CONSUMPTION INEQUALITY AND THE FREQUENCY OF PURCHASES

Olivier Coibion
UT Austin
and NBER

Yuriy Gorodnichenko
UC Berkeley
and NBER

Dmitri Koustas
UC Berkeley

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Abstract: We document a decline in the frequency of shopping trips in the U.S. since 1980 and consider its implications for the measurement of consumption inequality. A decline in shopping frequency as households stock up on storable goods (i.e. inventory behavior) will lead to a rise in *expenditure* inequality when the latter is measured at high frequency, even when underlying *consumption* inequality is unchanged. We find that most of the recently documented rise in expenditure inequality in the U.S. since the 1980s can be accounted for by this phenomenon. Using detailed micro data on spending which we link to data on club/warehouse store openings, we directly attribute much of the reduced frequency of shopping trips to the rise in club/warehouse stores.

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Introduction

Income inequality has been rising sharply since the 1980s, raising concern among economists, policymakers, and the general public. However, whether consumption inequality has gone up in similar fashion, which is arguably more relevant for welfare, remains the subject of heated debate in the literature. Understanding what has happened to consumption inequality can also be informative about the forces underlying the rise in income inequality.

For example, Krueger and Perri (2005) argue that improved financial intermediation has allowed households to more easily smooth their consumption over transitory income shocks, thereby compressing consumption inequality. Relatedly, Pistaferri, Blundell and Preston (2008) argue that much of the rise in income inequality since the mid-1980s came from transitory shocks (as opposed to permanent shocks) that households are able to partially insure themselves against, consistent with the Permanent Income Hypothesis (PIH) and the absence of a commensurate rise in consumption inequality. On the other hand, Battistin (2003), Attanasio et al. (2007), Attanasio et al. (2015), Aguiar and Bils (2015) and others argue that the flat profile of consumption inequality is nothing more than a measurement artifact and that consumption inequality has risen in line with income inequality since 1980.

We build on this literature by emphasizing the distinction between *spending (expenditure)* inequality and *consumption* inequality. While households can enjoy a smooth consumption flow from most goods, their purchases may occur only infrequently. Because household surveys typically track expenditures for a short period of time to minimize recall error and reporting burden (e.g., a two-week period in the Diary Survey of the Survey of Consumer Expenditures (CEX)), measures of spending inequality can fail to correctly measure the underlying consumption inequality due to the timing of purchases. This can matter not only in the cross-section (if one household happened to buy paper towels in a period and another did not, spending inequality over that period would be higher than consumption inequality even if both households have the same flow consumption of paper towels) but also for measuring trends over time. To see the latter, suppose that consumers start stocking up on food once a month rather than once a week. Even if they maintain the same consumption flow, the cross-sectional inequality of spending measured at a less than monthly horizon will rise despite the fact that underlying *consumption* inequality would have stayed the same. In this paper, we document such a decline in the frequency of shopping,

quantify its potential implications for historical changes in consumption inequality, and study its potential sources.

Our starting point is the well-documented difference in the trend of expenditure inequality across the Diary and Interview surveys of the CEX. While the latter points toward little change in expenditure inequality over time (as documented in Krueger and Perri 2005), the former instead suggests that expenditure inequality has risen more closely in line with income inequality (see e.g. Battistin 2003). Although there are many potential sources for this difference, one is the differing frequency over which expenditures are measured: bi-weekly in the Diary Survey and monthly (or quarterly for some categories) in the Interview Survey.[1] Consistent with the frequency of expenditure measurement being a force behind the different inequality trends in the two surveys, we then document that the frequency of shopping has indeed systematically declined over time. Using data from the CEX Diary Survey, we find that the fraction of days in which households engage in any shopping for non-durable goods has been falling over time, so that households concentrate their shopping into fewer days of the week. Using even more detailed information on household expenditures from the Nielsen HomeScan data, we again document a decline in the number of days in which households do their shopping.[2] Hence, part of the greater increase in inequality as measured by the Diary Survey may indeed be coming from a changing frequency of shopping by households.

We provide several additional pieces of evidence, based on micro data, consistent with this conjecture. First, while average real expenditures on goods in the Nielsen sample has been approximately constant between 2004 and 2014, this masks underlying changes along the intensive and extensive margins of shopping behavior. The number of shopping trips (extensive margin) has been steadily falling over the entire sample, whereas the average expenditures per trip (intensive margin) have been rising. Hence, we see households making fewer, but larger, shopping trips on average. Second, using information on the volumes and sizes of individual goods purchased in the Nielsen sample, we find that households have been purchasing larger quantities or volumes of goods over time, consistent with increased stocking up. Third, using the American Time Use Survey, we compute average shopping times for individuals. We find a

[1] Attanasio et al. (2007) provide a discussion of other potential sources for differing trends in expenditure inequality across the two CEX surveys.

[2] We first perform a battery of checks to ensure that the Nielsen data are comparable to CEX Diary Survey. We find that mean expenditures and implied inequality levels are quite close across the two datasets, once one focuses on goods that are common across the two.

strong decline in the average amount of time spent shopping by US households, driven entirely by the extensive margin. Households do fewer trips per day and are less likely to go to any store on any given day. In contrast, the average duration of a shopping trip (the intensive margin) has held steady over this time period. These are precisely the expected patterns as households buy larger quantities of goods while at the store and therefore need to go to the store less often. Thus, the ability to stock up appears to be a critical component of these differences in trends.

To quantify the contribution of changing frequency of shopping to the differential trends in expenditure inequality across frequencies of aggregation, we pursue two approaches. Ideally, one would simply vary the duration of periods over which each household's expenditures are aggregated then construct cross-sectional measures of dispersion for each frequency. Unfortunately, the data in each of the CEX surveys are inadequate for this since households in the Diary Survey only report their expenditures for two weeks while households in the Interview Survey report their expenditures over one-to-three month periods but do not provide higher frequency variation within those periods. However, the Nielsen data tracks spending by households daily for extended periods, thereby allowing us to assess the extent to which trends in expenditure inequality are sensitive to the frequency over which expenditures are aggregated, e.g. weekly, biweekly, monthly, quarterly and annual. This approach yields five different measures of inequality based on differing time frequency aggregations, albeit over a more limited sample than the CEX. We use these series to assess the extent to which time aggregation affects the trend in spending inequality and document a clear effect of time aggregation on the trends in spending inequality. Short time horizons for measuring consumption yield positive trends in inequality but much flatter profiles at lower frequencies.[3] When household spending is aggregated over the course of the year, there is essentially no trend in inequality. Hence, time aggregation can effectively account for all of the difference in the trends of consumption inequality identified by these two surveys.

