SNAP and Food Consumption among the Elderly: a Collective Household Approach with Homescan Data*

Xirong Lin†

March 13, 2019

Abstract

Evaluation of welfare programs matters for individual welfare analysis and better policy design, for example, in-kind versus cash transfers. Previous literature normally assumes a household to be a single utility-maximizing agent. The resulting policy implications can be misleading because it ignores intra-household heterogeneity in preferences and bargaining power and joint consumption. Rather, this paper estimates a collective household model for evaluating the Supplemental Nutrition Assistance Program (SNAP) among the elderly population with longitudinal Homescan data which allows me to identify SNAP-eligible food. Using a counterfactual SNAP cash transfer experiment, I find that the husband has relatively stronger preferences for food than the wife. If one ignores that, the elderly couples' overall demand for food will be underestimated and it will further bias downwards, both intensively and extensively, the number of elderly couples whose demand for food is affected by cash transfers. Strong evidence of preference heterogeneity also highlights the important role of bargaining power within households. Given the lack of a SNAP cash transfer in real-world, the counterfactual experiment also directly tests the assumption, which is the main support for in-kind transfers, that poor households like less nutritious food than non-poor households. I find that for most eligible elderly households, their counterfactual SNAP-eligible spending is above the program's needs standard. Suggestive evidence on spending pattern implies that they are too poor to be food secure, not that they have different preferences. These results suggest that grocery vouchers or cash transfers would be more cost-effective than current in-kind transfers for the elderly population.

Keywords: SNAP, food consumption, elderly, collective household model, in-kind transfers, intra-household bargaining power, intra-household preference heterogeneity, consumption economies of scale, poverty

JEL codes: D11, D12, D13, I31, I32, I38

---

*I am extremely grateful to my advisors Arthur Lewbel and Claudia Olivetti for their invaluable guidance. I also thank Rossella Calvi, Tomoki Fujii, Denni Tommasi, Jacob Penglase, Yong-Hyun Park, Solvejg Wewel, and all participants of the Boston College Dissertation Workshop, the Boston University Labor Reading Workshop, the Economic Graduate Students' Conference (EGSC) at WUSTL, Eastern Economics Association Annual Meeting, BC-BU econometrics workshop, and AGEW for valuable comments. My research has been supported financially by the the Institute on Aging at Boston College. Researcher own analyses calculated (or derived) are based in part on data from The Nielsen Company (US), LLC and marketing databases provided through the Nielsen Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the Nielsen data are those of the researcher and do not reflect the views of Nielsen. Nielsen is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported here. All errors are my own.

†Department of Economics, Boston College, Chestnut Hill, MA 02467. E-mail: linxf@bc.edu

1 Introduction

Policymakers are interested in the evaluation of welfare programs (e.g., taxes, subsidies, and cash/in-kind transfers) in order to improve individual welfare by changing household consumption behavior. Household demand often has been modeled as the outcome of a single decision-maker/utility-maximizing agent (unitary approach). However, the literature on collective households argues that the assumptions under the unitary approach are too restrictive. Household consumption outcomes should be made by heterogeneous individuals within the household, not by one representative agent. The estimated demand responses to transfer programs would be biased if it did not account for within-household differentials.

Following the collective approach, this paper uses longitudinal Homescan data to estimate a collective consumption model for evaluating the Supplemental Nutrition Assistance Program (SNAP) among the elderly population (widows, widowers, and couples). I focus on the elderly because 70% of goods in the scanner data are food-related. For the elderly, expenditures such as clothing and transportation decrease dramatically while food remains a large chunk of their budget.[1] Food security and nutrition intake are among the largest concerns for the aging population.[2]

With the longitudinal Homescan data, I first estimate a collective demand model, accounting for within-household preference differentials, bargaining power, and savings through joint consumption. The resulting elasticities of substitution are estimated across aggregate goods, household members, and between more public and less public goods. Then, using information on household income, I select the SNAP-eligible households and calculate their potential benefits. Finally, I conduct a counterfactual experiment of a SNAP cash transfer and analyze the demand responses to this income effect, especially among the constrained elderly households (those whose SNAP-eligible spending was below their benefits). I find that husbands prefer relatively more food than wives. If one ignores that, the elderly couples' overall demand for food is underestimated. This further biases downwards, both intensively and extensively, the number of elderly couples whose demand for food would be affected by cash transfers.

The Nielsen Homescan data is a panel dataset covering 2004 - 2014. Households use in-home scanners to record all the purchased items, including prices, quantities, and coupon usage. The rich price variation across households and over time enables more accurate estimation of preferences. Individual goods are recorded at bar-code level, which allows me to identify SNAP-eligible food and spending.[3] This further allows me to more precisely estimate the proportion of

[1] Previous literature on the consumption retirement puzzle focuses explicitly on food among the elderly. For example, Aguiar and Hurst (2007) uses scanner-type data and finds that food expenditures are reduced while food consumption is not due to increased shopping intensity for lower prices and home production.

[2] SNAP provides 4.8 million seniors with the resources to afford an adequate diet. Kelsey Farson Gray, Sarah Fisher, and Sarah Lauffer, Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2015, prepared for the Food and Nutrition Service, USDA, November 2016, https://www.fns.usda.gov/snap/characteristics-supplemental-nutrition-assistance-households-fiscal-year-2015

[3] SNAP is an in-kind transfer. The benefits can only be spent on certain categories of food, including breads and cereals; fruits and vegetables; meats, fish and poultry; and dairy products.

constrained households, who are the main target of an in-kind transfer.[4]

Using the Homescan data, I estimate a collective household demand model. The household consumption decision is a bargaining outcome among household members, each with their own preferences and bargaining power. Following the collective literature, I use the resource share, the share of total expenditures enjoyed by the individual, as an indirect measure of the individual's bargaining power. A higher resource share implies that the couple's consumption behavior is represented more by one individual's preference. This model also allows goods to be jointly consumed, such that individuals not only make consumption decisions on aggregate goods, but also on more versus less public goods. I identify the separate preferences of each household member, their resource share, and the consumption economies of scale by adopting the methodology developed by Browning et al. (2013). The identification of the wife's and husband's respective preferences inside a couple comes from the preference similarity assumption between the wife and widow or husband and widower. widow(er)s' preferences are modeled by the Quadratic Almost Ideal Demand System developed by Banks et al. (1997). The key source of identification comes from the variation in prices and household expenditures: this enables me to disentanfgle price effects, income effects, and the observed heterogeneity in preferences by household characteristics.

Even though the data is at the bar-code level, which allows me to define narrow categories such as SNAP-eligible food, it is computationally impossible to estimate a demand system for millions of goods. Hence, I aggregate goods according to the product hierarchy imposed by Nielsen. Namely, I focus on the categories: *1)* General Merchandise, *2)* Health and Beauty, *3)* Food Grocery, *4)* Non-food Grocery.[5] I then construct the Stone Price Index for each aggregate good. Additionally, following a large literature in Industrial Organization, I address the price endogeneity problem using the average prices in nearby areas to construct price instruments.

The results of the benchmark demand model are the following: first, I find strong evidence of preference heterogeneity inside elderly couples. The wife prefers more Health and Beauty and Non-food Grocery, while the husband prefers more Food Grocery and General Merchandise. The mean resource share of the wife is 0.675, implying that the couple's consumption decision is represented more by the wife's preference. Strong evidence of preference heterogeneity highlights the important role of bargaining power, in this case within households. In terms of consumption economies of scale, I find General Merchandise to be the most public, while Food Grocery and Health and Beauty are the least public. These results are intuitive, because General Merchandise is composed mainly of household appliances and small electronics, which can be highly shareable. The finding on food is consistent with the previous literature.

After structural estimating the collective demand model, I conduct a counterfactual experi-

[4]Previous literature that uses expenditure survey data, such as CEX and PSID, only identifies total food and uses that to approximate SNAP-eligible spending. The resulting estimate of the proportion of constrained households would be too low. Unconstrained households have already spent out-of-pocket money equivalent to their benefits on SNAP-eligible food. For them, the in-kind transfer would be equivalent to a cash transfer. However, constrained households did not spend enough money on nutritious food. Previous literature normally assumes their preferences to be different, such that they might prefer other non-food necessities to food (Southworth 1945). Hence, policymakers use in-kind transfers to potentially distort their consumption towards more healthy food.

[5]Nilsen aggregates millions of bar-codes into 10 departments. Because six of them are food-related, I aggregate those departments into one aggregate good — Food Grocery. I drop Alcohol due to the censoring problem. I also move Tabacco from department Non-food Grocery to Food Grocery, which is common practice.

ment of a SNAP cash transfer. Even though the scanner data does not include information on SNAP eligibility or participation, the means-tested program feature of SNAP allows me to select SNAP-eligible households by using information on household income.[6] I also calculate potential household benefits following the current SNAP benefit formula. I simulate this as a cash transfer rather than an in-kind transfer because in the real-world, we only observe the outcomes of SNAP in-kind transfers, not the counterfactual cash transfer. One important basis for using in-kind transfers is the assumption that poor households have different preferences so that they might not spend all of their benefits, if given in cash, on nutritious food. I test that assumption directly by conducting the cash transfer experiment. My results have important implications for the debate on in-kind versus cash transfers. These results also allow me to calculate the *average*, rather than *marginal*, propensity to consume SNAP-eligible food out of benefits/cash. The estimate represents the demand responses to a substantial transfer, which speaks to the non-marginal design of SNAP.[7]

My counterfactual results show that the wife and husband both increase spending on Food Grocery and Non-food Grocery and decrease spending on General Merchandise and Health and Beauty. However, the husband's increase in food spending is 2.45% higher than the wife's. This means that the couple's demand for food is re-inforced by the husband's stronger preferences for food. The demand for food with SNAP might be underestimated without accounting for such preference heterogeneity. Further, the proportion of constrained elderly households is 43 - 47%, which is much higher than previous estimate using total food expenditures to approximate SNAP-eligible spending. Lastly, I find that among all constrained elderly couples, and 60-70% of constrained elderly widow(er)s, their post-treatment SNAP-eligible spending is above the program's needs standard; i.e., they are infra-marginal. This directly rejects the main argument of the in-kind design, that poor households would use most cash benefits to buy non-food goods. I further compare the spending pattern between constrained and unconstrained households, and SNAP-eligible versus ineligible households. I find the ratio of SNAP-eligible spending over total food spending to be around 80% for all of these households. By dividing food into healthy and unhealthy categories, I do not find that constrained households are more likely to eat unhealthy food. Next, by comparing the household income and food expenditures of infra-marginal versus extra-marginal households, I find the latter to be much poorer but to have similar total food expenditures.[8] All of the suggestive evidence implies that constrained households are too poor to be food secure, not that they have different preferences.[9]

In terms of policy implications, my results first show the importance of accounting for a within-household preference differential and bargaining power when we estimate the household

[6]Households whose income is below 130% of the poverty line are eligible for SNAP. There are requirements on employment and household assets. However, the requirements do not apply to the elderly population.

[7]Previous literature using a reduced-form approach only obtains the *marginal* propensity to consume food out of benefits. However, as pointed out by Hoynes and Schanzenbach (2009), one should be cautious in interpreting the "marginal" calculation for food stamps income due to the "non-marginal" nature of the program design.

[8]The infra-marginal households are those whose counterfactual SNAP-eligible spending is higher than SNAP benefits. The extra-marginal households are those whose counterfactual SNAP-eligible spending is higher than SNAP benefits

[9]a similar finding is obtained in Hoynes et al. (2015), which studies the spending pattern between SNAP-eligible and SNAP-ineligible households in the CEX and does not find significant differences in terms of expenditure shares.

demand responses to transfer programs. Second, because I find that poor elderly households like nutritious food as much as non-poor households, it would be more cost-effective to replace in-kind transfers with cash transfers in order to provide nutrition assistance among the elderly, given all of the screening costs, administrative costs, and collusion problems that are associated with in-kind transfers.

The remainder of this paper is organized as follows. Section 2 provides an overview of the related literature. Section 3 discusses the design of SNAP, its main objective, and particularly how a collective consumption model is appropriate in analyzing SNAP. Section 4 describes the data source and the construction of aggregate goods and prices. Section 5 presents the household model, its identification assumption, and the structural estimation results. Section 6 outlines the counterfactual exercise of a hypothetical SNAP cash transfer and its impact on household demand. Section 7 concludes.

2 Related Literature

This paper is related to two strands of literature: previous work on intra-household resource allocation, bargaining power, and consumption economies of scale; and the studies of in-kind transfer programs, in particular, of the impact of SNAP on food expenditures.

Early literature on household behavior often uses the so-called unitary approach, which assumes a household to be a single decision-maker. The implications from such models are income pooling and symmetry of the Slutsky matrix, both of which are frequently rejected in empirical studies.[10] In contrast with this unitary approach, a number of papers have focused on using household-level expenditure data to recover unobserved information about individual household members. Building on Becker (1965, 1974), Chiappori (1988, 1992) and Apps and Rees (1988), a number of papers adopt the collective approach, modeling a household as composed of several members, each with different preferences and among whom an intra-household bargaining process takes place. The only assumption in this type of model is Pareto efficiency of outcomes. One important element in these models is bargaining power, which is unobserved and is empirically challenging to identify. Recent papers propose to use *resource share*, i.e., the fraction of household resources that is enjoyed by an individual, as an indirect measure for the bargaining power. The early literature only identifies the change in resource share with respect to the change in *distribution factors* (the factors that affect bargaining power only, not preferences or budget constraint) (Chiappori (1992), Chiappori, Blundell, and Meghir (2002)). Later literature point-identifies the resource share with certain preference similarity assumptions (Browning, Chiappori, and Lewbel (2013) BCL hereafter; Lewbel and Pendakur (2008), Bargain and Donni (2009; 2012), Lise and Seitz (2011), Dunbar, Lewbel, Pendakur (2013; 2016), Calvi (2017), Calvi et al. (2017), Tommasi (2017), Tommasi and Wolf (2017), Penglase (2017), Wewel (2017), Wolf (2018)). Besides sharing resources, individuals in multi-person families also enjoy savings from joint consumption. This is

[10] Please see Chiappori and Mazzocco (2017) for a summary of tests on implications of the unitary approach.

related to studies on household size and composition and household expenditures (Barten (1964), Gorman (1976), and Lewbel (1985)). In the collective literature, goods are normally assumed to be either purely private or purely public due to identification difficulties. However, BCL does not impose this assumption. It identifies both the resource share and the public nature of goods. It is ideal to be applied to study individual welfare inside multi-person households. Cherchye et al. (2012) apply BCL to an individual welfare analysis of elderly widow(er)s using Dutch data. Wewel (2017) applies BCL to PSID in the U.S. and studies the heterogeneity in gains from marriage. This paper is the first one that applies BCL to scanner-type consumption data and studies the effect of transfer programs on household demand.

Closely related to demand estimation, demand responses to in-kind transfer programs have attracted much attention. Among these programs, SNAP has been widely studied.[11] Early literature on in-kind transfers (Gruber and Yelowitz (1999), Fraker (1990); Haider et al. (2003)) and cash-transfers (Engen and Gruber (2001), Gruber (1997; 2000), Hubbard et al. (1995), and Kantor and Fishback (1996)) often finds that among constrained households an in-kind transfer induces a larger increase in demand for the subsidized good than an equivalent cash transfer. However, they often compare participants with non-participants, and the results suffer from a "selection into the program" problem. That is, those who enroll might have different preferences from those who do not, and preferences are correlated with food expenditures (Bitler (2014)). A recent exception in the literature is Hoynes and Schanzenbach (2009), who used a difference-in-difference model, exploiting the county-level variation in the timing of adopting the food stamp program (FSP). They argued that food stamps are equivalent to cash among most households. Another exception in the literature is Cunha (2014), who finds little distortion under the in-kind design in total food consumption, but large variation in distortion in individual foods. All of these reduced-form papers argue that the effectiveness of an in-kind transfer relative to an equivalent cash transfer relies on the proportion of constrained households, who are hypothesized to have different preferences and to dislike nutritious food. However, no studies have directly tested this assumption. As an indirect evidence, Hoynes and Schanzenbach (2015) compares the expenditure pattern between eligible and ineligible households using Panel Study of Income Dynamics (PSID) and find no significant difference between them. I directly test this assumption by conducting a hypothetical SNAP cash transfer in my counterfactual analysis. Moreover, previous research normally uses expenditure survey data (CEX or PSID), which only has information on total food expenditures, not SNAP-eligible spending. The resulting estimate of the proportion of constrained households is biased downwards. Recent papers overcome that data limitation by using Homescan data (Johnson et al. (2018), Hasting and Shapiro (2017), Dubois et al. (2014), Amano (2018)). However, they all assume a household to be a single utility-maximizing agent and do not account for intra-household heterogeneity in preference and bargaining.

[11] Please see Bitler (2014) and Hoynes and Schanzenbach (2016) for a comprehensive literature on the effects of SNAP and its predecessor the Food Stamp Program, on food spending.

3 Supplemental Nutrition Assistance Program: the Design and its Main Objective

I begin my empirical inquiry by describing the background of SNAP, particularly its objective and its chief characteristics of operation, i.e., the in-kind design. I then discuss the theoretical support for the in-kind design by distinguishing its impact on consumption between constrained versus unconstrained households. Third, I analyze the situations in which the theoretical predictions might not hold, in particular, where the in-kind design would be equivalent to a cash transfer, even for constrained households. Finally, I discuss why the collective approach matters for the demand responses to cash transfers and how it alters the implications on in-kind versus cash transfers.

