	1.10***	.87***	.73**
	(.13)	(.22)	(.22)
GSP/capita gr rate	.10	.068	.23*
	(.071)	(.071)	(.095)
Population gr rate	-.15	-.11	-.94*
	(.49)	(.46)	(.45)
Unemployment rate	1.2*	2.2**	2.4***
	(.52)	(.65)	(.55)
Minimum wage	-.010	-.017*	-.006
	(.008)	(.007)	(.009)
Max EITC credit 2 dep	.000*	.000	.000
	(.000)	(.000)	(.000)
HH frac: in metro area	-.004	-.018	-.006
	(.013)	(.020)	(.020)
HH frac: owns house	-.25***	-.12**	-.25***
	(.062)	(.036)	(.045)
HH av: number of persons	.045**	-.0018	.037*
	(.016)	(.013)	(.014)
Observations	968	968	968
R squared	0.885	0.801	0.765
F stat on eligibility	71.6	15.6	11.0

Notes: Standard errors in parentheses and are clustered at the state level. All state level rates and fractions range from 0 to 1. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.2: First stage - 12 month average fraction of state population eligible

	(1) High school	(2) Black/Hispanic	(3) Single mom
12m sim state frac elig	1.10***	.82**	.79**
	(.14)	(.24)	(.24)
GSP/capita gr rate	.12	.07	.19*
	(.075)	(.076)	(.086)
Population gr rate	-.099	.083	-.67
	(.4)	(.39)	(.39)
Unemployment rate	1.3**	2.2**	2.5***
	(.49)	(.66)	(.52)
Minimum wage	-.009	-.019**	-.005
	(.007)	(.006)	(.009)
Max EITC credit 2 dep	.000*	.000	.000
	(.000)	(.000)	(.000)
HH frac: in metro area	-.009	-.027	.0093
	(.012)	(.019)	(.022)
HH frac: owns house	-.26***	-.17***	-.29***
	(.057)	(.041)	(.046)
HH av: number of persons	.034*	-.012	.032*
	(.015)	(.016)	(.015)
Observations	616	616	616
R squared	0.895	0.818	0.782
F stat on eligibility	61.7	11.7	10.8

Notes: Standard errors in parentheses and are clustered at the state level. All state level rates and fractions range from 0 to 1. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: First stage - 8 month average fraction of state population participating

	(1) High school	(2) Black/Hispanic	(3) Single mom
8m sim state frac elig	.12	.18	.45*
	(.15)	(.15)	(.21)
GSP/capita gr rate	.061	.091	.21**
	(.052)	(.05)	(.072)
Population gr rate	.41	.51	.74
	(.47)	(.42)	(.41)
Unemployment rate	-.054	-.35	1.2*
	(.48)	(.61)	(.56)
Minimum wage	-.014*	-.013*	-.014
	(.006)	(.005)	(.01)
Max EITC credit 2 dep	.000	-.000	-.000
	(.000)	(.000)	(.000)
HH frac: in metro area	-.042	-.052	-.046
	(.023)	(.036)	(.023)
HH frac: owns house	-.24***	-.24***	-.25***
	(.058)	(.059)	(.063)
HH av: number of persons	.048**	.016	.064***
	(.014)	(.015)	(.018)
Observations	968	968	968
R squared	0.835	0.832	0.792
F stat on eligibility	0.6	1.4	4.6

Notes: Standard errors in parentheses and are clustered at the state level. All state level rates and fractions range from 0 to 1. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.4: First stage - 12 month average fraction of state population participating

	(1) High school	(2) Black/Hispanic	(3) Single mom
12m sim state frac elig	.16	.13	.51*
	(.15)	(.15)	(.22)
GSP/capita gr rate	.064	.085	.25**
	(.054)	(.053)	(.083)
Population gr rate	.43	.82*	1.1*
	(.36)	(.35)	(.52)
Unemployment rate	-.26	-.32	1.3**
	(.52)	(.58)	(.47)
Minimum wage	-.013*	-.012	-.012
	(.006)	(.006)	(.010)
Max EITC credit 2 dep	.000	-.000	-.000
	(.000)	(.000)	(.000)
HH frac: in metro area	-.046*	-.05	-.043
	(.02)	(.03)	(.023)
HH frac: owns house	-.25***	-.23**	-.25***
	(.061)	(.068)	(.062)
HH av: number of persons	.049***	.0076	.067***
	(.014)	(.015)	(.018)
Observations	616	616	616
R squared	0.837	0.831	0.793
F stat on eligibility	1.1	1.4	5.4

Notes: Standard errors in parentheses and are clustered at the state level. All state level rates and fractions range from 0 to 1. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.5: Results - Each line shows a separate regression. The coefficient is that of 8m simulated state fraction eligible

	HS educated or less	Black or Hispanic	Single Mothers
Income volatility (8 month AAD/mean)			
Total income w/ SNAP	-0.14	-0.01	-0.22
	(0.28)	(0.09)	(0.24)
Total income w/o SNAP	-0.18	0.02	-0.34
	(0.31)	(0.09)	(0.33)
Earned Income	-0.32	-0.12	-0.23
	(0.43)	(0.11)	(0.25)
N	792	792	792
F stat first stage	71.6	15.6	11.0

Notes: Standard errors in parentheses and are clustered at the state level. AAD stands for absolute average deviations from the mean. All income variables are in 1996 dollars. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student, state growth rate per capita, state population growth rate, state unemployment rate, state minimum wage, maximum state EITC benefit for a HH of 2, HH lives in metro area, HH owns a house, and average HH size. Number of observations and F stat are reported for income volatility regressions.

Table A.6: Results - Each line shows a separate regression. The coefficient is that of 12m simulated state fraction eligible

	HS educated or less	Black or Hispanic	Single Mothers
Income volatility (8 month AAD/mean)			
Total income w/ SNAP	-0.25	0.01	-0.08
	(0.42)	(0.11)	(0.16)
Total income w/o SNAP	-0.29	0.01	-0.1
	(0.45)	(0.11)	(0.26)
Earned Income	-0.33	-0.12	-0.01
	(0.59)	(0.14)	(0.31)
N	484	484	484
F stat first stage	61.7	11.7	10.8

Notes: Standard errors in parentheses and are clustered at the state level. AAD stands for absolute average deviations from the mean. All income variables are in 1996 dollars. Other regressors included but not shown are state and month fixed effects, reference person age, reference person sex, reference person non white, reference person Hispanic, reference person married, reference person student, state growth rate per capita, state population growth rate, state unemployment rate, state minimum wage, maximum state EITC benefit for a HH of 2, HH lives in metro area, HH owns a house, and average HH size. Number of observations and F stat are reported for income volatility regressions.

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