Our second and complementary approach to quantifying these effects exploits the changing dispersion in individual households' expenditures over time (i.e., dispersion of a household's expenditures over the course of a year when expenditures are measured weekly,

[3] We perform a similar test in the CEX Diary survey by comparing trends in inequality of expenditures summed at the weekly vs biweekly frequency and in the CEX Interview survey by comparing trends in inequality of expenditures summed at the quarterly vs annual frequency. In each case, we find the same qualitative result that higher frequencies of aggregation lead to steeper trends in expenditure inequality.

biweekly, etc.). We show using a simple model that the latter measure provides a convenient metric to assess the contribution of shopping frequencies to the cross-sectional dispersion of expenditures. Based on how individuals' time-dispersion of expenditures have changed over time according to the Nielsen data, we can attribute all of the differential increase in cross-sectional expenditure inequality across the two surveys to a changing frequency of shopping.

There are many mechanisms which could explain why American households are increasingly purchasing larger quantities when shopping and therefore shopping less frequently. One such mechanism is the rise of club/warehouse stores (Costco, Sam's Club, BJ's, etc.) which, by design, sell larger quantities of goods to households at lower unit prices. As these stores have expanded throughout the country since the 1980s, it has become easier for households to stock up in ways that were not feasible in the past, consistent with the decreased frequency of shopping that we observe. Furthermore, there is considerable geographic variation in the ease with which households can access one of these retailers, enabling us to quantify the contribution of this mechanism.

To assess whether club/warehouse stores can explain some of the rising concentration in household shopping trips, we characterize the link between how much variation there is in an individual's spending over time and their reliance on club stores in their expenditures. Specifically, we first measure the variation in a household's expenditures over a year using different time frequencies for subperiods: weekly, bi-weekly, monthly and quarterly. Households who do more infrequent shopping trips have relatively higher dispersion in their expenditures at higher frequencies than at lower frequencies. This greater time-series dispersion in expenditures for one household when it does large purchases infrequently is therefore analogous to how cross-sectional dispersion in consumption is higher when more households engage in infrequent shopping. To assess how much households use club stores, we measure the fraction of a household's expenditures that were spent at a club store over the course of that year.

The link between shopping at club stores and stocking up can then be assessed by regressing an individual's expenditure dispersion on that individuals' share of expenditures going to club stores, using dispersion measures at different time frequencies. The results suggest that shopping at club stores is indeed correlated with significantly more stocking up. There is a strong positive correlation between the coefficient of variation at the weekly frequency and a household's share of expenditures at club stores, but this correlation declines rapidly as we increase the amount

of time over which expenditures are aggregated, as expected since it becomes progressively more difficult to stock up for longer periods. Shopping at club stores also explains a diminishing fraction of the variance in households' coefficients of variation at longer durations for time aggregation of expenditures. An instrumental variable strategy, based on the differing distance of households from club/warehouse stores, supports causality running from access to club/warehouse stores to increased stocking up in expenditures. We find that the increased prevalence of club/warehouse stores since the early 1980s can account for approximately 40 percent of the rise in measured inequality in expenditures.

This paper relates to a growing literature on measuring and understanding the sources of economic inequality. Unlike much recent work on the rising share of income and wealth of the top 1% (e.g., Piketty and Saez 2003, Piketty et al. 2016), we focus on inequality outside of the top 1% since our data sources are not informative about top income earners. Instead, our results build on the literature relating consumption and income inequality amongst households in the bottom 99% in the U.S. (e.g. Krueger and Perri 2005, Aguiar and Bils 2015, Attanasio and Pistaferri 2016) or abroad (Gorodnichenko et al. 2009). Relative to these papers, our contribution is to document how the changing frequency of shopping contributes to the *measured* trends in spending inequality. This paper is also closely related to a growing literature on shopping behavior of households and its implications for macroeconomics. For example, Nevo and Wong (2015) focus on the substitution between expenditures and home production during the Great Recession. Wong (2016) studies infrequent purchases of durable goods, Aguiar and Hurst (2013) focus on life-cycle consumption patterns of households, and Coibion, Gorodnichenko and Hong (2015) study the implications of store-switching for macroeconomic dynamics. We extend this line of work to study how shopping behavior can affect the measurement of expenditure inequality. Another closely related line of work focuses on household search for goods. Menzio and Trachter (2015) for example focus on the implications of consumer search for equilibrium price dispersion while Michaillat and Saez (2015) study the implications of product market search for macroeconomic dynamics. Finally, our use of time use data to study household decisions echoes Aguiar et al. (2013) and Lee et al. (2012). But whereas they use time use surveys to study the substitution between labor, leisure and home production, we exploit information on time spent shopping and traveling to stores to characterize the changing nature of household shopping behavior in the U.S.

The paper is organized as follows. In section 1, we discuss the different CEX surveys and their implications for trends in expenditure inequality, as well as providing preliminary evidence on how the frequency of shopping has declined over time. Section 2 introduces the Nielsen data and provides additional evidence on the changing characteristics of household shopping. Section 3 provides two ways of quantifying the contribution of these changing shopping patterns to expenditure inequality trends. Section 4 assesses how much of the changes in household shopping behavior can be attributed to the growing prevalence of club stores. Section 5 concludes.

I. Expenditure Inequality and the Changing Frequency of Purchases

To measure consumption inequality, previous work such as Krueger and Perri (2005), has focused primarily on the Consumer Expenditure Survey (CEX). Since the CEX is a well-known and well-documented data source, we provide only a brief overview of these data. We focus in particular on the differences between the two main components of the CEX, both of which have been used to measure consumption inequality: the Interview Survey (IS) and the Diary Survey (DS). We also highlight changes in the survey methodology over time that could impact the dispersion of measured spending.

In the IS, about 1,500-2,000 households are asked each month to *recall* the dollar value of spending over the previous month or quarter (depending on the category). Households are interviewed once per three months for five consecutive three-month periods, although the BLS only makes data available for interviews two through five. While early Interview surveys exist in 1960-1 and 1972-3, the modern Interview Survey begins in 1980 and is not directly comparable to prior waves of the IS. In the 1981-1983 waves for the IS and 1982-3 waves for the DS, only urban households were sampled due to budget cuts. A main advantage of the Interview Survey is its broad coverage of goods purchased by households (approximately 95% of typical household's consumption expenditures) since it is used to create expenditure weights for the Consumer Price Index.

A separate sample of households participate in the Diary Survey. Households are asked to record their spending each day for two weeks in a diary, which is later transcribed by U.S. Census Bureau officials. Records of daily spending become available to researchers starting in 1982, for the categories of food-at-home as well as food away from home. In 1986, the Diary Survey was

expanded to cover a comprehensive set of spending categories. In 2004, the Census Bureau adopted a variety of changes to Diary data collection procedures that resulted in potentially more accurate recording of purchases, including computer assisted technology for U.S. Census Bureau enumerators. In the figures made using the DS, we include a vertical line to indicate these structural breaks.