SNAP is the largest program in the domestic hunger safety net. According to the U.S. Department of Agriculture (USDA), its main objective is to increase food security and to reduce hunger by increasing access to food, a healthy diet, and nutrition education for low-income Americans. Besides its nation-wide coverage for poor households, SNAP plays an important role for seniors living in poverty.[12] Specifically, SNAP provides 4.8 million seniors with the resources to afford an adequate diet. Seniors represent 11 percent of all SNAP recipients in 2015.[13] Moreover, seniors receiving SNAP benefits tend to live alone: only 1 in 4 live in households with other members.

3.1 the In-Kind Design of SNAP

As an in-kind transfer program, SNAP benefits can only be used for food that recipients buy to prepare and eat at home. Because its goal is promoting nutrition among the poor population, SNAP mainly covers four categories of food: 1) breads and cereals; 2) fruits and vegetables; 3) meats, fish and poultry and dairy products; 4) and seeds and plants that produce food for the household to eat. The subsidies exclude beer, alcohol, cigarettes, or tobacco. Moreover, it has to be food to be prepared at home, implying that any hot food or deli is not allowed. The participants use an electronic benefits card (EBT card), which is accepted at a broad range of businesses, including pharmacies, grocery stores, gas stations, and other small chains such as convenience stores.[14]

[12]The seniors defined by SNAP are individuals aged 60 years and older.

[13]Kelsey Farson Gray, Sarah Fisher, and Sarah Lauffer, Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2015, prepared for the Food and Nutrition Service, USDA, November 2016, https://www.fns.usda.gov/snap/characteristics-supplemental-nutrition-assistance-households-fiscal-year-2015

[14]The Electronic Benefits Transfer (EBT) card is how Department of Transitional Service (DTA) delivers its core services: food and economic assistance. It works and looks like a debit card. The benefits are kept in a special account for participants. For SNAP participants, they can use the EBT card anywhere that displays a "Quest" logo and the participating store will have an EBT working machine. At check-out, the participant simply swipes the EBT card and tells the cashier how much money to enter or enter the purchase amount by self. SNAP participants can only buy eligible food items with the SNAP benefits.

3.2 the Motivations of an In-Kind Transfer

This subsection describes the motivations behind an in-kind transfer. One main justification for in-kind design of transfer programs, as opposed to cash transfers, is to promote consumption of certain goods that are policy desired, i.e., paternalistic motivations (Currie and Gahvari 2008). In terms of SNAP, whose main objective is to promote food security and nutrition intake among the impoverished population, the paternalistic motivation would be to promote a nutritious, home-made food diet, given the worrisome fact that malnutrition and a poor-nutrition diet are more common among low-income households (Amano 2018).

Figure A1 shows the impact of SNAP benefits on the budget constraint.[15] The red line represents the original budget constraint. The dashed green line represents the post-transfer budget constraint. Without an in-kind design, SNAP benefits would be equivalent to income transfers. However, the in-kind design forces participants to spend benefits only on SNAP-eligible food. This results in the upper rectangular area which is unattainable with in-kind transfers.

Figure A2 shows the demand responses to SNAP benefits among unconstrained households. For them, since they have already spent at least the same amount of out-of-pocket expenditure as their potential SNAP benefits on SNAP-eligible food, the in-kind transfer would simply act like cash and replace, one-to-one, their out-of-pocket expenditure on SNAP-eligible food. Their optimal consumption choice would change from A_0^* to A_1^*.

Figure A3 shows the demand responses to SNAP benefits among constrained households. B_0^* is the pre-treatment consumption allocation and B_1^* is the post-treatment consumption allocation. B_1^* in both the left and right panel represents the demand response under a cash transfer. The left panel (a) represents the situation in which constrained households have strong preferences for food and their post-treatment SNAP-eligible spending is above the program's needs standard. In this case, in-kind transfers are equivalent to cash transfers, even for these very poor and constrained households. The right panel (b) represents the situation in which constrained households have stronger preferences for other non-food goods than for SNAP-eligible food, so that they spend most of their benefits on other goods. By giving them in-kind benefits, their consumption would be distorted to the kink point C.

Constrained households are normally very poor households with household income below that of unconstrained households. Empirical evidence suggests that poor households eat less nutritious food than non-poor households (Amano 2018). Hence, the previous literature often assumes that poor households have different preferences: that they don't like nutritious food as much as non-poor households (Southworth 1945). This provides the main support for using in-kind transfers. However, it is not clear whether households are too poor to be food secure or have different preferences. I directly test this assumption with a counterfactual experiment of a hypothetical SNAP cash transfer. I further use suggestive evidence on spending patterns and compare it for constrained versus unconstrained households to explore whether poor households indeed prefer

[15] The budget constraint in figure 1 represents exactly the average constraint faced by elderly couples in Nielsen Homescan data. The budget constraint shifts outwards by an amount that is equal to the average benefits that I calculate for the elderly eligible couples in Nielsen Homescan data.

less nutritious food.

Specifically, under a cash transfer consumption re-allocation for constrained households is a function of the content of the in-kind transfer, the content of other goods shown in diagram 1, and the characteristics and preferences of the analyzed population.

The content of an in-kind transfer is the extent of restrictions of a voucher and the magnitude of distortion. The more limited the SNAP-eligible foods are versus total foods, the less an in-kind nature is a food stamp, and the less distorting is the impact of in-kind design. Hence, it is crucial to clearly identify SNAP-eligible food. I achieve this using the Nielsen Homescan data, which has bar-code level information on goods.

Household preferences for SNAP-eligible food are affected by other possible choices, i.e., the non-food goods. Nielsen Homescan data mainly consists of grocery-type goods, and 70 percent of the goods are food-related. This might lead my results to overstate the preferences for food and suggest the benefits to be infra-marginal. However, the problem is less serious because I focus on the elderly population, whose expenditures on transportation or clothing decrease dramatically after retirement. Instead, food constitutes a large chunk of their budget.

One crucial determinant of consumption choice is the characteristics and preferences of the analyzed population. Strong preferences for food would be evidence supporting cash transfers, given all the screening costs and collusion problems associated with in-kind transfers. This leads to my argument: that the collective approach is critical in estimating households' preferences for food as discussed in the next subsection.

3.3 The In-kind Design: a Collective Household Approach

Given these descriptions the theoretical motivations of an in-kind transfer, and its implications for the distorting effect, I proceed to demonstrate why the collective household approach is more appropriate than the unitary approach or the reduced-form approach for studying the in-kind design.

The collective approach allows for preference heterogeneity between the wife and husband. If one ignores that and if one partner has very strong preferences for food, the overall household demand for food might be underestimated. This further biases downwards, both intensively and extensively, the number of households who would be affected under a cash transfer. Moreover, preference heterogeneity exists not only on aggregate goods but also on goods with different jointness/publicness. For example, a microwave is more attractive to an individual who lives within the couple rather than the same individual living alone because it can be shared between wife and husband. When couples decide an consumption allocation between food, which has less jointness, versus general merchandise, they also take savings from joint consumption into consideration.

In short, the collective approach allows for elasticities of substitution not only across aggregate goods but also across household members, and between more public versus less public goods. It allows for counteracting or reinforcing preferences across households members; such preferences

exist not only on aggregate goods but also on goods with different jointness. If one ignores these interactions, the resulting demand estimates will be biased and further bias the demand responses to cash transfers. Eventually this would result in biased implications about the cost-effectiveness of cash versus in-kind transfers.

Generally speaking, the collective demand model is a model of structural demand, which allows me to conduct a counterfactual experiment of a hypothetical SNAP cash transfer. In the real-world, we only observe the outcomes under the SNAP in-kind transfer never under a counterfactual equivalent cash transfer. But replying only on the proportion of constrained households to show the effectiveness of in-kind transfers is also questionable, because the underlying assumption "that poor households have different preferences" is never verified. The collective approach allows me to both test the assumption directly and to simulate the outcomes under a cash transfer.

4 Data Sources

4.1 Nielsen Homescan Data

I base my analysis on the Nielsen Homescan Data made available through the Kilts Center at the University of Chicago Booth School of Business. The data period studied in this paper ranges from year 2004 to 2014. The database is particularly suitable for analyzing consumption behavior as it provides detailed information on price, quantity, and comprehensive household characteristics.

The data comprises a representative panel of households in the U.S. that use in-home scanners to record all of their purchases (from any department stores, grocery stores, drug stores, convenience stores, and other similar retail outlets) intended for personal, in-home use.[16] Nielsen maintains a dataset of current prices for stores within its metropolitan area. Given the store and date information, Nielsen links the product/UPC scanned by the household to the actual price of the store that the product was sold.

A key advantage of the data is that it directly measures prices at the household level. The rich price variation over time and across households allows me to estimate preferences. Estimates using more aggregated purchase data and price indexes from other sources, such as the Consumer Price Index, provides much less accurate estimates of preference parameters and price elasticities. Another advantage of the data is its highly disaggregated product structure (barcode - product module - product group - department), which allows me to identify different types of food, especially SNAP-eligible and non-SNAP-eligible food. The estimates of SNAP's impact on food expenditures will be much more accurate. Panel data on household purchase information and characteristics allows me to control for individual heterogeneity. Other consumption datasets are often cross-sectional, and hence the identification of preferences often relies on enough price and expenditure variation across households. The preference parameters estimated from panel data

[16]For more description of Nielsen Consumer Panel data, please see https://research.chicagobooth.edu/nielsen/datasets

not only reflect cross-household variation but also within-household variation.

Nielsen aggregates millions of UPCs into 9 departments, 6 out of which are food-related, including dairy, deli, dry grocery, fresh produce, frozen food, and packaged meat. I aggregate these 6 departments into one aggregate good food. The items under food in Nielsen while excluded by SNAP include prepared food (ready to serve, dry mixes, and frozen), pet food, ice, and deli. They account for 20% of the food expenditure. Besides food, the remaining three aggregate goods are health and beauty, non-food groceries (like housekeeping supplies, smoking supplies, pet food and services), and general merchandise.[17]

The largest aggregate good in Nielsen Homescan data is food, which accounts for around 70% of the total expenditure tracked by Nielsen. Aguiar and Hurst (2007) points out that the life-cycle pattern of household expenditures recorded in Homescan is roughly consistent with that reported for food expenditures at home in PSID. Table A12 in the Appendix maps the aggregate goods in this paper to the categories of goods in CEX. Table A13 compares the total food expenditure in Nielsen with that in CEX. The numbers are very similar. Nielsen estimates that approximately 30 percent of household consumption is accounted for by consumer panel data categories; however, they do not track other sources of consumer spending beyond the Nielsen-tracked categories. Nonetheless, the fraction might be larger for the elderly population. It is because their non-food expenditures such as clothing, transportation, etc decrease dramatically after retirement. It is suggested by figures A6 and A7.

In the Appendices, I provide details on how Nielsen tracks prices. I also discuss a number of potential data quality issues and attritions with the Homescan data. These issues include: coverage of the goods scanned by households in Nielsen and its comparison between other commonly used survey data (CEX; PSID), measurement error in price, and sample attrition.

5 A Structural Analysis of Household Demand

In this section, I provide a structural model of household demand to study the effects of transfer programs on household consumption later. In particular, I follow the collective framework developed by Browning et al. (2013) to account for gender asymmetries in preferences, bargaining power, and savings through joint consumption in elderly couples. To estimate the demand system, I also discuss the price construction and the instrument for price corresponding to the aggregate goods constructed in section 4.

5.1 A Collective Model of Households

The households studied in this paper are elderly widowhood households living alone and elderly couples. For widows and widowers living alone, the unitary approach would be appropriate since there is only one decision maker. However, a household of a couple is composed of a wife and a

[17]The goods under general merchandise are normally small household electronics, such as scissors and toasters. They are less of durable goods like refrigerator or television.

husband. Children can be modeled as public goods. Let superscript i denote household member, h denote household, and subscript j denote goods. For convenience, let f denote wife and m denote husband. There are n goods in the model, i.e., $j = 1, ...n$. $x^i = (x_1^i, ..., x_n^i)$ is the vector of member i's private equivalent consumption of goods. z is the purchased bundle of goods of a household.

Each household member i has a monotonically increasing, continuously twice differentiable and strictly quasi-concave utility function $U^i(x^i)$ over a bundle of n goods x^i. The household solves the following household program

$$\max \mu(p/y)U^f(x^f) + U^m(x^m) \text{ subject to the following constraints} \tag{1}$$

$$x = x^f + x^m \tag{2}$$

$$z = F(x) = z = Ax \tag{3}$$

$$p'z = y \tag{4}$$

p is the price vector of purchased goods. y is the total expenditure. Equation (2) says that the household private consumption is equal to the sum of the wife's private consumption and the husband's private consumption. Equation (4) is the household's budget constraint. μ is the Pareto weight of the wife relative to the husband. It measures the relative decision power of the wife in the household consumption decision process. Larger μ implies that a household's preferences represent more of the wife's preferences relative to the husband's. However, Pareto weight suffers from the utility cardinalization problem. Instead, BCL (2013) uses resource shares to represent bargaining power.

Equation (3) is the consumption technology function. I assume there exists a linear consumption technology function between x and z. A is a diagonal matrix with off diagonal elements equal to zero. The intuition of the consumption technology function is that a household purchases a bundle of goods and then transforms the purchased bundle into private equivalent consumption following the technology function. The diagonal element of matrix A is the Barten scale.

The key assumption in the above household program is that the decisions are Pareto efficient. From the second welfare theorem, any Pareto efficient outcomes can be implemented as an equilibrium of the economy, possibly after some lump sum transfers between members. Hence, the duality of the above household program can be summarized as a two-stage process. In stage one, household's total expenditure is divided between wife and husband according to some sharing rule $\eta(p/y, d)$, which is the fraction of resources enjoyed by the wife. The husband then enjoys $1 - \eta(p/y, d)$ fraction of resources. Sharing rule depends on price, total expenditure, and distribution factors. In stage two, each member i chooses her or his private equivalent consumption

x^f and x^m to maximize her or his own utility U^i given a Lindahl (1919) type shadow price vector and resource share (η for wife and $1-\eta$ for husband). To summarize, under Pareto efficiency, there exists a shadow price π and a sharing rule η, with $0 \leq \eta \leq 1$, such that

$$\pi(p/y) = \frac{A'p}{y} \tag{5}$$

$$z = h(p/y) = Ah^f(\frac{A'p}{y}\frac{1}{\eta(p/y)}) + Ah^m(\frac{A'p}{y}\frac{1}{1-\eta(p/y)}) \tag{6}$$

Shadow price π is determined by the Barten scale A and the market price p. The smaller the A is, the greater the sharing degree of the good, and hence the lower the shadow price. $h(p/y)$ is the Marshallian demand function. Equation (6) says that the couple's Marshallian demand is a weighted average of the wife's Marshallian demand and husband's Marshallian demand, where the weight is given by their resource share respectively.

5.2 Quadratic Almost Ideal Demand System ($QAIDS$)

In the empirical application, I assume that individuals have preferences given by the $QAIDS$ demand system of Banks et al. (1997). For $i = f$ or m, let $\omega_i(\frac{p}{y^i})$ denote the n-vector budget share of member i when living as a single, faced with n-vector of price p and total expenditure y^i. The $QAIDS$ demand equation takes the following form

$$\omega_i(\frac{p}{y^i}) = \alpha^i + \Gamma^i \ln p + \beta^i[\ln(y^i) - c^i(p)] + \frac{\lambda^i}{b^i(p)}[\ln(y^i) - c^i(p)]^2 \tag{7}$$

where $b^i(p)$ and $c^i(p)$ are price indices defined as

$$\ln[b^i(p)] = (\ln p)'\beta^i \tag{8}$$

$$c^i(p) = \delta^i + (\ln p)'\alpha^i + \frac{1}{2}(\ln p)'\Gamma^i \ln p \tag{9}$$

Here, α^i, β^i, and λ^i are n-vector parameters, Γ^i is $n \times n$ matrix of parameters. δ^i is a scalar parameter which I set to zero (Browning et al. (2013) also imposed this condition based on the sensitivity reported in Banks et al. (2017)). The adding up condition implies that $e'\alpha^i = 1$ and $e'\beta^i = 0$ where e is an n-vector of ones. In other words, the sum of budget shares at zero expenditure level equals to one . Homogeneity implies that $\Gamma^i e = 0$. Slutsky symmetry is equivalent to Γ^i being symmetric.

5.3 Prices

The Nielsen Consumer Panel Data provides information on total money spent, purchase date, and store code for every trip made within the year. For each trip, panelists are instructed to

scan all UPCs purchased during the trip.[18] The scanned information includes a UPC number, the total price paid, coupon value, deal flag (1 = deal, 0 = no deal), and quantity.

Not all the panelists will purchase every UPC, and not all UPCs are available in every state. Instead of aggregating from UPCs to an aggregate composite, I first calculate the household yearly average price of a product group and then aggregate price from group to composite. If a panelist does not purchase a product group during the year, I use the average price of that group of the state that the panelist lives in to refer to the household's price for that group.

Ideally, to reflect the price faced by a specific household, the weight for each product group price should be the household's own expenditure share for that group. However, the more precise the weight is, the more serious the endogeneity problem of the price index will be. Another common way is to use nation-level expenditure share (Amano (2018)). However, it loses too much of a household's own price information and is not precise. In this paper, I choose the state-level expenditure share, which will suffer less from the endogeneity problem while still providing certain precision of the household's own price index.