An extensive literature exists discussing the pros and cons of the two surveys. For example, Krueger et al. (2010), Aguiar and Bils (2015) and Attanasio et al. (2012) find that the Interview survey in the CEX underreports spending relative to aggregate data and that this underreporting has become more severe over time. On the other hand, Bee et al. (2012) compare reported consumption spending data in the CEX to comparable data from the national income accounts data and find that the CEX data conform closely to aggregate data for large consumption categories. Battistin (2013) and Attanasio et al. (2007) argue that, given data in the DS, the IS underestimates the rise in expenditure inequality since the 1980s. In contrast to the view promoted by Krueger and Perri (2005) that expenditure inequality (measured using the CEX IS) has not risen nearly as much as income inequality, more recent work has instead concluded that expenditure inequality has in fact grown more rapidly than implied by the CEX IS.

To illustrate how pronounced the differences are between the Interview and Diary surveys are for resulting trends in expenditure inequality, we construct a coefficient of variation for each survey. Specifically, for each survey, we measure each household's expenditures on non-durable goods and services.[4] In the Diary survey, expenditures are daily while in the Interview Survey they are over a monthly or quarterly horizon. We use BLS's monthly Personal Consumption Expenditures (PCE) price index to deflate household spending (for quarterly spending, we follow the BLS and allocate spending equally across months). Because the CEX IS and DS surveys use a somewhat different classification of goods and services (universal category codes, UCCs), we update the concordance created in Bee et al. (2012) and increase its scope to be comprehensive of all UCC codes (see Appendix E). We then calculate the coefficient of variation in expenditures across all households (the ratio of the cross-sectional standard deviation to the cross-sectional mean of expenditures) for each year.

[4] Our coverage of non-durable goods and services follows Coibion et al. (2012). Clothing and most services are not consistently measured in the Diary survey until 1986. To minimize any adverse effects of outliers on measures of inequality, we winsorize the right tail of household spending for a given frequency in each year at 1 percent.

We use the coefficient of variation (CV) as our baseline measure of inequality because it allows us to include households reporting zero spending in a given period. The latter is an important constraint because, as we document below, it is common for households to report zero weekly (or biweekly) spending for the studied categories of goods. Other popular measures of inequality (e.g., 90/10 ratio, standard deviation of logs) are ill-suited to the presence of many zeros in the data and therefore would not provide a comparable measure of inequality for this high-frequency (e.g., weekly) data on spending. In addition, our model allows us to derive a simple relationship between the time-series and cross-sectional coefficients of variation whereas no such simple formulas exist for other measures of inequality such as the Gini coefficient.

The resulting time series are plotted in Figure 1. Using the Interview Survey, we replicate the baseline result of Krueger and Perri (2005), finding little increase in expenditure inequality between 1980 and 2015. In contrast, the Diary Survey reveals a pronounced increase in expenditure inequality from 1980 to the early 2000s. The ratio of the two inequality measures provides a simple way of examining differences in trends across the two: *this ratio is increasing systematically over time, going from 1.05 in 1980 to 1.35 in 2015.* Its persistent increase even since the early 2000s reflects the fact that spending inequality as measured by the Interview Survey is declining over this time period but approximately constant in the Diary Survey. This *difference* in trends (rather than the trends themselves) is the focus of our analysis.

The diverging trends in inequality across the two survey measures are not driven by composition effects, either in terms of composition of goods or characteristics of households. For the former, we can compare spending inequality in the two surveys for matched and consistently (over time) collected categories of goods, thereby controlling for potential changing compositions of purchases over time. We find that the same trend in the ratio of inequality across the two surveys holds (Appendix Figure A1). Similarly, we can control for potentially changing household characteristics by looking at residual inequality in each survey. We do so by regressing household expenditures on a large set of observable characteristics of households (age, income, etc.) in each survey, then construct equivalent inequality measures from the residuals of household expenditures:

$$Y_{ht} = \boldsymbol{X}_{ht}\boldsymbol{\gamma} + \epsilon_{ht} \quad (1)$$

where h and t index households (respondents) and years, Y is a variable of interest, $\boldsymbol{X}$ is a vector of controls which includes a polynomial in the age of household head, gender dummy for household

head, a set of race dummies for household head, a set of dummies for educational attainment of household head, number of children, dummy for employment of household head, and a set of region dummies. The coefficient of variation adjusted for changes in demographics is calculated as $\sqrt{var(\epsilon_{ht})}/mean(\hat{Y}_{h,t})$. The results yield a similar pattern of a systematically rising ratio of consumption inequality in the DS relative to the IS from 1.1 in 1980 to 1.5 in 2015 (see Figure 1). Results are also similar if we use different metrics for measuring inequality (Gini coefficients are plotted in Appendix Figure A3) or within subgroups of the population. For example, in Appendix Figure A4, we document that the same patterns of rising inequality in DS survey relative to IS survey hold within both younger and older households, for the employed and the non-employed, for different races, for households of different sizes, as well as for households of high and low income.[5]

It is also worth noting the large difference in level between the two series. Although the IS likely has larger measurement error than the DS, this difference in levels is to be expected since the DS measures expenditures at the biweekly frequency whereas the IS measures expenditures over a monthly/quarterly horizon. Since some goods are purchased infrequently, the Diary Survey will record zero expenditures for some households and large expenditures for others depending on the timing of their purchases. In contrast, the Interview Survey will more consistently measure positive expenditures due to the longer horizon. By the same logic, inequality among weekly household expenditures in the Diary Survey is approximately 20 percent higher on average than for expenditures at the bi-weekly frequency in the same survey (see Appendix Figure A2).

Importantly, the fact that expenditures are measured over different horizons can be a source of differences in *trends* of measured "consumption" inequality if the frequency of household purchases is changing over time. For example, if households change their frequency of purchasing toilet paper from a weekly to a monthly frequency while keeping their flow consumption of toilet paper unchanged, this would induce a rise in the ratio of spending inequality when expenditures are measured at the bi-weekly frequency relative to when expenditures are measured at the monthly frequency. In this case, consumption inequality would not have changed (everyone is still using the same amount of toilet paper per unit of time) but inequality in spending at high frequencies would rise thus underscoring the difference between spending inequality and consumption inequality.

[5] We have also calculated the CV for income in both of the surveys, and find that income inequality has risen hand-in-hand in both, so these differences cannot be explained by differences in the cross-section of income across the two surveys.

There is evidence consistent with this hypothesis. Since the CEX diary survey provides daily expenditures, we can measure the average number of days in which households engage in positive expenditures (out of 14 possible days in the diary) for each survey year.[6] The result is plotted in Figure 2. Panel A refers to all nondurables including services, while Panel B focuses on a more limited set of nondurable goods: food at home, alcohol, tobacco, and other small nondurable goods. In 1980, households purchased a positive amount of nondurable goods 9 out of the 14 days of each bi-weekly period, but this number had fallen to 8 days by 2004. There is a structural break in the series of 2005 (because of the changes in how CEX DS data are collected), but the average number of days falls another 0.5 by 2015. Panel B shows an even steeper drop in shopping for the narrower set of nondurables. Almost identical trends are obtained if we use positive values (e.g. $5, $10, etc. including with inflation adjustment) as the threshold for daily expenditures instead of zero.

Like the changing ratio of expenditure inequality in the two surveys, the declining frequency of shopping, at least as measured in days with positive spending, holds for a wide range of products and is not driven by household characteristics, such as a growing share of working spouses. To see the latter, we construct residual measures of the number of days with positive expenditures for each household after controlling for the household observable characteristics as before and measure the average across households (normalizing it to have the same value as the raw measure in 1980 and again in 2005). The trends are almost identical, so the declining frequency of days with positive shopping experiences is not coming from changes in household characteristics.

Unfortunately, the CEX data present many limitations which do not allow us to characterize these effects in a more detailed way. For example, without more detailed information on households' shopping activities, we cannot quantify whether households are doing fewer shopping trips or are combining the same number of trips into fewer days. Without information on quantities and sizes of purchased goods, we cannot assess e.g. whether households are buying larger quantities on their less frequent trips. Without information on time use, we cannot determine whether households are changing the amount of time they devote to shopping. And because neither the DS nor IS has long panels of high-frequency data on

[6] Since the Interview survey does not provide high-frequency expenditure data, we cannot construct equivalent measures in that data.

expenditures, we cannot quantify the extent to which changing frequencies for computing expenditure inequality contributes to the differential trends in spending inequality. Using additional data sets, we explore these questions in the next section.

II. Changing Patterns of Household Shopping Behavior

Evidence from the CEX Interview Survey suggests that households have been reducing the frequency of their shopping over time, a feature potentially explaining the differing trends in spending inequality observed in the Interview and Diary Surveys. In this section, we provide more detailed microeconomic evidence on the changing patterns of household shopping behavior. To do so, we begin by introducing an additional but more detailed dataset on household shopping, the Nielsen Home Scanner data and show that these data display similar shopping characteristics as the CEX. For example, in addition to presenting comparable measures of expenditures on different categories of goods, we confirm the finding from the CEX that households are doing their shopping on fewer days using the Nielsen data. Second, we show that while average real expenditures by households were relatively constant between 2004 and 2014, households have been spending relatively more on each shopping trip but doing fewer shopping trips per year, consistent with increased stocking up. Third, using data on quantities, we show that households are purchasing ever larger sizes or numbers of units of individual products on each trip. Fourth, we turn to time use surveys to show that the amount of time households have been spending on shopping has been decreasing. All four facts are consistent with households increasingly "stocking up" in their shopping.

II.A Characteristics of the Nielsen data

While CEX allows us to construct time series going back to the early 1980s and have a good coverage of goods and services purchased by households, the data in each of the CEX surveys present some limitations. For example, households in the CEX Diary Survey only report their expenditures for two weeks, so we may be missing important expenditures that are not made over that two-week measurement period. Households in the CEX Interview Survey report their expenditures over one month (or three months depending on the category) but do not provide higher frequency variation within those periods. Because the Diary and Interview surveys are not

connected in any way, we cannot establish how time aggregation affects trends in measured spending inequality. Moreover, measurement error due to by recall bias in the IS imposes additional challenges when comparing consumption inequality at quarterly frequency in the IS versus higher frequency in the DS.

To address these challenges, we turn to Nielsen Home Scanner (Nielsen) data, available through the Kilts Center at the Booth School of Business at the University of Chicago, which provides a source of rich, high-frequency household spending data. Nielsen data are currently available from 2004 to 2014. From 2004-2006, the sample included approximately 40,000 households, increasing to 60,000 households beginning in 2007. Over the period 2004-2014, the mean and median tenure in the sample were approximately 4 and 3 years, respectively.[7]

The Nielsen sample is comprised of a combination of households recruited by Nielsen, as well as unsolicited volunteers. In exchange for their participation, households receive points that can be redeemed for prizes as well as entry into lotteries that award more points or cash. Households are provided a scanning device by Nielsen to scan the barcodes of their purchases and they are encouraged to scan newly purchased items as soon as they return home. Nielsen employs their own sample filter, requiring that households must report a minimum dollar amount per month, which varies depending on household size, to be in the final sample. To ensure that our results are not driven by households with incomplete records, we include only households with a least one shopping trip where they scan items in each month of a given year.

After scanning a product using the device, households directly report the quantity of the barcode (or universal product code, UPC, a precise definition of a good) that they purchased. For a group of participating stores, prices are automatically reported to Nielsen; otherwise the household is also asked to manually enter the product price. Nielsen later merges in information about the product that is tied to the barcode, including a measure of volume or count if applicable. If a product does not have a barcode, a purchase of this product is generally not reported as the main Nielsen data focus primarily on nondurables with a barcode.

Household demographics, including zip code and employment status, are updated once per year as part of a household survey. Nielsen uses the demographic information to construct

[7] Households participating for a long time in the Nielsen panel may exhibit fatigue in reporting their purchases and shopping trips. We found that controlling directly for tenure in the panel does not materially affect the moments that we study. We also recalculated all the key figures in the paper restricting to new entrants and households with 0-1 years of tenure, and found similar results our unchanged.

household weights that weigh the sample to be nationally representative. The household spending data are technically available on a daily basis. However, in some cases, the purchase date in Nielsen could reflect the date the data were transmitted by the scanning device to Nielsen, rather than the true purchase date by the household.[8]

The Nielsen data include over 325 million barcodes that Nielsen estimates to cover approximately 30 percent of household spending. These barcodes are categorized by Nielsen into lower levels of aggregation. Nielsen's "Product Groups," of which there are 125, are closest to universal classification codes (UCCs) in the CEX Diary Survey. For our analysis, we construct a correspondence table between CEX Diary UCCs and Nielsen Product Groups (see Appendix B).

To ensure that our results are not driven by the specifics of how Nielsen data are collected, we compare basic moments for categories of consumer spending in CEX Diary Survey and in Nielsen. All statistics are for the biweekly frequency. We compute moments for categories of goods present in both sources so that the coverage of goods is comparable across data sets (e.g., Nielsen data have virtually no coverage of services). The set of comparable non-durable goods generally includes food, alcohol, and small non-durables. To differentiate the frequency of shopping trips and the size of purchases, we show the share of households reporting zero spending over two weeks for a given category of goods ("zero share") and moments (mean, standard deviation, interquartile range) for the size of purchases conditional on a purchase in the category. Results for selected categories of goods for year 2014 are reported in Table 1.

Consistently across data sources, we observe that purchases for many categories of goods are not made frequently. On average, there is an approximately 80 percent chance that there is no purchase in a typical category of goods over two weeks. Furthermore, for the comparable categories, the probability of no purchases for any of the categories during the period is 6 percent in the CEX data and 10 percent in the Nielsen data. The correlation of zero shares across the surveys is 0.74 thus indicating high consistency across data sources.

Average spending conditional on a shopping trip is higher in the CEX than Nielsen data. For example, the average total bi-weekly spending on comparable categories of nondurable goods is $239 in the CEX data compared with $149 in the Nielsen data. This difference reflects the fact that the Nielsen data report considerably lower levels of spending for categories with few

[8] Nielsen made changes in 2009 that resulted in more purchases being assigned a transmission date rather than the true purchase date. We therefore must be cautious comparing higher frequency (especially daily) behavior across these regimes.