Denoting t as purchase date, yr as year, s as state, g as product group, I calculate the household average price per group at year y as

$$p_{g,h,yr} = \sum_{u \in g, t \in yr} \frac{total\ price\ paid_{u,h,t} - coupon_{u,h,t}}{quantity_{u,h,t}} \tag{10}$$

If a household does not purchase any products among a group, the imputed price for this household is

$$p_{g,h,yr} = \sum_{u \in g, t \in y, h' \in s(h)} \frac{total\ price\ paid_{u,h',t} - coupon_{u,h',t}}{quantity_{u,h',t}} \tag{11}$$

where $s(h')$ is the state that household h lives in.

The yearly stone price index for composite c is calculated as

$$SPI_{c,h,yr} = \sum_{u \in c} share_{g,s,yr} \times \log(P_{g,h,yr}) \tag{12}$$

where $share_{g,s,yr}$ is the state-level average budget share of a product group out of its corresponding aggregate good c among all the households in state s. Particularly, it is defined as

$$share_{u,s,yr} = \frac{1}{H} \sum h \in s(h) \frac{total\ price\ paid_{g,h,yr} - coupon_{g,h,yr}}{total\ price\ paid_{c,h,yr} - coupon_{c,h,yr}} \tag{13}$$

where H is the total number of households in state s.

[18] The Universal Product Code (UPC) is a barcode symbol that is widely used in the United States, Canada, United Kingdom, Australia, New Zealand, in Europe and other countries for tracking trade items in stores. UPC (technically refers to UPC-A) consists of 12 numeric digits, that are uniquely assigned to each trade item.

5.4 Identification

The main identifying equation for the couples' demand is equation (6), which decomposes a couple's demand function into a weighted sum of the wife's and husband's demand function, where the weight is given by the resource share and the Barten scale enters as a price discount factor inside their respective demand function. Because that consumption data for a couple is only observed at the household level but not at the individual level, the wife's demand h^f and the husband's demand h^m are not observable (at least for non-private goods). To overcome the identification challenge, Browning et al.(2013) uses single females' demand to represent the wives' demand and single males' demand to represent the husbands' demand. The implicit assumption is that singles' preferences are similar to married people's. The assumption is vulnerable to the selection into marriage problem, that is, those who get married might have different preferences compared with those who stay single. It has been challenged empirically by Brugler (2016), who uses the Consumer Expenditure Survey in the U.S. and rejects the assumption. Instead, since my sample focuses on the elderly, I use the widows' and widowers' preferences to represent the elderly wives' and husbands' preferences. Both widows and widowers were married before and hence the identification does not suffer from the selection problem. In other words, the identification assumption in this paper is that widows' and widowers' preferences are similar to the elderly wives' and husbands' preferences.[19] It implicitly assumes that married people do not change preferences after the loss of their significant others.[20]

5.5 Estimation

5.5.1 Instrument for price

Prices could be endogenous in the estimation of the demand function. Particularly, the error term of the demand equation can have unobserved household preference, which might be correlated with prices. For example, consumers might have different preferences in terms of stores at which they shop. The prices at a high-end supermarket, such as Whole Foods, will be different from the prices at a low-end supermarket. To account for this potential endogeneity, I use "leave out" yearly average price for each product group. Specifically, for each household i, the instrument of $\textit{yearly average price}_{g,h,y}$ will be calculated in the same way as in equations (1) and (2), while only for the households whose county codes are different from household h. The implicit assumption is that the unobserved preferences are not correlated across different markets (defined by county). The "leave out" price for a group is defined as

[19] The same identification strategy has been used in Cherchye, De Rock, and Vermeulen (2012)

[20] Table 1 shows that elderly widow(er)s tend to be older than elderly wives (husbands). Even though I control for "age" in QAIDS, there can still be unobserved characteristics of elderly widow(er)s that might be correlated with the explanatory variables and leads to "endogeneity issue". For example, elderly widow(er)s might be more likely to choose their spouse who might die early and hence they are different compared to elderly couples. This would challenge the preference similarity assumption. However, it is not clear how this issue would bias the results since the preferences of wife or husband are unobserved.

$$\pi_{g,y,m} = \frac{1}{M} \sum_{m \neq m(h)} \frac{1}{m} \sum_{h' \in m(h')} p_{g,h',t} \tag{14}$$

where m is a market(county) and M is the total number of markets excluding household h's own market.

5.5.2 Sharing Rule

For couples, I need to estimate the sharing rule and Barten scales from equation (6). The sharing rule is parametrically identified with the functional form

$$\eta = \frac{\exp(s'\delta + q'\sigma)}{1 + \exp(s'\delta + q'\sigma)} \tag{15}$$

where s denotes distribution factors, δ denotes its coefficients, q denotes preference factors, and σ denotes its coefficients. Both distribution factors and preference factors can affect the sharing rule. The logistic form bounds the resource share between 0 and 1. If none of the distribution factors are significant, then the resource share of the wife will be 0.5. The distribution factors are chosen such that they affect bargaining power but not the preferences. The distribution factor candidates include difference in education.[21] The preference factors include female some college, male some college, log real total expenditure, dummy for Black or African American, dummy for the households with microwave, garbage disposal, and dishwasher, and dummy for the households with Internet connection.

5.5.3 Budget shares for elderly widows and widowers

My model starts with the utility derived functional form of the budget shares for the singles and married couples. I use a $QAIDS$ demand system to estimate equations (12) to (14). The system of demand equations for a type i (i = female, male, or couple) household is defined as below

$$\omega^i(\frac{p^h}{y^h}) = \alpha^i + \gamma^i \ln p^h + \beta^i[\ln(y^h) - c^i(p^h)] + \frac{\lambda^i}{b^i(p^h)}[\ln(y^h) - c^i(p^h)]^2 \tag{16}$$

where $b^i(p)$ and $c^i(p)$ are price indices defined as

$$\ln[b^i(p^h)] = (\ln p^h)'\beta^i \tag{17}$$

$$c^i(p^h) = \delta^i + (\ln p)'\alpha^i + \frac{1}{2}(\ln p^h)'\Gamma^i \ln p^h \tag{18}$$

I allow observable preference heterogeneity in α^i and β^i by letting the α^i parameters to depend on demographic variables. The equation of α^i is written as below

[21] Previous literature also includes difference in age, unemployment, and wage ratio as potential distribution factors. However, the sample in this paper only consists of the elderly, who age is either "55-64" or "65+". The majority of the sample do not work (76% of elderly widows and 79% of elderly widowers, and more than 60% of the female and male heads in elderly couples do not work). Including employment status might cause multicollinearity problem in the estimation. Wage information is not available in the data as well.

$$\alpha_k^i = \alpha_{k0}^i + \sum_{m=1}^{M_\alpha} \alpha_{km}^i d_m \tag{19}$$

$$\beta_k^i = \beta_{k0}^i + \sum_{m=1}^{M_\beta} \beta_{km}^i d_m \tag{20}$$

where $M_\alpha = 10$ for the widows and widowers respectively. It includes 8 region dummies, a Black/African American dummy, and a some college education dummy. $M_\beta = 2$ for the widows and widowers respectively. It includes a kitchen appliances dummy (microwave, garbage disposal, and dishwasher owner) and an Internet ownership dummy.

I next estimate the full $QAIDS$ demand system for the widows and widowers. With unobserved heterogeneity, equation (16) is re-written as

$$\omega_i(\frac{p^h}{y^h}) = \alpha^i + \gamma^i \ln p^h + \beta^i[\ln(y^h) - c^i(p^h)] + \frac{\lambda^i}{b^i(p^h)}[\ln(y^h) - c^i(p^h)]^2 + u^{ih} \tag{21}$$

where u^{ih} denotes household unobserved heterogeneity in α^i and β^i. Both prices and total expenditures can be endogenous. Total expenditure from the purchase data is instrumented with the total expenditure from the trip data. The latter is the total amount on the receipt of a household trip. The former are author-calculated expenditures by summing up expenditures of all scanned items. Since the household might forget to scan some item or scan the wrong item, the latter is more accurate than the former.[22] Previous literature often argues that total expenditures can be endogeneous. For example, there might be discount on general merchandise for a particular year such that the panelist has strong preference for general merchandise and the total expenditure in that year is much higher than in other years. However, since there are fewer large durable goods contained in the data, even under general merchandise, which contains mainly small electronics in grocery-type stores. The engogeneity problem is not as serious as in other papers that use more aggregated-level expenditure surveys like CEX or PSID. Previous literature has used household income as instrument for total expenditure. However, household income is collected only across discrete income ranges and the income bins are measured with a two-year lag relative to the observed shopping date. It will not be a good instrument for total expenditure. If households have preferences in terms of which item to scan, and such unobserved preferences might also be correlated with the total expenditure from the purchase data, then the total expenditure from the trip data will also account for such endogeneity since it does not depend on the selections of scanned items. Equation (21) is estimated with the General Method of Moment (GMM). The full set of instruments for the widows/widowers includes the demographic variables, log relative prices plus log real total expenditure from the trip data, its square, and its interaction with the kitchen appliances ownership dummy and the Internet dummy. The instruments for couples include the instruments that I use for widow(er)s, with individual specific values for husbands and wives, where appropriate.

[22] Total expenditures from the purchase data is around two thirds of that from the trip data

Following BCL (2013), I also assume that the errors are uncorrelated across households but are correlated between goods within households. To allow for the adding up condition, I drop one aggregate good demand in estimation and the resulting system is composed of $n-1$ goods and the budge share vector ω_k is an $(n-1)$ vector. Let θ denote the vector of all parameters and let $\hat{\omega_h}(\theta)$ denote the predicted budget share for household h. Let H_f denote the number of widows. Let z_h^f) denote the vector of instruments in widows' demand estimation. z_h^f) is a $(1 \times g_f)$ vector. The vector of moment conditions is given by the $(n-1)g_f \times 1$ vector:

$$v^f(\theta) = \sum_{h=1}^{H_f} \hat{u_h}'(I_{n-1} \otimes z_h^f) \tag{22}$$

and similarly for the widowers. The weighting matrix for the widows is defined as

$$W_f = (\sum_{h=1}^{H_f}(I_{n-1} \otimes z_h^f)\breve{u_h}\breve{u_h}'(I_{n-1} \otimes z_h^f))^{-1} \tag{23}$$

where $\breve{u_h}$ are taken from the first stage GMM with an identity weighting matrix. The GMM criterion for the single females is:

$$\min_{\theta}(v^f(\theta)'W_f v^f(\theta)) \tag{24}$$

The estimation of the widowers' demand is similar to that of the widows'.

5.5.4 Estimation of the Joint Model

The widows' and widowers' budget shares are computed by estimating equations (16) to (18). For elderly couples, I assume a Barten type consumption technology function

$$z_j = A_j x_j \tag{25}$$

The implied shadow price for this technology is

$$\pi_j = \frac{A_j p_j}{y} \tag{26}$$

where p is the market price faced by a household and y is the total expenditure of the household.

The parameterization of η is denoted as equation (15). With the specified technology function, the shadow price, and the sharing rule, equation (11) yields the following couples' budget share equation

$$\omega_j(p/y) = \eta\omega_j^f(\frac{\pi}{\eta}) + (1-\eta)\omega_j^m(\frac{\pi}{1-\eta}) \tag{27}$$

where ω_j^f and ω_j^m are the female head's and the male head's demand functions, estimated using equations (16) to (18).

The baseline parameters of the couples' model consist of the $QAIDS$ parameters for the widows' and widowers' budget shares, ω_j^f and ω_j^m; distribution factors and preference factors of the sharing rule and 4 parameters of the Barten scales. I estimate the $QAIDS$ parameters of the widows and widowers alone with the Barten scales and the sharing rule.

The joint model is estimated by GMM using the following criterion

$$\min_{\theta}(v^c(\theta)'W_c v^c(\theta) + v^f(\theta)'W_f v^f(\theta) + v^m(\theta)'W_m v^m(\theta)) \tag{28}$$

where θ is the full set of parameter values, and W_m and W_f are taken from equation (20). The weighting matrix for the couples W_c is derived by using a 2 stage GMM for the full system, starting with an identity matrix.

5.6 Empirical Results

5.6.1 Sample selection

I choose the elderly widows and widowers who are "ever-widowed households", i.e., who have been widowed at least once during the sample period. The elderly are defined as those who are 55+. I further trim the three samples with respect to key variables (yearly budget share of each aggregate good and log yearly total expenditure) by dropping observations in the lower and upper 5 percentiles.[23] I also drop observations if one of the household heads is a student.[24] Table 1 presents the summary statistics.[25]

5.6.2 The sharing rule

The main results for the preferred model are displayed in table 2. Model (1) includes only one distribution factor: a dummy of female's education higher than male's. A female who has higher education than a male will have 0.58 more resource share than one who does not. Model (2) includes all distribution factors and preference factors. The significant positive sign of log real total expenditure suggests that female heads in households with higher total expenditure are more likely to have higher resource share.[26] In addition, female heads in households with Internet connection or microwave, dishwasher, and garbage disposal have lower resource share on average.

[23] This drops 14747 observations of elderly widows, 2926 observations of elderly widowers, and 44791 observations of elderly couples.

[24] This drops 42 observations for elderly widow and 291 observations for elderly couples. None of the elderly widowers are students.

[25] The sample size of elderly widows is about five times that of the elderly widowers. This is consistent with current elderly widow-widower ratio in the U.S.. Elderly widows are on average poorer than widowers. The average household income of elderly widows is about 70% of that of elderly widowers. Despite the difference in income, the total expenditure and the budget shares across the four aggregate goods are similar between elderly widows and widowers. Elderly widows prefer slightly more of health and beauty and non-food groceries, while elderly widowers prefer slightly more of general merchandise and food groceries. The share of SNAP food out of aggregate food is around 80% for all of the three samples. The fraction of people with at least some college is higher among widowers compared to widows.

[26] This finding is different from empirical results in previous literature. Especially, a key assumption Dunbar, Lewbel, and Pendakur (2013), which point identifies the resource share, is that the resource share does not depend on total expenditure. Menon, Pendakur, and Perali (2012) test the assumption with Italian International Center of Family Studies (CISF) and do not reject the assumption. The different results might be driven by the different samples used in this paper, which only focuses on the elderly. It might also be due to that the total expenditure in this paper is not comprehensive and mainly covers grocery-type goods.

Table 1: *Demographic Characteristics*

	Elderly Widows	Elderly Widowers	Elderly Couples
Obs	19,366	3,440	82716
Number of unique households	5,455	1,092	23,807
Household income	24338.49	33555.20	46732.05
Yearly expenditure (trip data)	2968.27	2837.00	6425.16
Yearly expenditure (purchase data)	1933.45	1926.53	4256.22
Budget share (health&beauty)	0.13	0.10	0.12
Budget share (general merchandise)	0.09	0.09	0.10
Budget share (food grocery)	0.68	0.72	0.68
Budget share (non-food grocery)	0.10	0.08	0.10
Yearly SNAP expenditure (dollar)	1181.02	1200.74	2167.89
SNAP food share out of food grocery	0.79	0.77	0.81
Female head age	73.41	-	66.03
Male head age	-	75.60	68.66
>= Graduated high school (Female)	0.95		0.96
>=Some College (Female)	0.58		0.61
>= Graduated high school (Male)		0.95	0.93
>=Some College (Male)		0.70	0.66
Microwave, Dishwasher, & Garbage Disposal	0.23	0.25	0.22
Regular & Pay Cable	0.31	0.39	0.39
Internet connection	0.60	0.68	0.83

Notes: values are mean. Yearly expenditure from the trip data is the total expenditure for each trip. Yearly expenditure from the purchase data is the sum of money spent on the scanned items by the panelists. The latter is smaller than the former due to miss scanned items or items were eaten on the way home.

In both models, the wife's mean resource share is higher than the husband's, implying that the couple's preferences are more represented by the wife's preferences. According to Goodman (2008), two thirds of grocery shoppers are women. Hence, wives' preference are more likely to be represented by the couples' preferences.[27] Since preference factors might be correlated with distribution factors and induce the endogeneity problem, I choose model (1) as the benchmark model in the following analyses.

5.6.3 Barten scales

The lower panel of table 2 shows the mean Barten scales for the four aggregate goods. The rankings are similar across the two models, in which food grocery and health and beauty are the least shareable, non-food grocery is shareable to some extent, and general merchandise is the most shareable. In particular, the finding on the Barten scale of food is consistent with previous literature (0.77 in Browning et al. (2013); 0.994 in L. Cherchyeetal et al (2012)). In Nielsen homescan data, general merchandise is mainly composed of household appliances and small electronics, both of which are highly shareable.

[27] Browning et al. (2013) and Cherchye et al. (2012) both find that the wife has a higher resource share than the husband in developed countries (Canada and Netherlands respectively).

Table 2: *Estimation Results: Sharing Rule and Barten Scales*

	Model (1)		Model (2)	
Mean wife's share	0.675		0.824	
Distribution factors	coef	Std error	coef	Std error
Constant	0.679***	0.042	0.074	0.707
Female some college			-0.117	0.710
Male some college			-0.291	0.860
Difference in age(female - male)			0.005	1.048
Difference in edu (female - male)	0.213***	0.043	-0.001	0.503
Black or African American			-0.094	0.148
Kitchen appliances			-0.117***	0.072
Internet			-0.128***	0.059
Log real total expenditure			0.273***	0.100
Aggregate Goods	Barten scale	Std error	Barten scale	Std error
General Merchandise	0.669***	0.011	0.665***	0.014
Food Grocery	0.785***	0.016	0.837***	0.023
Non-food Grocery	0.780***	0.021	0.713***	0.020
Health & Beauty	0.799***	0.013	0.834***	0.019

Notes: Barten Scales are assumed to be homogeneous across all households. Model (1) includes only distribution factors in the sharing rule. Model (2) includes both distribution factors and preference factors in the sharing rule. Kitchen appliances is a dummy denoting whether the household owes microwave, garbage disposal, and dishwasher. *p < 0.10, **p<0.05, ***p<0.01.