UPCs such as "fresh meat", "fresh produce", "bread and baked goods", and "lawn and garden." The levels of spending are much closer for categories of goods populated by products with UPCs. For example, the average spending on "baby food" (a category where most goods have UPCs) in the Nielsen data is close to the average spending on "baby food" in the CEX data while the average spending on "fresh meat" in the Nielsen data is smaller than the average spending on "fresh meat" in the CEX data. Note, however, that despite this limitation, the correlation between average spending or dispersion of spending in the CEX and Nielsen data is above 0.85 and can be further increased (up to 0.95) if a few outlier categories such as "fresh meat" are excluded. Measures of dispersion across the sources are close to each other too. We conclude that Nielsen data provide a useful complement to the CEX Diary Survey data for an analysis focusing on nondurable goods.

II.B Evidence from the volume/size of purchases

We can assess the possibility of increased stocking up by looking directly at volumes purchased: we should not only see increased spending per trip, but also increased physical volumes of goods purchased by households. Because Nielsen data report not only dollar spending for each UPC but also units purchased as well as volumes of units, we can check if this prediction is borne out by the data. In particular, the Nielsen dictionary of UPCs specifies count or weight for each UPC. Using 2004 as the benchmark year, we examine the distribution of purchased weights or counts for each module[9] of goods. We identify a purchase as "large volume" if the purchased weight or count is greater than the 90th percentile of the size distribution of purchased weights or counts in the module.[10] Then for each year we compute the share of purchases (by weight or count) for each module and household holding the "large volume" threshold constant across years. Using annual expenditure shares to aggregate across modules and sampling weights to aggregate across households, we construct an average share of "large volume" purchases for each year. We find (Figure 3) that over time "large volume" purchases were increasingly prevalent. For products sold by weight, the share of large-volume purchases increased from 16.8 percent in 2004 to 22.3 percent in 2014. For products sold by count, the share rose from 19.3 percent to 21.8 percent

[9] A module in the Nielsen data is a highly-disaggregated category of goods. There are over 1,000 modules in the data. Example of modules are "FRUIT JUICE - APPLE", "FRUIT JUICE – GRAPE", "MEXICAN SHELLS", "MEXICAN TORTILLAS", "DAIRY-MILK-REFRIGERATED", "DAIRY-BUTTERMILK-REFRIGERATED", "DAIRY-CREAM-REFRIGERATED", "EGGNOG - FRESH & CANNED".

[10] Results are similar when we consider alternative thresholds.

over the same period. As before, these results are robust to conditioning on observable household characteristics or considering other thresholds for large-volume purchases (see Appendix Figure A7). They therefore provide direct evidence that households are engaging in larger-sized purchases of goods.

II.C Evidence from the intensive and extensive margins of purchases

In addition to the evidence from inequality measures and days of with positive shopping, we can assess more directly whether households are indeed stocking up more on their increasingly infrequent shopping trips. One indicator of shopping becoming increasingly concentrated over time would be that the amount of spending per shopping trip should be increasing as long as the total annual spending is stable. To assess this prediction, we decompose average annual expenditures by households into their average expenditure per shopping trip (the intensive margin) and their average number of shopping trips per year (the extensive margin). The results are presented in Figure 4. The figure shows three lines: average log annual spending per household, the average number of shopping trips per year, and the average log spending per shopping trip. All series are normalized to be equal to one in 2004. While annual spending is approximately constant over 2004-2014, we see that the number of shopping trips declines by close to 20 percent while the average spending per trip increases by the same amount. Hence, households are doing fewer shopping trips, which is consistent with the CEX data for 1980-2015, but spending more on each trip. Furthermore, the results are unchanged if we control for household observables as in section I, so these patterns are not driven by a changing composition of households but rather by changing behavior of households.

II.D Evidence from time spent shopping

Our argument suggests that households should increasingly buy goods in bulk and consequently spend less time shopping. While Nielsen data do not permit us to assess changes in shopping time for purchases of goods (e.g., we know the number of shopping trips but not their duration), we can use the American Time Use Survey (ATUS) to examine the evolution of households' shopping time.

Since 2003, U.S. Census Bureau on behalf of the Bureau of Labor Statistics (BLS) surveys a randomly chosen subset of households participating in the Current Population Survey (CPS) to report their time use for a given day. Each year, approximately 25,000 households are requested to

recall their activities for a 24-hour period and provide detailed information on the type and duration of each activity.[11] For each activity start/end times are indicated which allows us to observe how many shopping trips were done by a respondent. Time spent for purchases of goods includes not only shopping time but also travel time, researching time, comparison time, etc. Because ATUS respondents are sampled from the CPS, we also have detailed demographic information (age, gender, marital status, educational attainment, employment status, income bracket, etc.).

Using this information, we compute average shopping time for each year and report the resulting series in Figure 5. In addition to the total time spent on purchases of goods, we show the intensive (average time per shopping trip) and extensive (number of shopping trips per day) margins of shopping. Because the composition of U.S. population has been changing over time, we also present series adjusted for the changes using a specification similar to regression (1). The type of regression (1) depends on the nature of the dependent variable. When the dependent variable is the number of trips, we use a Poisson regression. For the average time spent on shopping for purchases of goods we use a Tobit regression (because the distribution is censored at zero). For the average duration of shopping trips (which is conditional on having a trip), we use OLS. When the dependent variable is an indicator variable for having a shopping trip on a given day, we use a logit regression. In cases other than OLS, we take $\hat{\beta}$ as the marginal effects calculated at means.[12]

Figure 5 documents that shopping time (Panel A) has been declining since 2003. Adjusting for the observed characteristics of respondents yields an even greater decrease. Panels B through D show that this reduction in shopping time is driven exclusively by the extensive margin rather than the intensive margin. Indeed, the average duration of a shopping trip (Panel D) varies over time but does not exhibit any trend. In contrast, the probability of having a shopping trip (Panel C) and the number of trips (Panel B) decline over time.[13] These patterns are consistent with households doing fewer shopping trips but increasing the sizes of the products they buy during these trips. We find

[11] There are precursors of the ATUS. An early time-use survey was implemented in 1965. Subsequent time-use surveys were done in 1975, in the mid-1980s and in the mid-1990s. Unfortunately, these earlier surveys differ in sample design, coverage and level of detail. To ensure consistency of the series, we restrict our analysis to the surveys implemented by the BLS since 2003.

[12] In addition to demographic characteristics of households, these regressions include a set of dummies to capture within-week variation in shopping intensity and income brackets. We include dummies for week days because the day-of-week sampling of respondents has changed over time. We include controls for income because as income increase households may engage in more shopping (shopping is leisure) or less shopping (shopping is home production). We generally find that in the cross-section high incomes are associated with higher shopping time.

[13] The cumulative decline in the number of shopping trips is lower in the ATUS data than in the Nielsen data. This difference likely reflects the fact that the definition of a shopping trip is broader in the ATUS data than in the Nielsen data and covers goods with fewer opportunities to buy in bulk at low unit prices.

similar patterns for demographic subsamples (see Appendix Figure A6). In addition, the decline in shopping trips with no rise in shopping time (Panel D) suggests that households are engaging in larger purchases at approximately the same number of stores, not combining multiple store visits into single trips. As a result, it is unlikely that increasing geographical concentration of stores into strip malls, shopping centers, etc. that lowers the fixed costs associated with a shopping trip can account for increased lumpiness of consumer purchases.

III. Quantifying the Contribution of Changing Shopping Patterns

Given this evidence on how shopping patterns have changed over time, we are interested in quantifying the potential contribution of this channel to explaining the differential trends that we observe across survey measures of expenditure inequality. We consider two ways of doing so. The first exploits the fact that, in the Nielsen data, we track high-frequency expenditures of households over extended periods of time and can therefore construct measures of expenditure dispersion that mimic the timing of the CEX Interview and Diary surveys, as well as even shorter and longer periods of aggregation. This provides a direct test of how the frequency of aggregation can affect measured trends in expenditure inequality. The second method relies on the fact that we can also measure the dispersion in an individual's expenditures over time, which will be directly related to their frequency of shopping. We show using a simple model that this "time-dispersion" in expenditures can contribute to the measured cross-sectional inequality in expenditures and that it can be used to quantify the contribution of changes in shopping patterns to trends in cross-sectional expenditure inequality.

III.A Trends in expenditure inequality

With the Nielsen data, we can examine directly how spending inequality varies with the level of time aggregation. Let X_{htpl} be spending of household h in period p (a week, bi-week, month, quarter of a given year, or a year itself) of calendar year t in location l (zip code, metropolitan area, or national level). Suppose the frequency of p is set to a week. Then for each week p of year t, we calculate the cross-sectional coefficient of variation $CV_{tl} = \sigma_{tl}/\bar{X}_{tl}$ where average spending for period p year t is $\bar{X}_{tl} = \frac{1}{\#h}\Sigma_h \frac{1}{\#p}\Sigma_h \, x_{htpl}$ and the standard deviation of spending for the period is $\sigma_{tl}^2 = \left(\frac{1}{\#h \times p}\Sigma_{hp}(x_{htpl} - \bar{x}_{tl})^2\right)$. The procedure for other frequencies is similar. In the Nielsen data, we treat weeks with no shopping activity over p as a true "zero"; in the DS and IS,

we only keep households that have complete records over the length of p (two weeks of diaries for analysis at biweekly frequency, and four quarters of interviews for analysis at the annual frequency). Our measure of spending in the Nielsen data includes three major categories of goods: food-at-home, alcohol/tobacco, and small non-durables (e.g., paper towels, razors).

Panel A of Figure 6 plots the resulting measures of consumption inequality using the different levels of time aggregation for the 2004-2014 period. We observe two important patterns in the data. First, as we increase the level of time aggregation, the level of spending inequality declines. For example, the coefficient of variation for the weekly frequency is between 1 and 1.2 while for the biweekly frequency it is approximately 0.8. At the annual frequency, the coefficient of variation is less than 0.6. If household consumption were equal to household spending, we should not have observed such dramatic differences. The inequality of spending decreasing in the level of aggregation is consistent with consumption being smoother than spending.

Second, the trends in expenditure inequality are different across frequencies. While spending inequality measured at high frequencies (weekly and biweekly) increases over time, it is generally flat when measured at low frequencies (quarterly and annual). Table 2 reports the average annual change in inequality by frequency and documents that the slope of the time trend decreases considerably in the frequency of time aggregation until we reach the quarterly frequency of aggregation. Thus, simply changing the time horizon over which one measures expenditures significantly alters the measured growth in expenditure inequality, and in precisely the direction that we would expect if households are reducing the frequency at which they purchase goods. This difference in time aggregation could potentially account for much of the difference in observed trends between the Interview and Diary survey measures of expenditure inequality.

We can use disaggregated data to further explore this insight. Specifically, for each module in the Nielsen data for year 2014, we compute the ratio of spending inequality at the weekly frequency to spending inequality at the annual frequency. Then we relate this ratio to the frequency of shopping trips households have on average for goods in the corresponding modules.[14] We find (Figure 7) a strong negative relationship between the ratio and the frequency of shopping, which is consistent with the predictions of our theory. Given that the frequency of shopping trips has declined, we can in principle reconcile why the levels and trends are different for spending inequality measured at different frequencies. Dynamics of the ratio of CVs in the CEX data are

[14] This frequency is taken from Baker and Kueng (2017). We are grateful to Lorenz Kueng for sharing the data.

consistent with this hypothesis. Specifically, we find (Appendix Figure A8) that the ratio for "food at home" category (many goods in this category are storable and can be purchased in bulk) rises more sharply than the ratio for "purchased meals" (effectively, non-storable goods).

We can also directly explore the importance of the frequency of time aggregation for expenditures in the CEX data, albeit in a more limited way than in the Nielsen data. Within the Diary Survey, we can determine whether there is a difference in the growth of expenditure inequality when expenditures are measured bi-weekly, as done in Figure 1, versus an even higher frequency: weekly. Columns 1 and 2 of Panel B in Table 2 report the results: the growth in expenditure inequality in the Diary Survey is significantly larger when expenditures are measured at the weekly frequency than the bi-weekly frequency. Within the Interview Survey, we can compare trend growth in expenditure inequality measuring expenditures at the quarterly (three-month period) frequency versus the annual frequency. Columns 4 and 5 of Panel B in Table 2 report the results. As with the Nielsen data, we find no significant difference in the slopes, suggesting that few purchases in these data are conducted at a less than quarterly frequency. We reach the same conclusions when we restrict the CEX data to include goods that are covered in our Nielsen sample (Panel C). In short, the Nielsen data provide additional evidence that most of the difference in expenditure inequality trends observed between the Interview and Diary surveys can be accounted for by time aggregation of expenditures.

III.B The dispersion over time of a household's expenditures

A related approach to quantifying the contribution of time aggregation of expenditures to cross-sectional inequality is to consider the time-dispersion of households' expenditures. When households make their purchases less frequently, we will observe rising dispersion in a household's expenditures when those expenditures are measured over sufficiently short periods. Hence, we should observe similar patterns in the time dispersion of expenditures across frequencies of aggregation as we do in the cross-sectional data.

To see more precisely how the time-series dispersion of expenditures for individuals relates to the cross-sectional dispersion of expenditures, consider an environment similar in spirit to the celebrated Baumol-Tobin model. Specifically, each household h consumes a target dollar amount of consumption C_h over a total period of time of length T (e.g. a year where $T = 52$ weeks). Suppose a household makes equally-sized purchases only on N_h periods out of the T. In a

period when the household makes a purchase (which happens N_h/T of the time), that purchase is $X_{h,t} = C_h/N_h$ while in other periods (the remaining $1 - N_h/T$ fraction of the time) its purchases are $X_{h,t} = 0$.