5.6.4 Poverty analyses with Indifference Scale

Given the structural estimates of the sharing rule and the Barten scales, I further study the welfare implications for elderly widows, widowers and couples. The main interest is the welfare comparison of the widow and the widower living alone versus living as a couple. I construct the equivalent budget share (EBS) ω^f for the widows and ω^m for the widowers. For widows, EBS is calculated as the wife's QAIDS budget share if she is faced with a resource share of 0.675 and the shadow prices. The calculation is similar for the widower's but he is faced with a resource share of 0.325. The equivalent budget share represents the private good equivalents, that is, the quantities the female or male head consumes out of the purchased bundles.

Table 3 reports the female and male head's equivalent budget shares, their equivalent expenditures, their indifference scales, and the overall scale economy R.[28] The numbers of EBS represent how the wife or husband allocates her or his budget across the four composites. Compared with husbands, wives demand less food and general merchandise but more health and beauty and non-food groceries. This is consistent with the actual budget shares reported in table 1.

The next two rows of table 3 show the equivalent expenditures for the female and male head. The equivalent expenditure is the amount of money that the member needs to attain the same allocation of goods in marriage while living alone, that is, being faced with full market price and

[28](The equations of equivalent budget shares, equivalent expenditures, indifference scales, and the overall scale economy R are presented in the appendix.)

their respective resource share. The equivalent expenditure of the female head is higher than that of the male head since her higher resource share.[29]

The last row of table 3 reports the scale economy R, which is equal to 0.293. It implies that it would cost the couple 29.3% more to buy the (private equivalent) goods they consumed if there had been no shared or joint consumption.[30]

Table 3: *Implications of estimates*

Wife's share	0.500		0.675	
Equivalent budget share	f	m	f	m
General merchandise	0.095	0.092	0.093	0.102
Food grocery	0.666	0.721	0.673	0.703
Non-food grocery	0.106	0.082	0.109	0.082
Health and beauty	0.133	0.105	0.125	0.114
Her equivalent expenditure	2104.9		2842.0	
His equivalent expenditure	2104.4		1368.9	
Actual couple's expenditure	3256.7		3256.7	
Indifference scale for women	0.646		0.873	
Indifference scale for men	0.646		0.420	
Scale economy, R	0.292		0.293	

Notes: values are in mean. Equivalent budget share is the budget share of the wife (husband) if she (he) is endowed with the fraction of resources and faced with shadow prices (market prices discounted by the Barten scales). The equivalent expenditure is the expenditure that the wife (husband) needs to obtain the same private good equivalents in marraige if she (he) is living alone, endowed with the fraction of resources in marriage and faced with market prices. Scale economy means it would cost the couple R percent more to buy the (private equivalent) goods they consumed if there had been no shared or joint consumption.

Next, I compare the average equivalent expenditure of the widow and widower with that of their current yearly total expenditure (Figures A2 and A3 in the appendix). On average, elderly widows are much more impoverished than elderly widowers since elderly widows require higher equivalent expenditures in marriage while they are have relative lower household income when become widowhood. This finding is similar to Cherchyeetal et al (2012), which finds that the drop in material well-being is substantial for widows while the picture is reversed for widowers.

Robustness Checks I perform a series of robustness checks to test the sensitivity of the empirical results. First, I compare the collective approach (estimate widow(er)s' and couples' demand jointly, where couples' demand is a collective demand using the widow(er)s' preferences) with the unitary approach (estimate widow(er)s' and couples' demand jointly, and all of their demands are estimated by QAIDS). The goal is to select the model most consistent with the data among non-nested competing models. I use the non-nested testing procedure proposed by Smith

[29] In principle, an individual would have higher equivalent expenditure if she enjoys higher resource share or prefers more highly shareable goods. The budget shares across four goods are similar between the female and male head. Hence, the main reason for the high equivalent expenditure of the wife is her higher resource share.

[30] According to BCL (2013), this estimate presents an upper bound of the total expenditure the couple needs if they live apart. The reason is that they can re-allocate purchases and attain more cheaply the same indifference curves that x^f and x^m lie on. That is what the indifference scales measure.

(1992).[31] The resulting Cox-type statistics is 0.0098. Hence, the collective demand model is not rejected.

6 Counterfactual Exercises: a Hypothetical SNAP cash transfer

Using the benchmark estimates of preferences, resource share, and Barten scales, I next perform a counterfactual experiment: a hypothetical SNAP cash transfer to eligible households selected according to the current SNAP eligibility based on household income and size.[32]

The goal of this counterfactual exercise is to study demand responses to cash transfers, especially among the constrained households. If their spending on food, given a cash transfer, is above the program's needs standard (panel (a) of Figure 3), then cash transfers would be more cost-effective than in-kind transfers. Moreover, I compare the demand responses to cash transfers between the wife and husband. The strong evidence of preference heterogeneity highlights the importance of bargaining power within households.

I describe the design of the counterfactual experiment first, and then present the outcomes and implications, particularly on constrained households. Then, I explain the implications of the outcomes, relating them to the discussion in Section 3.2 and 3.3 on the motivations and role of a collective household model and by comparing the demand responses between the wife and husband.

6.1 Sample selection of the SNAP eligible elderly households

Nielsen does not have information on eligibility for participation in SNAP. Hence, I select the sample of eligible elderly households according to the current eligibility scheme. The determinants of SNAP eligibility include household income, household resources, household size, and employment requirements. The maximum gross income of a household to receive SNAP benefits is set at 130 percent of the poverty line.[33] Table 4 reports the maximum gross income and the maximum SNAP benefits for one-person and two-person households. Since elderly households need not meet this limit, I might underestimate the number of eligible elderly households by

[31] In particular, the Cox-type statistics is constructed by examining the difference of the estimated GMM criterion functions for the collective demand model M_c and for the alternative unitary demand model M_u. Normalized, standardized, and compared to a standard normal critical value, a large positive statistic in this one-sided goodness-of-fit test leads to the rejection of the null model M_c against M_u.

[32] Nielsen does not provide information on SNAP participation. Some of the households might already be SNAP recipients. Their budget constraint would be different from equation (4) due to the binding feature of SNAP in-kind transfer. Specifically, their budget constraint would be $p_1 z_1 + p_2 z_2 = y + min(p_1 z_1, b)$, where p_1 and z_1 are the price and purchased quantities of SNAP-eligible good. p_2 and z_2 are the price and purchased quantities of other goods. b is the amount of SNAP in-kind transfers. I might overestimate the demand/preferences for food for SNAP recipient households in the benchmark case because I treat their total expenditure as if all cash. This may lead me to overstate that SNAP benefits are mostly infra-marginal. However, the SNAP participation rate is low among the elderly, so I would expect fewer eligible households to be recipients. Moreover, SNAP recipients are less likely to be constrained households, which are the main target of my counterfactual exercise and the debate on in-kind versus cash transfers. The conclusion for constrained households is less likely to be affected by the problem.

[33] In most cases, a household must meet both the gross and net income limits. However, a household with an elderly or disabled person only has to meet the net income limit.

following only this criteria. On the other hand, since I don't have information on household resources or assets, I might underestimate household income and hence overestimate the number of eligible elderly households. In order to overcome the potential measurement error in selecting the potential eligible households, as a robustness check I compare the income and expenditure characteristics of the eligible sample in this paper with that in previous literature as a robustness check.

I follow the SNAP benefit formula to calculate the potential benefits available to the eligible elderly households. Specifically, I calculate the net income, which is the gross income subtracted by certain deductions, and then multiply it by 30%.[34] That number is then subtracted from the maximum allotment, and the remaining amount is the potential SNAP benefit. The deductions include a 20-percent deduction from gross income, a standard deduction of $160 for household sizes of 1 to 3 people, and a standard shelter deduction for homeless households of $143. I exclude the dependent care deduction and the medical deduction since they are not available in the data.[35] Since my sample is restricted to the elderly, and the poor elderly are more likely to have medical deductions, the resulting estimated benefits are likely to be underestimated. Equation 36 shows the benefit formula.

$$\text{Benefits} = \text{maximum allotment} - 30\% * (\text{gross income} - \text{deductions}) \tag{29}$$

Table A1 reports the summary statistics for SNAP eligible households. The proportion of constrained households, if defined as those eligible households whose pre-treatment expenditure on SNAP-eligible food is less than their potential SNAP benefits, is around 43% to 47%. The fraction is around 30% if calculated as those whose expenditure on overall food is less than their SNAP benefits, which is consistent with estimates from previous literature (Johnson et al. 2018). Comparing table A1 to table 1, there are no significant differences in demographic characteristics between the eligibles and the entire samples, except that the eligibles have lower household income. Table A2 reports the summary statistics for constrained and unconstrained households. The budget share on SNAP-eligible food is similar between constrained and unconstrained households. There is no evidence that constrained households are more likely to eat unhealthy foods.

Robustness Checks I follow Hoynes et al. (2015) in defining healthy foods, unhealthy foods, and sugar-sweetened beverages, and compare food spending by types of food between SNAP-eligible and ineligible elderly households.[36] The results are reported in table A3. Again, the budget shares of health and unhealthy food are similar between the two groups. This is consistent with the finding in Hoynes et al. (2015), which also compares the expenditure pattern

[34] The households are expected to spend 30% of their gross income on food.

[35] A dependent care deduction is the expenditure needed for work, training, or education. For elderly or disabled members, medical expenses more than $35 for a month can be deducted if they are not paid by insurance or someone else.

[36] The healthier foods category includes bread, poultry, fish and shellfish, eggs, milk, cheese, other non-ice cream dairy foods, fruit (excluding juice), vegetables, dried fruit, nuts, prepared salads and baby food. The unhealthy foods category comprises ice cream, candy, gum, hot dogs, potato chips and other snacks, and bakery goods and prepared desserts such as cakes, cupcakes, doughnuts, pies, and tarts. The sugar-sweetened beverages group includes colas, other carbonated drinks, and non-carbonated fruit-flavored and sports drinks.

between eligible and ineligible households using Consumer Expenditure Survey. All the suggestive evidence implies that poor elderly households are not more likely to eat unhealthy food. Their low total expenditure on food is mainly due to their low household income.

Table 4: *SNAP Eligibility Criteria and Maximum Benefits*

Number of Household Members	Maximum Amount of Gross Income for All Household Members	Maximum Food Stamp Benefits
1	$1,307	$192
2	$1,760	$352

Notes: the table reports the maximum gross income and maximum allotment by household size of current SNAP eligibiligy and benefits scheme. Gross income is a household's total, non-excluded income, before any deductions have been made. Source: United States Department of Agriculture (USDA) Food and Nutrition Service

Next, I add potential benefits as cash transfers to the total expenditure of SNAP-eligible households. The predicted expenditure shares of eligible widow(er)s are given by

$$\hat{\omega^i}(\frac{p^h}{y^h+b}) = \hat{\alpha^i} + \hat{\gamma^i}\ln p^h + \hat{\beta^i}[\ln(y^h+b) - \hat{c^i}(p^h)] + \frac{\hat{\lambda}^i}{\hat{b^i}(p^h)}[\ln(y^h+b) - c^i(p^h)]^2 \tag{30}$$

where b is the amount of benefits.

The predicted expenditure shares of eligible couples are given by

$$\hat{\omega_j}(\frac{p^h}{y^h+b}) = \hat{\eta}\hat{\omega_j}^f(\frac{\pi}{\hat{\eta}}) + (1-\hat{\eta})\omega_j^m(\frac{\pi}{1-\hat{\eta}}) \tag{31}$$

One caveat in the analyses that I should be clear about is that the demand in this paper is only modeled at the level of aggregate food. That is, I could only predict the counterfactual expenditure share for overall food grocery. Nonetheless, by assuming that the ratio of SNAP-eligible food out of overall food is the same as in the benchmark case (around 80%), I can back out the expenditures on SNAP-eligible food by multiplying the post-treatment food expenditure with the pre-treatment SNAP-eligible food share of the overall food ratio.

6.2 Counterfactual Results

Given the sample of SNAP-eligible households, I conduct a counterfactual experiment of a SNAP cash transfer among them. The SNAP-eligible households can be further divided into constrained and unconstrained households. In this subsection, I report the counterfactual results among constrained households, unconstrained households, and elderly couples overall. The constrained households are the main target of an in-kind design and are especially concerned by policymakers. Their counterfactual results are the main focus of this paper.

6.2.1 Counterfactual Results among Constrained Elderly Households

The counterfactual results among constrained widows, widowers, and couples are reported in tables A6, A7, and A8 respectively. Constrained households are more concerned by policymakers,

because they did not spend enough on nutritious food and have relatively low income. They are also the main target of an in-kind transfer because theory predicts that their preferences might be different: they might prefer other non-food necessities rather than nutritious food. Using an in-kind transfer is likely to distort their consumption to be at the kink point, as illustrated in figure A3. However, it is not clear whether the main reason for being constrained is low income or preference differences.[37] If giving them cash transfers can encourage them to spend all benefits on nutritious food, it implies that these households are constrained because they are too poor to be food secure, not that they have different preference. It also implies that cash transfers would be more cost-effective than in-kind transfers in achieving the desired outcomes.

For constrained elderly widows (table A6), 42% are extra-marginal households, meaning that they do not spend all SNAP benefits on SNAP-eligible food. Even among those extra-marginal elderly widows, a large fraction spend 80 - 90% of SNAP benefits on SNAP-eligible food (figure A4). The results are similar for constrained elderly widowers (table A7), among whom only 30% are extra-marginal and most spend 80 - 90% of SNAP benefits on SNAP-eligible food (figure A5). Moreover, for constrained elderly couples (table A8), none of the households are extra-marginal. These results suggest that constrained households are not necessarily equivalent to extra-marginal households. It rejects the theory's prediction on constrained households, that they have low preferences for food. Instead, when we compare the average household income between infra-marginal and extra-marginal households for elderly widows and widowers (last column in A6 and A7), we see that the latter is much lower. Combining the suggestive evidence from before, that poor households are not more likely to eat unhealthy food compared to relatively rich households, it seems that households are too poor to be food secure rather than having different references. The average propensity to consume SNAP-eligible food out of SNAP benefits among infra-marginal constrained households is similar to that among unconstrained households (around 0.8). For extra-marginal households, their expenditure on SNAP-eligible-food-to-overall-food ratio is low, only around 0.3 among elderly widows and 0.2 among elderly widowers. Their average propensity to consume SNAP-eligible food out of SNAP benefits is also very low (0.21 for elderly widows and 0.15 for elderly widowers).

These results suggest that not all constrained households are necessarily extra-marginal households. Over half of those constrained households who are at the upper income percentile among constrained households prefer healthy food just as much as unconstrained households do. They are too poor to be food secure, rather than having preference differences. However, households who are at the the bottom income percentile among the constrained households are more likely to be extra-marginal households. They have extremely low income and their expenditure share of nutritious food is also low. For those households, it is likely that both low income and preferences might explain low consumption of nutritious food. For them, in-kind transfers would be desirable and useful in terms of promoting nutritious food consumption. However, they still

[37]Previous literature on "food dessert" points that the poor access to healthy and affordable food may contribute to social and spatial disparities in diet and health-related outcomes (Beaulac et al. 2009). Hence, poor people eat poorly might be due to low income, poor access to healthy diet, or preference differences.

only constitute a small fraction of the eligible households, and they are more prevalent among widowhood households, not among elderly couples.

6.2.2 Counterfactual Results among Unconstrained Elderly Households

Table A4 panel *A*, *B*, and *C* report the counterfactual results for unconstrained elderly widows, widowers, and couples, respectively. For them, the theory predicts that SNAP in-kind transfers are equivalent to cash transfers, in the sense that the food vouchers would replace one-to-one their out-of-pocket spending on SNAP-eligible food.[38]

I find that for elderly unconstrained widows, SNAP cash transfers lead to higher expenditures on food groceries and an even larger increase in non-food groceries. The expenditures on health and beauty drop by a fairly large amount. For elderly unconstrained widowers, SNAP cash transfers lead to higher food expenditures and lower expenditures on general merchandise and health and beauty. For elderly unconstrained couples, expenditures on food and non-food groceries increase while expenditures on general merchandise and health and beauty decrease, with or without assuming equal sharing. However, the increase in non-food groceries would be overestimated under equal sharing because it overlooks the small change in non-food groceries by the husband. Overall, the demand responses of unconstrained widows and widowers are very similar, so the results for unconstrained elderly couples under the unitary model are not very different from those under the collective household model.

Table A5 reports the *average* propensity to consume food (APCF) out of SNAP cash benefits, which is around 0.8 among all three samples. By assuming the same ratio of expenditure on SNAP-eligible food to expenditure on overall food (around 0.8), the *average* propensity to consume SNAP-eligible food out of SNAP cash benefits is around 0.61-0.66. That figure is much larger than the previous findings on the *marginal* propensity to consume food (MPCF) out of cash based on a reduced-form approach.[39] It highlights the danger in using the effect of a marginal change to infer the effect of a substantial change. The reason for the difference is that the previous literature normally uses first-order approximation to infer the impact of a welfare program. However, given the shape of indifference curves, the second-order approximation also plays an important role when the welfare program induces a substantial change in price or total income. The results in this paper speak to the non-marginal design of SNAP and are more meaningful in terms of implications of SNAP for household consumption.

In summary, the infra-marginal households among the constrained households are similar to the unconstrained households in terms of preferences for nutritious food. None of the elderly constrained couples are extra-marginal. A poor diet is more prevalent among elderly widowhood households. In terms of policy implications, cash transfers would be more cost-effective than in-

[38] Recent finding from Hasting and Shapiro (2018) suggests that in terms of magnitude, in-kind transfers might induce larger increase in food expenditure than an equivalent cash transfers due to mental accounting. Unfortunately, I am not able to model this effect because I can't identify SNAP recipients or their consumption under in-kind transfers due to data limitation.

[39] Previous literature normally finds the *marginal* propensity to consume food out of cash to be around 0.1. For example, Hoynes and Schanzenbach (2009) estimate an MPCF out of cash income of 0.09 to 0.10. Beatty and Tuttle (2015) estimate an MPCF out of cash income of 0.15. Hasting and Shapiro (2018) estimate an MPCF out of cash income of no more than 0.1.

kind transfers among elderly couples. For elderly widowhood households, in-kind transfers might be desired only for those living under the extreme poverty threshold.

6.2.3 Counterfactual Results among All Elderly Couples

To highlight the importance of the collective approach, I compare the counterfactual results under unequal sharing with equal sharing (table A9). Tables A10 and A11 show the demand responses of wives and husbands, if they are faced with the shadow prices, and their respective resource share. Both spouses increase spending on Food Grocery and decrease spending on General Merchandise and Health and Beauty. However, the wife increases Non-food Grocery by 9.95% while the husband does not have a significant change in this category. The husband decreases General Merchandise by 14.69% while the wife only decreases spending on it by 3.53%. In terms of food spending, the increase in budget share for food is 2.45% higher for husbands than wives. If we ignore the wife's higher bargaining power and assume her resource share to be 0.5, we would overestimate the demand for food by 1.8%. On the other hand, without accounting for the husband's stronger preferences for food, we might underestimate the couple's increase in food spending.

7 Conclusion

This paper considers the role of intra-household gender asymmetries in preferences and bargaining power in the evaluation of welfare programs. Specifically, I focus on the Supplemental Nutrition Assistance Program (SNAP), the largest anti-hunger program in the U.S.. By looking at elderly widow(er)s and couples, using the Nielsen Homescan data, I am able to identify SNAP-eligible food. I find strong evidence of heterogeneity in preferences, not only for aggregate goods but also for more versus less public goods. If one ignores that heterogeneity, then the elderly couples' demand for food will be underestimated and this will further bias downwards, both intensively and extensively, the number of elderly couples whose demand for food is affected by cash transfers. The observation of preference heterogeneity also highlights the important role of bargaining power, in this case within households.

I estimate a structural model of household demand that identifies the wife's and husband's respective preferences and bargaining power and the extent to which goods are shared. I find that the husband prefers more Food and General Merchandise while the wife prefers more Health and Beauty items and Non-food Grocery. General Merchandise is the most shareable while Food and Health and Beauty is the least shareable. The mean wife's resource share, that is the share of household expenditures enjoyed by an individual, is higher than the husband's. This suggests that the elderly couple's consumption decision is represented more by the wife's preferences. Using a counterfactual SNAP cash transfer experiment, I find that for all constrained elderly couples, and 60-70 percent of constrained elderly widow(er)s, their post-treatment spending on food is above the program's needs standard. If one ignores preference heterogeneity, household demand for food will be underestimated and this will further bias downwards, both intensively and extensively, the number of households whose demand for food is affected by cash transfers. Combing these results with household spending patterns, I argue that poor elderly households like nutritious food as much as non-poor households, but are too poor to be food secure.

This paper is one of the few if any that demonstrates the importance of within-household preference differentials and bargaining power in evaluating welfare programs, the goal of which is to improve welfare by changing household consumption behavior. Future research should focus on the individual welfare analysis within households even though welfare programs are often targeted at household-level. One promising avenue of research is the investigation of household demand within families with children, where preferences are heterogeneous among both adults and children, the parents have caring preferences for children, and there are both adult-specific and child-specific goods.

References

Aguiar, M., and Hurst, E. (2007). Life-cycle prices and production. American Economic Review, 97(5), 1533-1559.

Aker, J. (2013). Cash or coupons? Testing the impacts of cash versus vouchers in the Democratic Republic of Congo.

Amano, N. (2018). Nutrition Inequality: The Role of Prices, Income, and Preferences. In 2018 Meeting Papers (No. 453). Society for Economic Dynamics.

Apps, P. F., and Rees, R. (1988). Taxation and the Household. Journal of Public Economics, 35(3), 355-369.

Banks, J., Blundell, R., and Lewbel, A. (1997). Quadratic Engel curves and consumer demand. The review of economics and statistics, 79(4), 527-539.

Banks, J., Blundell, R., and Lewbel, A. (1996). Tax reform and welfare measurement: do we need demand system estimation?. The Economic Journal, 1227-1241.

Barten, A. P. (1964), Family Composition, Prices, and Expenditure Patterns, in Hart, P., Mills, G. and Whitaker, J. K.(eds) Econometric Analysis for National Economic Planning: 16th Symposium Colston Society (London: Butterworth), 277292.

Beatty, T., Cheng, X. H., and Tuttle, C. (2015). The Scope and Magnitude of Food Sharing Among US Households: New Evidence from FoodAPS. In 2015 AAEA and WAEA Joint Annual Meeting, July 26-28, San Francisco, California (No. 205886). Agricultural and Applied Economics Association and Western Agricultural Economics Association.

Beaulac, J., Kristjansson, E., and Cummins, S. (2009). Peer reviewed: A systematic review of food deserts, 1966-2007. Preventing chronic disease, 6(3).

Becker, G. (1965), A Theory of the Allocation of Time, Economic Journal, 75, 493517.

Becker, G. S. (1974). A theory of social interactions. Journal of political economy, 82(6), 1063-1093.

Bitler, M. (2014). The health and nutrition effects of SNAP: Selection into the program and a review of the literature on its effects.

Browning, M., Bourguignon, F., Chiappori, P. A., and Lechene, V. (1994). Income and outcomes: A structural model of intrahousehold allocation. Journal of political Economy, 102(6), 1067-1096.

Browning, M., Chiappori, P. A., and Lechene, V. (2006). Collective and unitary models: A clarification. Review of Economics of the Household, 4(1), 5-14.

Browning, M., Chiappori, P. A., and Lewbel, A. (2013). Estimating consumption economies of scale, adult equivalence scales, and household bargaining power. Review of Economic Studies, 80(4), 1267-1303.

Browning, M., and Chiappori, P. A. (1998). Efficient intra-household allocations: A general characterization and empirical tests. Econometrica, 1241-1278.

Brown, C., J. Penglase, and R. Calvi (2018): Sharing the Pie: Undernutrition, Intra-household

Allocation, and Poverty, Boston college.

Brugler, J. (2016). Testing preference stability between couples and singles. Economics Letters, 142, 15-17.

Bruich, G. A. (2014). The effect of SNAP benefits on expenditures: New evidence from scanner data and the November 2013 benefit cuts. Harvard University. Mimeograph.

Btikofer, A., and Gerfin, M. (2009). The economies of scale of living together and how they are shared: estimates based on a collective household model.

Btikofer, A., Lewbel, A., and Seitz, S. (2010). Health and retirement effects in a collective consumption model of older households. Boston College Working Papers in Economics 767, Boston College Department of Economics.[6].

Calvi, R. (2016): Why Are Older Women Missing in India? The Age Profile of Bargaining Power and Poverty, Mimeo.

Calvi, R., A. Lewbel, and D. Tommasi (2017): Womens Empowerment and Family Health: Estimating LATE with Mismeasured Treatment, Working Paper 2017-27, Universit libre de Bruxelles, ECARES.

Cherchye, L., De Rock, B., Surana, K., and Vermeulen, F. (2016). Marital matching, economies of scale and intrahousehold allocations.

Cherchye, L., De Rock, B., and Vermeulen, F. (2012). Married with children: A collective labor supply model with detailed time use and intrahousehold expenditure information. The American Economic Review, 102(7), 3377-3405.

Cherchye, L., De Rock, B., and Vermeulen, F. (2012). Economic well-being and poverty among the elderly: an analysis based on a collective consumption model. European Economic Review, 56(6), 985-1000.

Cherchye, L., De Rock, B., Surana, K., and Vermeulen, F. (2016). Marital matching, economies of scale and intrahousehold allocations.

Cherchye, L., Demuynck, T., De Rock, B., and Vermeulen, F. (2017). Household consumption when the marriage is stable. American Economic Review, 107(6), 1507-1534.

Cherchye, L., Cosaert, S., De Rock, B., Kerstens, P. J., and Vermeulen, F. (2017). Individual welfare analysis for collective households.

Chiappori, P. A. (1988). Rational household labor supply. Econometrica: Journal of the Econometric Society, 63-90.

Chiappori, P. A. (1992). Collective labor supply and welfare. Journal of political Economy, 100(3), 437-467.

Chiappori, P.A. and Ekeland, I. (2005), Characterizing Group Behavior, Journal of Economic Theory, 130, 126.

Chiappori, P. A., and Mazzocco, M. (2017). Static and intertemporal household decisions. Journal of Economic Literature, 55(3), 985-1045.

Chiappori, P. A., and Meghir, C. (2014). Intra-household welfare (No. w20189). National Bureau of Economic Research.

Choo, E., and Siow, A. (2006). Who marries whom and why. Journal of political Economy, 114(1), 175-201.

Choo, E., Seitz, S., and Siow, A. (2008). The Collective Marriage Matching Model: Identification, Estimation and Testing. Univ. of Toronto Working Paper, 340, 1-65.

Cunha, J. M. (2014). Testing paternalism: Cash versus in-kind transfers. American Economic Journal: Applied Economics, 6(2), 195-230.

Currie, J. (1994). Welfare and the well-being of children: The relative effectiveness of cash and in-kind transfers. Tax policy and the economy, 8, 1-43.

Currie, J., and Gahvari, F. (2008). Transfers in cash and in-kind: Theory meets the data. Journal of Economic Literature, 46(2), 333-83.

Deaton, A., and Muellbauer, J. (1980). An almost ideal demand system. The American economic review, 70(3), 312-326.

Deaton, A. S., and Paxson, C. (1998). Measuring poverty among the elderly. In Inquiries in the Economics of Aging (pp. 169-204). University of Chicago Press.

Dubois, P., Griffith, R., and Nevo, A. (2014). Do prices and attributes explain international differences in food purchases?. American Economic Review, 104(3), 832-67.

Dunbar, G. R., Lewbel, A., and Pendakur, K. (2013). Children's resources in collective households: identification, estimation, and an application to child poverty in Malawi. American Economic Review, 103(1), 438-71.

Dunbar, G. R., Lewbel, A., and Pendakur, K. (2017). Identification of Random Resource Shares in Collective Households Without Preference Similarity Restrictions. Bank of Canada.

Einav, L., Leibtag, E., and Nevo, A. (2010). Recording discrepancies in Nielsen Homescan data: Are they present and do they matter?. QME, 8(2), 207-239.

Feldstein, M. S. (1972). Distributional equity and the optimal structure of public prices. The American Economic Review, 62(1/2), 32-36.

Fraker, T. (1990). The effects of food stamps on food consumption: a review of the literature. Current perspectives on food stam p program participation (USA).

Foster, A. C. (2015). Consumer expenditures vary by age. Beyond the Numbers: Prices and Spending, vol. 4, no. 14 (U.S. Bureau of Labor Statistics, December 2015), https://www.bls.gov/opub/btn/volur 4/consumer-expenditures-vary-by-age.htm

Fox, M. K., Hamilton, W., and Lin, B. H. (2004). Effects of food assistance and nutrition programs on nutrition and health. Food Assistance and Nutrition Research Report, 19(3).

Gillen, M., and Kim, H. (2009). Older women and poverty transition: Consequences of income source changes from widowhood. Journal of Applied Gerontology, 28(3), 320-341.

Goodman, J. (2008). Grocery shopping: who, where and when. The Time Use Institute, 1-10.

Gorman, T. (1976), Tricks With Utility Functions, in Sheffield, M. J. A. and Nobay, A. R. (eds) Essays in Economic Analysis: Proceedings of the 1975 AUTE Conference (Cambridge: Cambridge University Press).

Haider, S. J., Jacknowitz, A., and Schoeni, R. F. (2003). Food stamps and the elderly: why is participation so low?. Journal of Human resources, 1080-1111.

Hastings, J. S., and Shapiro, J. M. (2017). How are SNAP benefits spent? Evidence from a retail panel (No. w23112). National Bureau of Economic Research.

Hokayem, C., and Heggeness, M. L. (2014). Living in Near Poverty in the United States, 1966-2012. US Department of Commerce, Economics and Statistics Administration, US Census Bureau.

Holden, K. C., and Smock, P. J. (1991). The economic costs of marital dissolution: Why do women bear a disproportionate cost?. Annual review of sociology, 17(1), 51-78.

Hoynes, H. W., and Schanzenbach, D. W. (2009). Consumption responses to in-kind transfers: Evidence from the introduction of the food stamp program. American Economic Journal: Applied Economics, 1(4), 109-39.

Hoynes, H. W., and Schanzenbach, D. W. (2015). US food and nutrition programs (No. w21057). National Bureau of Economic Research.

Hoynes, H. W., McGranahan, L., and Schanzenbach, D. W. (2015). SNAP and food consumption. SNAP Matters: How Food Stamps Affect Health and Well Being, 107-133.

Johnson, D., Schoeni, R. F., Tiehen, L., and Cornman, J. C. (2018). Assessing the Effectiveness of SNAP by Examining Extramarginal Participants. University of Michigan Population Studies Center Research Report 18-889

Lewbel, A. (1989). Household equivalence scales and welfare comparisons. Journal of Public Economics, 39(3), 377-391.

Lewbel, A. (1997). Consumer demand systems and household equivalence scales. Handbook of applied econometrics, 2, 167-201.

Lewbel, A. (2004). Equivalence scales based on collective household models. Household Behaviour, Equivalence Scales, Welfare and Poverty, 1-9.

Lewbel, A., and Pendakur, K. (2008). Equivalence scales. New Palgrave Dictionary of Economics.

Lewbel, A., and Pendakur, K. (2008). Estimation of collective household models with Engel curves. Journal of Econometrics, 147(2), 350-358.

Lise, J., and Seitz, S. (2011). Consumption inequality and intra-household allocations. The Review of Economic Studies, 78(1), 328-355.

Mayshar, J., and Yitzhaki, S. (1995). Dalton-improving indirect tax reform. The American Economic Review, 793-807.

Muellbauer, J. (1977). Testing the Barten model of household composition effects and the cost of children. The Economic Journal, 87(347), 460-487.

Penglase, J. (2017): Consumption Inequality among Children: Evidence from Child Fostering in Malawi, Boston college.

Pollak, R. A., and Wales, T. J. (1979). Welfare comparisons and equivalence scales. The American Economic Review, 69(2), 216-221.

Pollak, R. A., and Wales, T. J. (1992). Demand system specification and estimation. Oxford University Press.

Smith, R. J. (1992). Non-nested tests for competing models estimated by generalized method of moments. Econometrica: Journal of the Econometric Society, 973-980.

Southworth, H. M. (1945). The economics of public measures to subsidize food consumption. Journal of Farm Economics, 27(1), 38-66.

Stern, N. (1987). The theory of optimal commodity and income taxation: an introduction.

Tommasi, D. (2017): Control of Resources and Demand for Food, Working paper, Universit libre de Bruxelles, ECARES.

Tommasi, D. and A. Wolf (2018): Estimating household resource shares: A shrinkage approach, Economics Letters, 163, 75 78.

Wewel, S. (2017). Heterogeneity in Consumption Gainsfrom Living Together as a Couple . Boston College.