We assume households can smooth their consumption over time so that, regardless of N_h, their per-period consumption is $\bar{C}_h \equiv C_h/T$. In this case, the cross-sectional average level of consumption across all T periods is $E_h[\bar{C}_h] \equiv \bar{\bar{C}}$ and the corresponding dispersion of consumption, as measured by the cross-sectional coefficient of variation is $CV_h(\bar{C}_h) \equiv \sqrt{var(\bar{C}_h)}/\bar{\bar{C}}$, which we take as given. Note that, if one measures dispersion in *consumption* for a given household over each of the T sub-periods, it will be identical to the dispersion in consumption over a longer time period because by assumption households can perfectly smooth their consumption flow. If we could measure consumption flow directly, the time horizon used for measuring those flows would not matter for the resulting measures of the cross-sectional dispersion of consumption.

To see the link between the cross-sectional dispersion in expenditures and the time-variation in each household's expenditures, it's helpful to start with the latter. Suppose we measure expenditures for each of the T subperiods for household h. The average expenditures across T subperiods for household h is $E_T(X_{h,t}) = \frac{C_h}{N_h} * \frac{N_h}{T} + 0 * \left(1 - \frac{N_h}{T}\right) = \frac{C_h}{T} \equiv \bar{X}_h$ and the variance of these expenditures for household h over the T periods is $var_T(X_{ht}) = \frac{N_h}{T}\left(\frac{\bar{C}_h}{N_h} - \bar{X}_h\right)^2 + \left(1 - \frac{N_h}{T}\right)(0 - \bar{X}_h)^2 = \bar{X}_h^2(T/N_h - 1)$. Hence, the coefficient of variation for household h when its expenditures are measured over subperiods is given by $CV_T(X_{h,t}) \equiv \sqrt{var_T(X_{ht})}/\bar{X}_h = \sqrt{T/N_h - 1}$ so that a household's time dispersion in expenditures is directly related to its frequency of shopping. As a household increasingly bunches its expenditures into fewer shopping trips (N_h falls), the time-series dispersion in its measured expenditures will rise.

To measure time-series variation in purchases in the Nielsen data, we follow our previous notation and let X_{htpl} be spending of household h in period p (a week, bi-week, month, quarter of a given year) of calendar year t in location l. We calculate the average per period spending for household h in year t as $\bar{X}_{htl} = \frac{1}{\#p}\Sigma_{p \epsilon t} X_{htpl}$ and the variance of spending for household h in year t as $\sigma^2_{htl} = \left(\frac{1}{\#p}\Sigma_{p \epsilon t}(X_{htpl} - \bar{X}_{htl})^2\right)$ and compute each household's coefficient of variation for

spending over the course of the year as $CV_{htl} = \sigma_{htl}/\bar{X}_{htl}$. Households who do more infrequent shopping trips have relatively higher standard deviation in their spending at higher frequencies than at lower frequencies. This greater time-series dispersion in spending for one household when they do large purchases infrequently is therefore analogous to how cross-sectional dispersion in consumption is higher the more households engage in infrequent shopping. We calculate CV at four frequencies: weekly, bi-weekly, monthly and quarterly.

In Panel B of Figure 6, we plot time series of the average (across households) coefficient of variation of each household's expenditures over time (that is, $\overline{CV}_{tl} = \frac{1}{\#h}\sum_h CV_{htl}$), using different time frequencies ranging from weekly (T=51 weeks)[15] to quarterly (T=4 quarters). As expected from infrequent purchases, the dispersion in households' expenditures is higher on average at high frequencies of aggregation and as the frequency of aggregation declines, the dispersion in expenditures falls toward zero. For example, the average time-series CV at weekly frequency is about 1, while the average time-series CV at the monthly frequency is approximately 0.4. Importantly, we can see a rising trend in the time dispersion of households' expenditures at higher frequencies which is consistent with what we would expect when N is falling over time. The results are similar when we control for household characteristics.

To relate the cross-sectional and time-series measures of dispersion, note first that the coefficient of variation in *expenditures* summed across all T periods is equal to the cross-sectional dispersion in *consumption*: $CV_h(\bar{X}_h) = CV_h(\bar{C}_h)$. That is, by using a long period over which to aggregate expenditures, one can recover the underlying dispersion in consumption. Now suppose instead we measure expenditures each subperiod. Then one can show (see Appendix C for derivations) that, under general conditions (e.g., goods may or may not depreciate), the cross-sectional coefficient of variation for expenditures across households at a given frequency (weekly, biweekly, etc.) is

$$CV_h(X_{h,t}) \approx CV_h(\bar{X}_h)\sqrt{1 + \left(\frac{1}{CV_h(\bar{X}_h)^2} + 1\right)\left\{\overline{CV_T\left(X_{h,t}\right)}\right\}^2}$$

where $\overline{CV_T(X_{h,t})} \equiv E_T CV_h(X_{h,t})$ is the average across households of the time-dispersion of expenditures for each household at the given frequency. The first term ($CV_h(\bar{X}_h)$) captures the

[15] In the Nielsen sample design, households exiting the sample do not have observations in the last few days of the calendar year. To ensure this does not affect our results, we focus on the first 51 complete weeks of the year (or 50 weeks for biweekly frequency).

fact that higher underlying cross-sectional dispersion in consumption will lead to a higher dispersion of measured expenditures, even when the latter are measured at a higher frequency. For this term, we use $CV_h(\bar{X}_h)$ with $\bar{X}_h$ measured over a long horizon (e.g. a year) to measure $CV_h(\bar{C}_h)$. The last term ($\overline{CV_T(X_{h,t})}$) reflects the fact that more dispersion in each individual's expenditures *over time* will lead to a higher level of dispersion in the *cross-section* as well, as long as $N_h < T$ for some h, i.e. as long as households' purchases are made less frequently on average than the length of the measurement period. As can be seen in Figure 6, increasing the duration over which expenditures are aggregated pushes the time dispersion of expenditures toward zero, but the cross-sectional dispersion is converging to a positive value, which according to the model is equal to the underlying dispersion of consumption.

Using average values of $\overline{CV_T(X_{h,t})}$ at the weekly frequency and $CV_h(\bar{X}_h)$ at the annual frequency in the Nielsen data yields $\partial CV(X_{h,t}) / \partial \overline{CV_T(X_{h,t})} \approx 1$.[16] Given that the time-series dispersion in expenditures has risen by about 0.15 between 2004 and 2014 at the weekly frequency while the cross-sectional dispersion has also gone up by approximately 0.15 over the same period implies that the decreased frequency of expenditures can account for *all* of the rise in inequality of expenditures across households at the weekly frequency of aggregation in the Nielsen data.