Appendices

A Additional Figures and tables

Figure A1: *Impact of SNAP on Budget Constraint*

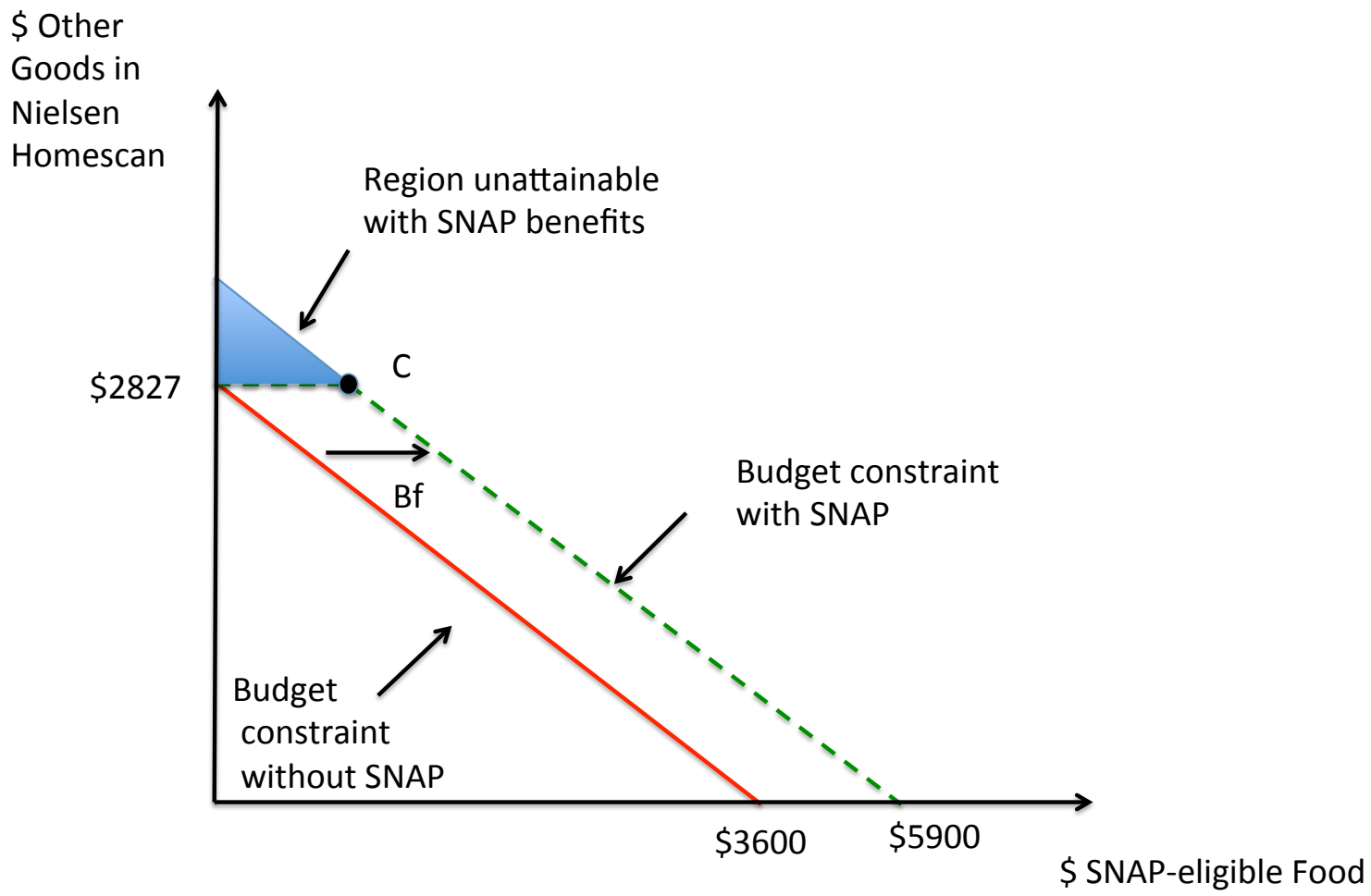


Figure A2: *Consumption Re-allocation for Unconstrained Households*

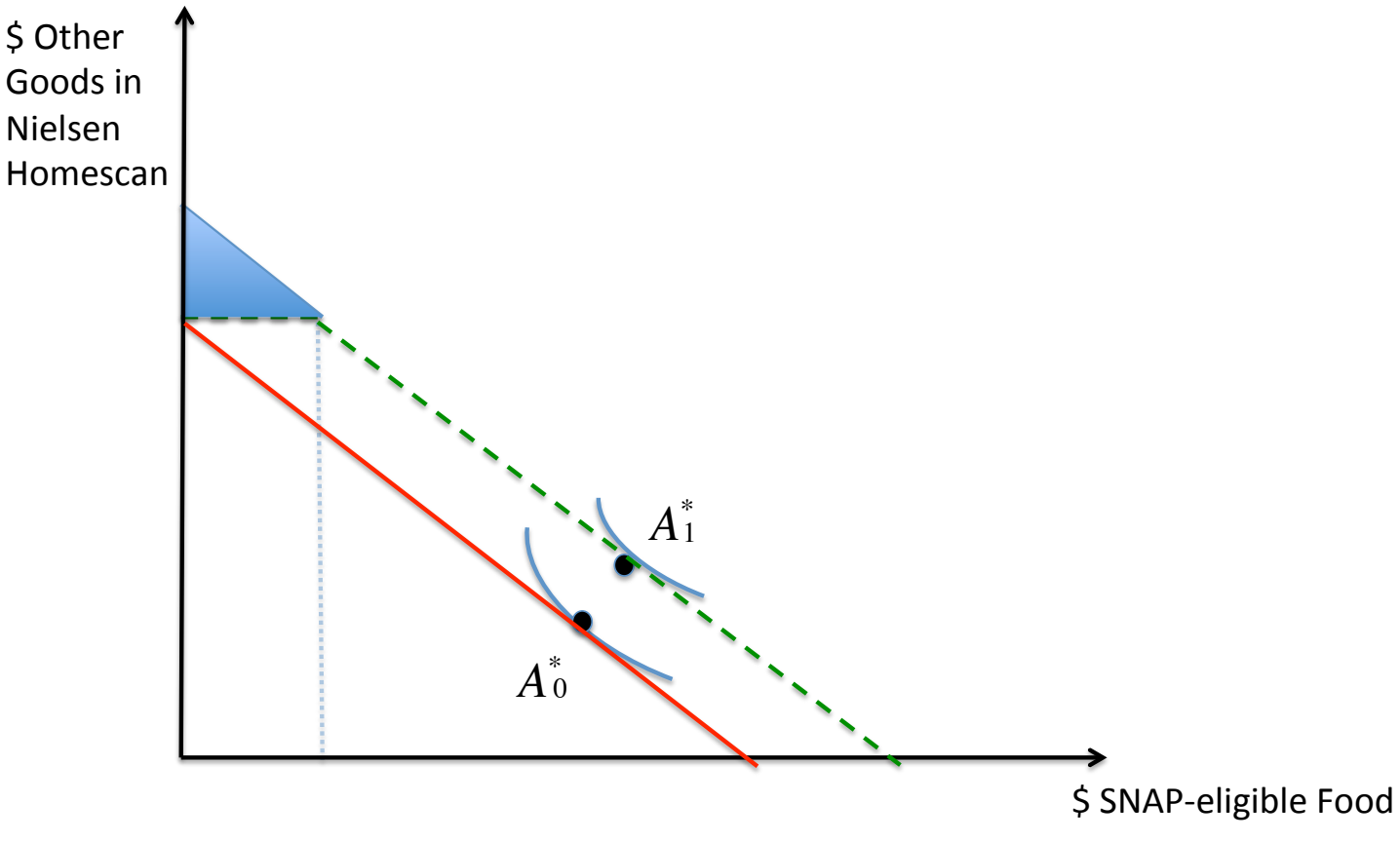
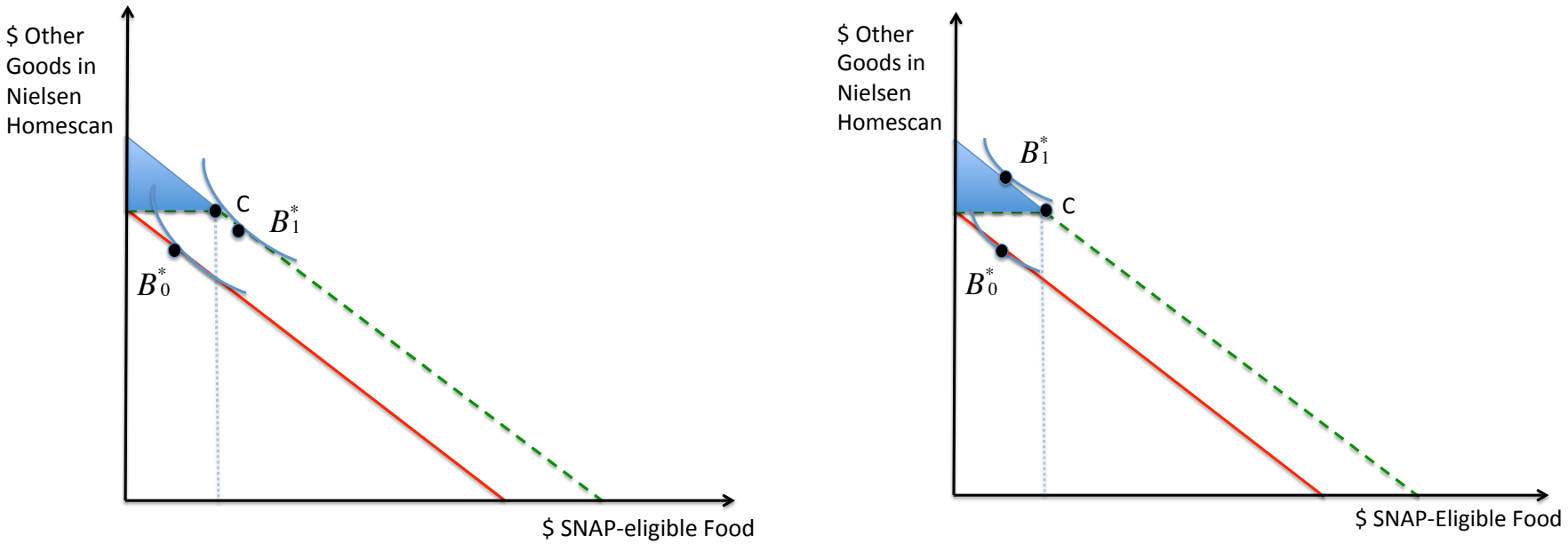


Figure A3: *Consumption Re-allocation for Constrained Households*



(a) Undistorted Case

(b) Distorted Case

Table A1: *Summary Statistics for SNAP Eligible Households*

	SNAP Eligible Elderly Widows	**SNAP Eligible Elderly Widowers**	**SNAP Eligible Elderly Couples**
Obs	5858	544	9132
Number of unique households	2153	237	3976
Constrained households: $ SNAP foods < benefits	42%	44%	48%
Constrained households: $ food < benefits	28%	26%	31%
Household income	11093.64	10977.35	15695.84
Yearly expenditure (trip data)	2678.25	2585.35	4615.00
Yearly expenditure (purchase data)	1800.14	1837.29	3159.79
Budget share (health&beauty)	0.13	0.09	0.11
Budget share (general merchandise)	0.08	0.09	0.09
Budget share (food grocery)	0.67	0.70	0.67
Budget share (non-food grocery)	0.09	0.07	0.09
Yearly SNAP foods expenditure (dollar)	924.76	1173.66	2044.70
Expenditure share (SNAP food/food grocery)	0.79	0.78	0.81
Potential yearly SNAP benefits	1222.36	1222.36	2329.80
Female head age	74.52	-	68.33
Male head age	-	75.27	71.45
>= Graduated high school (Female)	0.90		0.91
>=Some College (Female)	0.42		0.41
>= Graduated high school (Male)		0.86	0.82
>=Some College (Male)		0.53	0.43
Microwave, Dishwasher, & Garbage Disposal	0.15	0.12	0.13
Regular & Pay Cable	0.26	0.34	0.34
Internet connection	0.50	0.65	0.73

Notes: The values reported above are mean. The expenditures are deflated. Elderly are defined as those who are 55+. The constrained households are those whose expenditure on SNAP-eligible food is less than SNAP benefits.

Table A2: *Summary Statistics for Constrained and Unconstrained Households*

	Elderly Widows		Elderly Widowers		Elderly Couples	
	Constrained	**Unconstrained**	**Constrained**	**Unconstrained**	**Constrained**	**Unconstrained**
Obs	2,468	3,390	238	306	4,384	4,748
Number of unique households	1,158	1,523	130	148	2,214	2,536
Household income	9045.27	12584.90	8806.19	12666.04	13285.49	17921.40
Yearly expenditure (trip data)	2077.77	3115.42	2050.97	3000.99	3728.44	5433.59
Yearly expenditure (purchase data)	1401.80	2090.14	1455.93	2133.90	2533.56	3738.00
budget share (health&beauty)	0.14	0.13	0.09	0.09	0.11	0.11
budget share (general merchandise)	0.08	0.08	0.09	0.09	0.09	0.09
budget share (food grocery)	0.67	0.67	0.70	0.70	0.66	0.67
budget share (non-food grocery)	0.10	0.10	0.07	0.08	0.10	0.09
Yearly SNAP expenditure (dollar)	840.51	1321.62	903.54	1383.75	1588.59	2465.84
SNAP food share out of food grocery	0.78	0.80	0.77	0.79	0.80	0.81
Potential yearly SNAP benefits	1555.98	979.48	1540.01	885.26	2477.22	1913.35
Female head age	74.57	74.49	-	-	68.64	68.04
Male head age	-	-	74	76.26	71.87	71.07
>= Graduated high school (Female)	0.88	0.92	-	-	0.89	0.93
>=Some College (Female)	0.40	0.44	-	-	0.39	0.42
>= Graduated high school (Male)	-	-	0.85	0.86	0.79	0.85
>=Some College (Male)	-	-	0.53	0.53	0.41	0.44
Microwave, Dishwasher, & Garbage Disposal	0.12	0.16	0.08	0.15	0.13	0.13
Regular & Pay Cable	0.27	0.26	0.36	0.32	0.29	0.39
Internet connection	0.45	0.54	0.66	0.64	0.69	0.76

Notes: The values reported above are mean. The expenditures are deflated. Elderly are defined as those who are 55+. The constrained (unconstrained) households are those whose pre-treatment expenditure on SNAP-eligible food is less than (equal to or more than) SNAP benefits.

Table A3: *Spending Pattern between SNAP Eligible and Ineligible Households*

	Households eligible for SNAP		Households ineligible for SNAP	
	Mean	Standard deviation	Mean	Standard deviation
Panel A: Spending Level				
Total expenditure in Nielsen	3159.79	1250.98	3497.63	1337.88
Food grocery expenditure	2582.95	1054.72	2733.33	825.39
SNAP food expenditure	1641.25	587.56	1778.58	629.10
Healthier foods	2180.10	938.83	2300.78	972.46
Unhealthy foods	276.94	155.59	299.91	165.20
Sugar-sweetened beverages	125.91	114.83	132.64	113.50
Panel B: Spending as a Percent of Food Grocery Spending				
SNAP foods	63.54%		65.07%	
Healthier foods	84.40%		84.17%	
Unhealthy foods	10.72%		10.97%	
Sugar-sweetened beverages	4.87%		4.85%	

Notes: The "healthier foods" category includes bread, poultry, fish and shellfish, eggs, milk, cheese, other non-ice cream dairy foods, fruit (excluding juice), vegetables, dried fruit, nuts, prepared salads and baby food. The "unhealthy foods" category comprises ice cream, candy, gum, hot dogs, potato chips and other snacks, and bakery goods and prepared desserts such as cakes, cupcakes, doughnuts, pies, and tarts. The sugar-sweetened beverages group includes colas, other carbonated drinks, and non-carbonated fruit-flavored and sports drinks. The definitions follow Hoynes et al. (2015).

Table A4: *Counterfactual Results for Unconstrained Elderly Households*

	Benchmark	Counterfactual	
Panel A: Changes in Budget Shares among Unconstrained Widows			
General merchandise	0.078	0.079	
% change		0.77%	
Food grocery	0.679	0.706	
% change		3.92%	
Non-food grocery	0.101	0.110	
% change		9.20%	
Health & beauty	0.141	0.105	
% change		-25.99%	
Panel B: Changes in Budget Shares among Unconstrained Widowers			
General merchandise	0.097	0.090	
% change		-7.64%	
Food grocery	0.726	0.744	
% change		2.41%	
Non-food grocery	0.083	0.083	
% change		0.48%	
Health & beauty	0.094	0.084	
% change		-11.25%	
Panel C: Changes in Budget Shares among Unconstrained Couples		$\eta = 0.5$	$\eta = 0.675$
General merchandise	0.090	0.085	0.087
% change		-5.99%	-3.99%
Food grocery	0.696	0.716	0.704
% change		2.79%	1.13%
Non-food grocery	0.096	0.098	0.106
% change		2.19%	10.01%
Health & beauty	0.118	0.101	0.104
% change		-13.70%	-11.74%

Notes: the table reports the pre-teatment and post-treatment budget shares on the four aggregate goods among the elderly unconstrained widows, widowers, and couples. The results for couples are reported by assuming equal sharing (resource share of wife = 0.5) or unequal sharing (resource share of wife = 0.723). The demand for elderly widows and widowers are estimated using the unitary approach with QAIDS. Unconstrained households are defined as those whose pre-treatment expenditure on SNAP-eligible food is more than their potential SNAP benefits.

Table A5: *Average Propensity to Consume among Unconstrained Households*

APC among Unconstrained households	Elderly Widows	Elderly Widowers	Elderly Couples
SNAP benefits	979.00	835.00	1,913.00
Benchmark Food Expenditure	1,376.54	1,441.18	2,354.50
Counterfactual Food Expenditure	2,122.80	2,135.58	3,882.80
Increase in Food Expenditure	746.26	694.40	1,528.30
APC food out of SNAP benefits	0.76	0.83	0.80
APC SNAP-eligible food out of SNAP benefits	0.61	0.66	0.65

Notes: value are in mean. The table reports the average propensity to consume (APC) SNAP-eligible food out of SNAP benefits among unconstrained households. APC food out of SNAP benefits is calculated as the average increase in food

Table A6: *Counterfactual Results for Constrained Elderly Widows*

	Constained Households		Extra-marginal Households		Infra-marginal Households	
obs	2468		1051		1417	
Panel A: Changes in Budget Shares among Constrained Widows	Benchmark	Counterfactual	Benchmark	Counterfactual	Benchmark	Counterfactual
General merchandise	0.078	0.076	0.081	0.084	0.079	0.074
% change		-2.81%		3.21%		-6.35%
Food grocery	0.679	0.700	0.685	0.698	0.672	0.705
% change		2.99%		1.85%		5.03%
Non-food grocery	0.101	0.108	0.103	0.112	0.105	0.106
% change		6.43%		8.83%		1.04%
Health & beauty	0.141	0.105	0.131	0.106	0.144	0.114
% change		-25.99%		-18.67%		-20.79%
Panel B: Average Propensity to Consume among Constrained Widows	Values		Values		Values	
SNAP benefits	1556.00		1682.80		1461.90	
Benchmark Food Expenditure	929.08		906.99		940.31	
Counterfactual Food Expenditure	2045.57		2098.40		2018.85	
Increase in Food Expenditure	1116.49		1191.40		1078.55	
APC food out of SNAP benefits	0.72		0.71		0.74	
Expenditure on SNAP-eligible food to overall food ratio	0.78		0.30		0.84	
APC SNAP-eligible food out of SNAP benefits	0.56		0.21		0.62	
Household Income	9045.20		3552.40		9566.80	

Notes: values are in mean. Constrained households are defined as those whose pre-treatment expenditure on SNAP-eligible food is equal to or less than their potential SNAP benefits. The extra-marginal (infra-marginal) households are those constrained households whose post-treatment expenditure on SNAP-ligible food is less than (equal to or more than) SNAP benefits. APC food out of SNAP benefits is calculated as the average increase in food expenditures divided by the average SNAP benefits. APC SNAP-eligible food out of benefits is calculated as the average increase in food expenditures multiplied by the pre-treatment SNAP-eligible food to overall food ratio and then divided by the average SNAP benefits. .

Figure A4: *Distribution of SNAP-eligible food expenditure over SNAP benefits ratio (Extra-marginal Elderly Widows)*

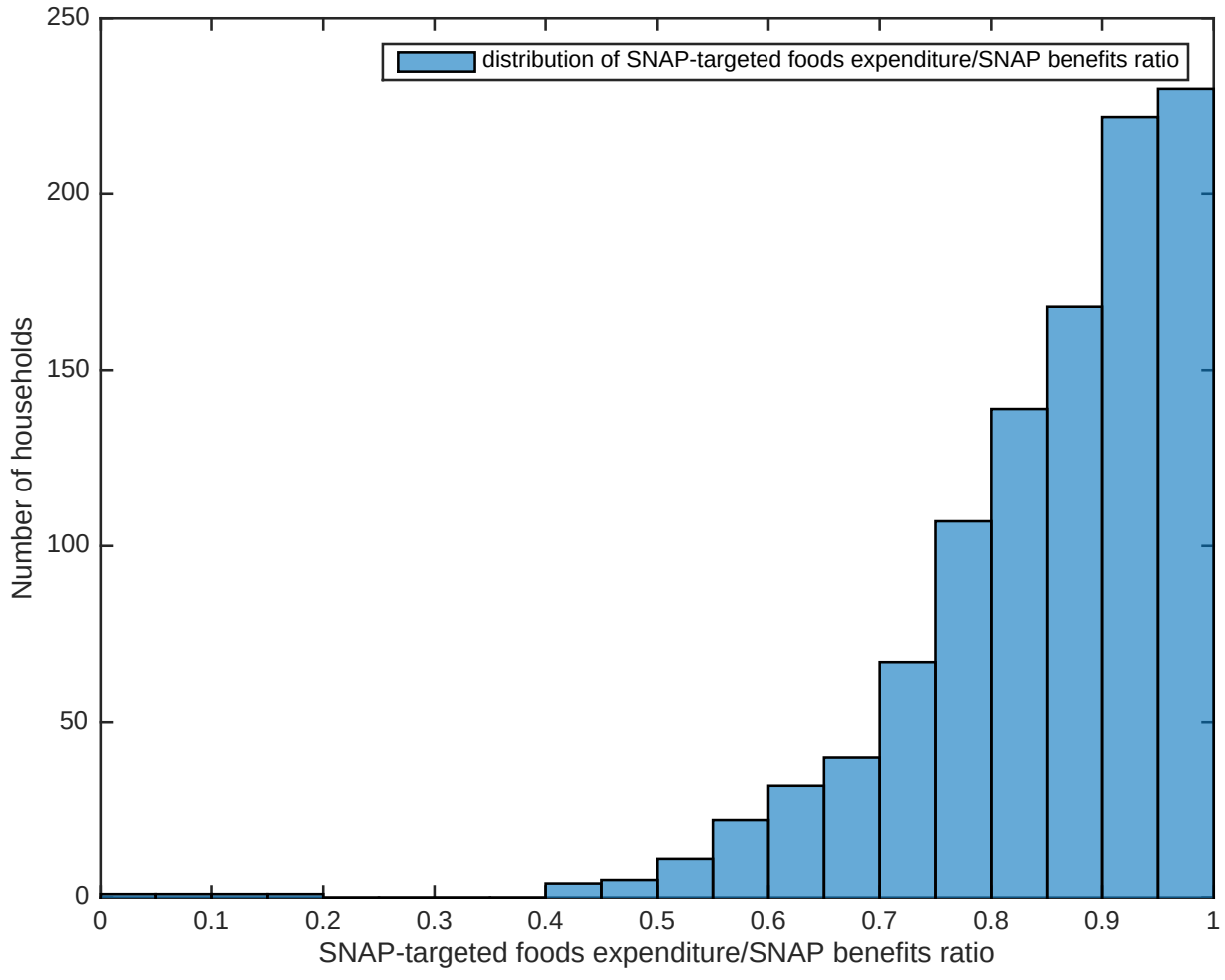


Table A7: *Counterfactual Results for Constrained Elderly Widowers*

	Constrained Households		Extra-marginal Households		Infra-marginal Houseoholds	
obs	238		71		166	
Panel A: Changes in Budget Shares among Constrained Widowers	Benchmark	Counterfactual	Benchmark	Counterfactual	Benchmark	Counterfactual
General merchandise	0.090	0.077	0.090	0.081	0.090	0.075
% change		-14.41%		-9.50%		-16.54%
Food grocery	0.735	0.764	0.753	0.760	0.727	0.765
% change		3.95%		0.96%		5.27%
Non-food grocery	0.078	0.082	0.075	0.082	0.079	0.082
% change		4.62%		8.66%		2.90%
Health & beauty	0.098	0.079	0.083	0.078	0.105	0.079
% change		-19.90%		-6.28%		-24.59%
Panel B: Average Propensity to Consume among Constrained Widowers	Values		Values		Values	
SNAP benefits	1540.00		1675.10		1482.60	
Benchmark Food Expenditure	999.36		980.26		1006.84	
Counterfactual Food Expenditure	2214.61		2262.38		2194.15	
Increase in Food Expenditure	1215.25		1282.12		1187.32	
APC food out of SNAP benefits	0.79		0.77		0.80	
Expenditure on SNAP-eligible food to overall food ratio	0.77		0.19		0.82	
APC SNAP-eligible food out of SNAP benefits	0.61		0.15		0.66	
Household Income	8806.10		2415.10		9108.20	

Notes: values are in mean. Constrained households are defined as those whose pre-treatment expenditure on SNAP-eligible food is equal to or less than their potential SNAP benefits. The extra-marginal (infra-marginal) households are those constrained households whose post-treatment expenditure on SNAP-ligible food is less than (equal to or more than) SNAP benefits. APC food out of SNAP benefits is calculated as the average increase in food expenditures divided by the average SNAP benefits. APC SNAP-eligible food out of benefits is calculated as the average increase in food expenditures multiplied by the pre-treatment SNAP-eligible food to overall food ratio and then divided by the average SNAP benefits. .

Figure A5: *Distribution of SNAP-eligible food expenditure over SNAP benefits ratio (Extra-marginal Elderly Widowers)*

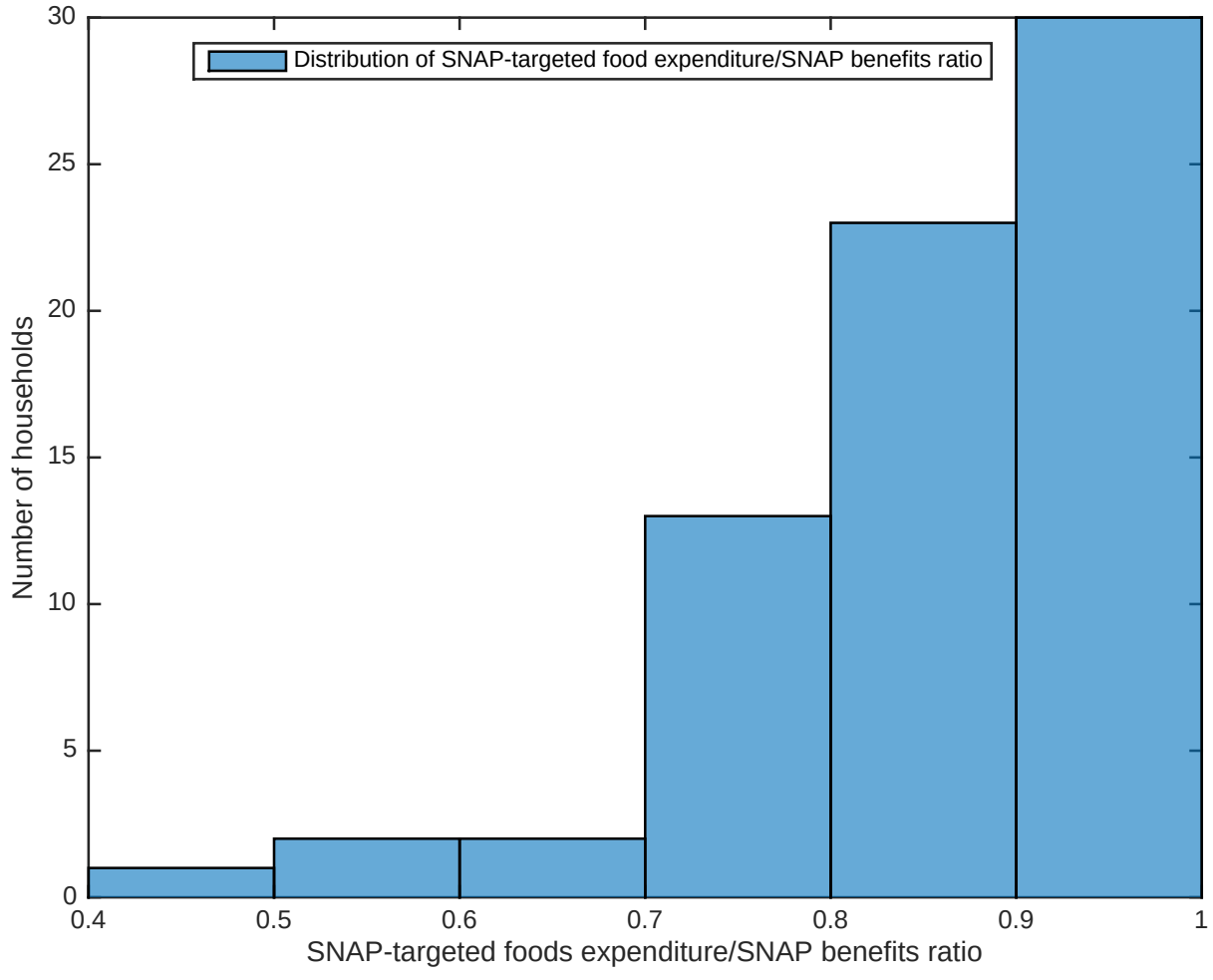


Table A8: *Counterfactual Results for Constrained Elderly Couples*

	Benchmark	Counterfactual	
Panel A: Changes in Budget Shares among Constrained Couples		$\eta = 0.5$	$\eta = 0.675$
General merchandise	0.0889	0.0776	0.0801
% change		-12.71%	-9.90%
Food grocery	0.6912	0.7255	0.7126
% change		4.96%	3.10%
Non-food grocery	0.1006	0.0981	0.1065
% change		-2.49%	10.19%
Health & beauty	0.1193	0.0988	0.1008
% change		-17.18%	-15.51%
Panel B: Average Propensity to Consume among Constrained Couples		Values	
SNAP benefits		2762.50	
Benchmark food expenditure		1641.80	
Counterfactual food expenditure		3667.20	
Increase in food expenditure		2025.40	
APC food out of SNAP benefits		0.73	
APC SNAP-eligible food out of SNAP benefits		0.59	

Notes: values are in mean. APC food out of SNAP benefits is calculated as the average increase in food expenditures divided by the average SNAP benefits. APC SNAP-eligible food out of benefits is calculated as the average increase in food expenditures multiplied by the pre-treatment SNAP-eligible food to overall food ratio and then divided by the average SNAP benefits. Constrained households are defined as those whose pre-treatment expenditure on SNAP-eligible food is equa to or less than their potential SNAP benefits.

Table A9: *Counterfactual Results for Elderly Couples*

		Benchmark	Counterfactual	
Changes in Budget Shares among Elderly Couples			$\eta = 0.5$	$\eta = 0.675$
General merchandise		0.0896	0.0813	0.0836
	% change		-9.26%	-6.70%
Food grocery		0.6939	0.7204	0.7079
	% change		3.82%	2.02%
Non-food grocery		0.0982	0.0981	0.1062
	% change		-0.10%	10.19%
Health & beauty		0.1184	0.1002	0.1023
	% change		-15.37%	-13.60%

Notes: values are in mean. The approximate increase in SNAP-eligible spending is calculated as the increase in food expenditures multiplied by the ratio between the expenditures on SNAP-eligible food over total food expenditures. I implicitly assume that a household's budget share of SNAP-eligible food out of total food does not change before and after the counterfacutal exercise. APC is the average propensity to consume. APC food out of benefits is calculated as the average increase in food expenditures divided by the average SNAP benefits.

Table A10: *Counterfactual Results for Wives*

Wife		Benchmark	Counterfactual
Equivalent budget share (EBS)	General merchandise	0.088	0.0847
	% change		-3.53%
	Food grocery	0.684	0.6931
	% change		1.40%
	Non-food grocery	0.109	0.1181
	% change		8.85%
	Health & beauty	0.120	0.1041
	% change		-13.39%

Notes: values are mean. EBS: Wife's QAIDS estimates of budget shares if she is faced with 0.7 resource share and the shadow prices.

Table A11: *Counterfactual Results for Husbands*

Husband		Benchmark	Counterfactual
Equivalent budget share (EBS):	General merchandise	0.095	0.081
	% change		-14.69%
	Food grocery	0.7114	0.739
	% change		3.85%
	Non-food grocery	0.081	0.081
	% change		-0.25%
	Health & beauty	0.1119	0.099
	% change		-11.80%

Notes: values are mean. EBS: husband's QAIDS estimates of budget shares if he is faced with 0.7 resource share and the shadow prices.

B Nielsen Homescan data

The Nielsen Homescan Data represents a longitudinal panel of approximately 40,000 - 60,000 U.S. households who continuously provide information on what products they buy, when and where they make the purchase, and their household characteristics. The Nielsen provides in-home scanners for the panelists to record all of their purchases, intended for personal, in-home use.

Products recorded in Nielsen include all Nielsen-tracked categories of food and non-food items, in which food accounts for approximately 70 percent. Nielsen adopts four-tier hierarchy of product structure: UPC (3.2 million UPC Codes) – Product Module (1,075 Product Modules) – Product Group (125 Product Groups) – Department (10 Departments). Since 6 out of the 10 departments are food related, I aggregate those 6 department into category Food Groceries. The resulting four aggregate goods in this paper are Health and Beauty, Food Groceries, Non-food Groceries, and General Merchandise.

For each shopping trip, the participant scans every barcode/Universal Product Code (UPC) so that information, such as price, quantity, deal or coupon used, date of shopping trip, and total amount spent on the trip, are recorded. Prices are either recorded as the weighted average price for the barcode that week in that particular store, if Nielsen has point of sale data of the store. Otherwise, the participant is instructed to enter the total price paid for the barcode (prior to any coupon or deal used). Information on store locations is not revealed up to the 3 digit zip code. Neither is the retailer name. Only the retailer channel type (drug store or convenience store) is revealed.

Information on household characteristics are collected through an annual questionnaire in which households report household size, composition, marital status, race, education, age, region, and zip code. Employment hours are collected only into three ranges of hours (under 30, 30-34, 35+, or not employed).Broadly defined occupations (12 types) are also collected. It also provides information on household ownership of TV items, cable, internet connection, and kitchen appliances.

Certain issues should be mentioned about the quality of the data, especially the price information. Since all data are collected by participants themselves within the home, they might suffer from common recording error. Items might be eaten on the way home or the participant might forget or scan the wrong item (Please see Einav, Leibtag, and Nevo (2010) for a more detailed analyses on the recording error of Nielsen home-scan data). Weekly average store price might overestimate the actual price that the consumer would have paid with a loyalist card. It leads to measurement errors in price. However, Einav, Leibtag, and Nevo (2010) finds that attrition in price in Nielsen Homescan data is not more serious than that in other consumption surveys, such as the Current Population Survey (CPS). As long as recording errors are not systematically different across participants, the results should not be severely impacted.

B.1 Compare Nielsen Homescan Data to CEX

Nielsen estimates that approximately 30 percent of household consumption is accounted for by consumer panel data categories; however, they do not track other sources of consumer spending beyond the Nielsen-tracked categories. I compare the goods included in Nielsen Homescan data to those in the Consumer Expenditure Survey (CES). [40] To better understand the definitions and coverage of aggregate goods, I map the aggregate goods in Nielsen to aggregate goods and sub-categories in CEX, as reported in Table A1. The categories in CES that are beyond the Nielsen-tracked categories include rent, clothing, transportation, etc. Since a lot of services and goods, such as heating, housing, and transportation, are highly shareable, the resulting analyses on consumption savings through sharing public goods in this paper will be a lower bound for the actual total consumption savings through cohabitation. Table A2 compares the mean food expenditure in Nielsen with CEX among the elderly population. The definition of food and total expenditures on food among the elderly are similar between CEX and Nielsen Homescan data. It implies that food products included in the Nielsen Homescan data is complete.

Note that goods such as heating, transportation, etc are not included in the paper. The implicit assumption in demand estimation is the separability assumption frequently made by previous literature. Here I assume that the elderly make separate spending decisions between grocery-type goods and other goods. Readers can also think of it as a two-stage budget problem. That is, the elderly first make decisions on how much to spend on housing, utilities, transportation, and grocery goods. In the second stage, they decide the consumption allocation within grocery goods.

Moreover, the problem of not having comprehensive goods is less serious when I only consider the elderly population. Figure A1 and A2 show food and non-food expenditures by age the reference person in CEX in 2013. Note that households whose reference person is middle-age are likely to have both adults and children. The average consumer units per household is 3. Household food expenditures decrease moderately after aging[41], while non-food expenditures such as clothing, transportation, and pensions and social security decrease dramatically after retirement age. Hence, even though Nielsen tracked only a subset of goods compared to other more comprehensive datasets, food constitutes a larger chunk of their budget among the elderly population compared to the younger population.

[40] For CES definition of goods and services, please visit the website of Bureau of Labor Statistics https://www.bls.gov/cex/csxgloss.htm

[41] Previous finding by Aguiar and Hurst (2007) shows that elderly population decrease total expenditures on food but increase time on food preparation, cooking, and shopping intensity. Hence, their overall food consumption does not decrease after aging.

Table A12: *Definitions of Aggregate Goods: Nielsen Homescan vs. CEX*

Aggregate goods in Nielsen homescan data	Aggregate goods and services in CEX
Health and beauty	Healthcare: drugs, medical supplies Other expenditures: personal care products and services
Food groceries	Food excluding food away from home Other expenditures: tabacco
Non-food groceries	Entertainment: pets, pet food, pet services Other expenditures: smoking supplies Housing: housekeeping supplies (laundry and cleaning supplies)
General merchandise	Housing: housekeeping supplies, household textiles, small appliances/miscellaneous housewares Transportation: maintenance and repairs Entertainment: Television, radio, and sound equipment, other entertainment equipment and services Other expenditures: education and reading (books, school supplies)

Notes: Food in CEX includes spending on food at groceries, convenience stores, specialty stores, farmers markets and home delivery services, minus the cost of paper products, cleaning supplies, pet food and alcohol.

Table A13: *Aggregate goods: Nielsen homescan vs. CEX*

	Nielsen	CEX
Mean food expenditure	6,425.00	6,066.00

Notes: the expenditure for Nielsen is among elderly couples, in which both spouses are aged 55 and above. The expenditure for CEX is among the households in which the age of the reference age is 55 and above. The source is from U.S. Bureau of Labor Statistics.

Figure A6: *Mean Food Expenditures: by Age of Reference Person, 2013, CEX*

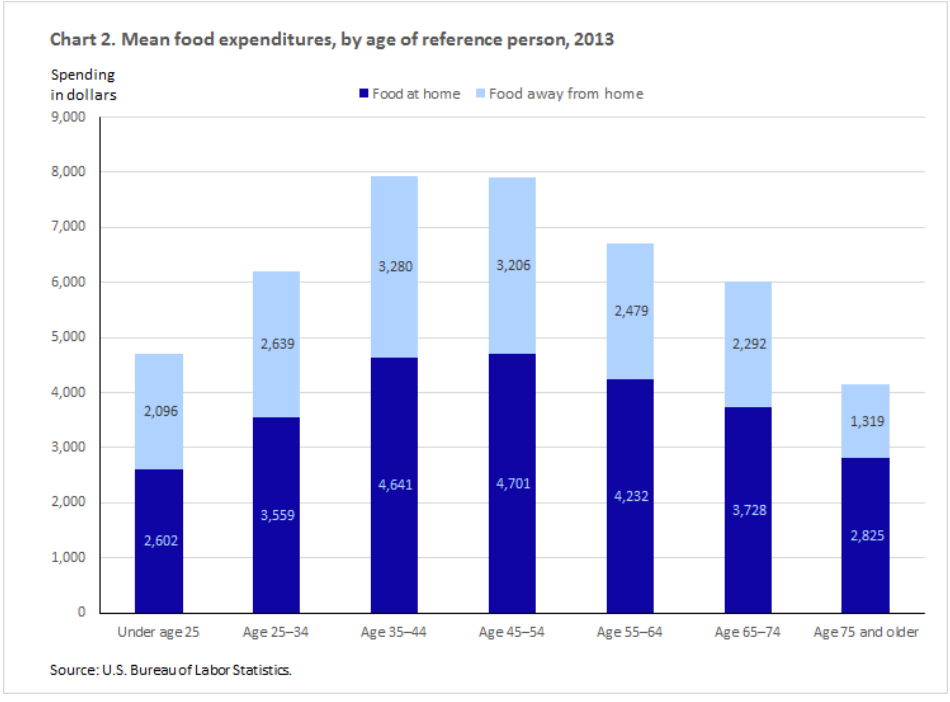
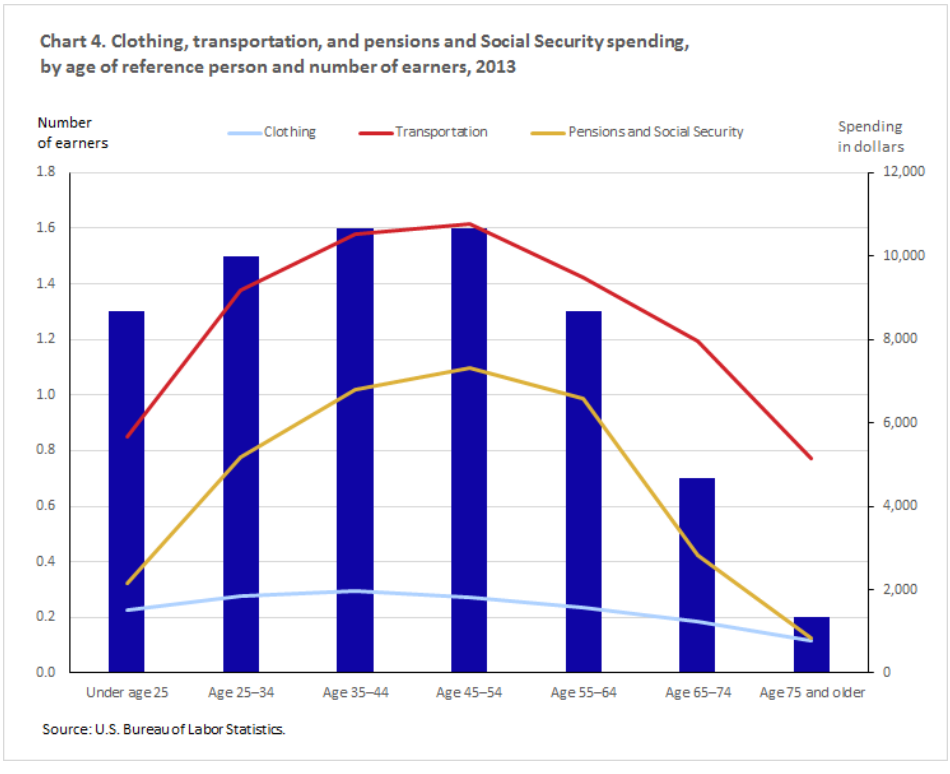


Figure A7: *Other Non-food Expenditures: by Age of Reference Person, 2013, CEX*



C Benchmark Engel Curves and Elasticities Estimates

Figure A8 plots the Engel curves for the elderly widows, widowers, and couples. The Engel curve for food grocery is downward sloping for all samples. It is consistent with the Engel's law and implies that food is a necessity good. The Engel curves for general merchandise is slightly upward sloping, implying that it is a luxury good. The Engel curves of health and beauty, which are slightly downward sloping, are similar between elderly widows and couples. It shows mild evidence that the elderly couple's preference is more representative of the female head. However, since the sample size of widowers is much smaller than that of the widows and couples, the evidence here is not strong enough.

Table A14 reports the $QAIDS$ elasticity estimates for elderly widows and widowers. The budget elasticities, which are the elasticities of demand (budget share) with respect to total expenditures, are given by $\epsilon_i^y = \frac{\beta_i}{w_i} + 1$. All of the own price elasticities are negative for both widows and widowers. For both widows and widowers, the compensated cross price elasticities are positive between food and non-food grocery, implying that they are substitutes. This is consistent with later evidence that SNAP benefits on food lead to increase in budget share of both food and non-food grocery.

D Individual Welfare Measures

The private good equivalents are given by:

$$x_k^f = \frac{\eta \omega_k^f(\pi/\eta)}{\pi_k} = \frac{\omega_k^f}{A_k}\eta y \tag{32}$$

$$x_k^m = \frac{(1-\eta)\omega_k^m(\pi/(1-\eta))}{\pi_k} = \frac{\omega_k^m}{A_k}(1-\eta)y \tag{33}$$

The equivalent expenditures for each are given by:

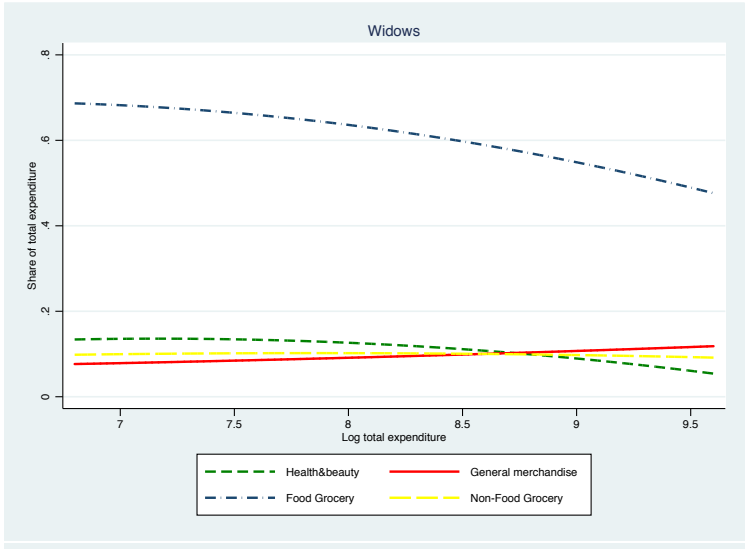
$$x^f = \sum_k x_k^f = \eta y \sum_k \frac{\omega_k^f}{A_k} \tag{34}$$

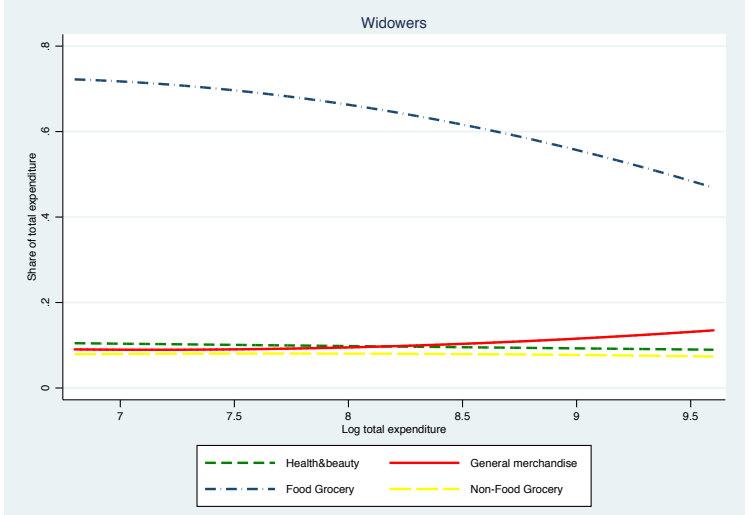
$$x^m = \sum_k x_k^m = (1-\eta) y \sum_k \frac{\omega_k^m}{A_k} \tag{35}$$

The indifference scales for each are given by:

$$IS^f = \frac{x^f}{y} = \eta \sum_k \frac{\omega_k^f}{A_k} \tag{36}$$

Figure A8: *Engel Curves for Elderly Widows, Widowers, and Couples*





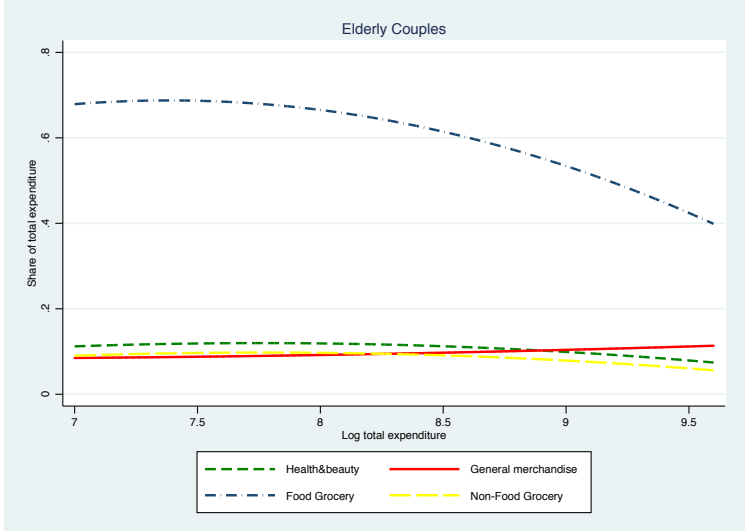


Table A14: *QAIDS Elasticities Estimates for Widows and Widowers*

Budget Elasticities

	Elderly Widow	Elderly Widower
General Merchandise	0.963	0.755
Food Grocery	1.041	1.079
Non-Food Grocery	1.081	0.923
Health and beauty	0.755	0.749

Uncompensated Price Elasticities (Elderly Widow)

	General merchandise	Food Grocery	Non-Food Grocery	Health and beauty
General merchandise	-0.365	-0.696	-0.162	-0.075
Food Grocery	-0.068	-0.773	-0.023	-0.182
Non-Food Grocery	-0.128	-0.091	-0.854	-0.029
Health and beauty	0.001	-0.998	0.089	-0.048

Compensated Price Elasticities/Slutsky Matrix (Elderly Widow)

	General merchandise	Food Grocery	Non-Food Grocery	Health and beauty
General merchandise	-0.246	-0.068	-0.065	0.050
Food Grocery	0.022	-0.062	0.085	-0.041
Non-Food Grocery	-0.035	0.637	-0.730	0.115
Health and beauty	0.061	-0.540	0.160	0.083

Uncompensated Price Elasticities (Elderly Widower)

	General merchandise	Food Grocery	Non-food grocery	Health and beauty
General merchandise	-0.596	0.149	-0.405	-0.042
Food Grocery	-0.017	-1.033	0.064	-0.105
Non-food grocery	-0.436	0.965	-1.194	-0.208
Health and beauty	0.027	-0.871	-0.080	-0.139

Compensated Price Elasticities/Slutsky Matrix (Elderly Widower)

	General merchandise	Food Grocery	Non-food grocery	Health and beauty
General merchandise	-0.477	0.522	-0.358	0.014
Food Grocery	0.086	-0.249	0.155	0.009
Non-food grocery	-0.354	1.593	-1.102	-0.117
Health and beauty	0.086	-0.435	-0.027	-0.027

$$IS^m = \frac{x^m}{y} = (1-\eta)\sum_k \frac{\omega_k^m}{A_k} \tag{37}$$

The relative economies of scale to consumption, R, are defined as

$$R = \frac{p'(x_f + x_m)}{y} - 1 = \frac{p'(x_f + x_m - z)}{p'z} \tag{38}$$

If all goods are public (private), then $R = 1$ ($R = 0$).

Figure A9: *Yearly Total Expenditure and Equivalent Expenditure (Elderly Widows)*

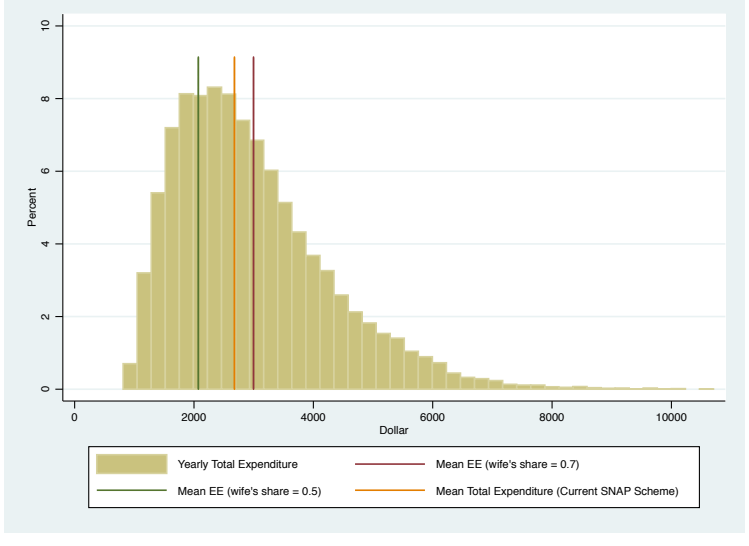


Figure A10: *Yearly Total Expenditure and Equivalent Expenditure (Elderly Widowers)*