IV. The rise of club stores and expenditure inequality

Previous sections document that U.S. households spend less time shopping and make their shopping trips less frequently so that inequality of *expenditure* measured at high frequency can rise over time while inequality of *consumption* can remain stable. Obviously, there are many possible sources underlying this changing behavior of U.S. households, but one such mechanism is likely the rise of club (warehouse) stores (e.g. Costco, Sam's Club, BJ's) which, by design, sell larger quantities of goods to households at lower unit prices and encourage households to buy goods in bulk. As a result, it has become easier for households to stock up in ways that were not feasible in the past.

Indeed, club stores have expanded dramatically throughout the country since the 1980s (see Panel A of Figure 8), which is consistent with the observed trend in expenditure inequality. To measure intensity of shopping in club stores for a given year, we use the fraction of a

[16] With those same parameter values, we can also verify that $\partial CV_t(X_{h,t}) / \partial CV_h(\bar{X}_h) \approx 1$ so changes in underlying consumption inequality translate one-for-one into changes in expenditure inequality measured at weekly frequency of expenditure aggregation.

household's expenditures that was spent at club stores over the course of that year. Specifically, we calculate the share as $share_{htl}^{(club)} = \sum_{p \epsilon t} X_{htpl}^{(club)} / \sum_{p \epsilon t} X_{htpl}$ where $X_{htpl}^{(club)}$ is spending at club stores. In the Nielsen data, the share of household spending at club stores in spending on goods in our sample (food-at-home, alcohol/tobacco, and small nondurables) increased from 7.9 percent (≈$320 per year) in 2004 to 9.8 percent (≈$390 per year) in 2014 (see Panel B of Figure 8).[17] Panel C of Figure 8 shows the degree of market penetration of these stores by plotting the distribution of households in the Nielsen data and their distance from the nearest warehouse/club store (in 2004 and 2014). While there is considerable variation in the ease with which households can access one of these retailers, approximately 40 percent of households live less than 5 miles away from one of these stores. At the same time, 30 percent of households have to drive more than 10 miles to reach the nearest store and almost 20 percent have to drive 25 or more miles. Panel D shows the geographical distribution of club stores in 2005.

To assess whether club stores can explain some of the rising concentration in household shopping trips, we characterize the link between how much variation there is in a household's expenditure over time and their reliance on club stores. We do so by regressing households' time-series coefficients of variation on households' club share expenditures, using coefficients of variation measured at different time frequencies. In other words, we estimate the following specification:

$$CV_{htl} = \beta \times share_{htl}^{(club)} + \boldsymbol{X}_{htl}\boldsymbol{\gamma} + \lambda_t + \psi_h + error \qquad (2)$$

where λ_t and ψ_h are the year and household fixed effects, and $\boldsymbol{X}$ is a vector of controls (the number of children, female head of households, employment status, income brackets, race, employment status of household head, educational attainment of household head, age and age squared for household head). We use information in $\boldsymbol{X}$ to control for changes in household characteristics over time (e.g., greater participation of women in labor force, rising incomes, aging of population). To make inference conservative, we cluster standard errors at the zip-3 level (i.e., first three digits of zip code).

Our theory predicts a positive relationship between time-series CV_{htl} and $share_{htl}^{(club)}$: as a household buys a greater share of their budget at club stores, their purchases should be lumpier.

[17] We exclude durables in Nielsen from this analysis since club stores also sell durables—although not in bulk—which would drive up the club share; however, our results are also robust to including durables. In Appendix Table A1, we document which household characteristics are strong predictors of shopping at club stores.

However, causation could run in the opposite direction. For example, if some households choose to have significant time variation in their expenditures (for example, because they like to host a party every month), they might also be more likely to go to club stores to stock up for these events. To rule out this alternative causality, we pursue an instrumental variable approach in which our instrument is proximity to a club store (as measured by miles to nearest store). This exploits time-series variation, e.g. stores open and reduce the distance to the nearest club stores faced by some households. To strengthen the quality of our instrumental variables, we exclude households who moved from one location to another. As a result of this restriction, time variation in distance to a club store is determined exclusively by entry/exit of stores.

To construct a measure of distance from club stores, we created a database of geographical locations and openings/closures of club stores for the three largest chains: Sam's Club, Costco, and BJ's. For example, we know that the Costco store in Richmond, CA was opened on October 16th, 1986 at 4801 Central Avenue. A household's distance from the nearest club store is calculated between the centroid of the zip code where a given household lives and the centroid of the zip code of the club store.

The results (Table 3) suggest that shopping at club stores is indeed significantly correlated with more stocking up. First, looking at high frequencies like weekly, there is a positive statistically significant coefficient on the share of expenditures going to club stores, so households who spend relatively more at these stores display more volatility in their expenditures across weeks in a year. However, when we increase the time span over which expenditures are measured, this coefficient shrinks rapidly. At the quarterly frequency, shopping at club stores leads to much less time variation in quarterly spending, which is as expected since it becomes progressively more difficult to stock up for longer periods. Shopping at club stores also explains a diminishing fraction of the variance in households' coefficients of variation at longer durations for time aggregation of expenditures.

Table 3 also shows that the distance to a club store is a strong instrument for the share of spending at club stores in total spending. Households located further from club stores display significantly smaller shares of expenditures at these stores. The first stage F-statistic is above 30. Overall, the OLS and IV estimates are similar. This finding supports the notion that the rising access to club stores has induced households to increasingly stock up on goods and reduce the frequency of their shopping trips. In turn, this change in shopping behavior has generated

spending patterns that appear more unequal in the cross-section when measured at high frequencies even if their underlying *consumption* flows have not changed.

The results are even stronger if we restrict our attention to households with 2 or more members (Panel B of Table 3), whereas the effects are quite small for single-member households. This is consistent with the idea that club stores are more advantageous for larger households, whereas single-member households may find it less useful to purchase very large quantities of each type of good. In Appendix Table A1, we document a number of other household characteristics which are associated with higher club store spending, such as education and income. However, we focus on results across all households since we map our estimates into cross-sectional dispersion measures that include all households.

Quantitatively, these estimates are economically significant. From 1980 to 2014, the average expenditure share of club stores has risen by approximately 10 percentage points. Given the IV estimates in Table 3 (Panel A), this implies that club stores can single-handedly account for approximately 40 percent of the trend rise in the cross-sectional dispersion of expenditures measured at the weekly frequency relative to the quarterly or annual frequency, since 0.1*0.375 implies a 0.0375 contribution to the level of dispersion or equivalently 0.0011 per year, relative to an average rise of 0.0029 (see column 1, Panel C, Table 2) over the same time period in the cross-sectional coefficient of variation measured bi-weekly in the CEX for the same set of goods that we use in the Nielsen data.[18] Note that this quantification of the club store contribution may understate the influence of club stores as these stores can influence the behavior of other stores, for example by inducing convenience and department stores to start selling multipacks or large packages of goods to keep up with club stores.

While the increasing prevalence of club retailers appears to have contributed significantly to changing consumer shopping patterns, there are a number of other complementary explanations that could also help account for these trends. For example, anything raising the fixed cost of shopping trips, be it financial (e.g. rising gas prices, rising opportunity cost of time, increasingly moving away from city centers and stores) or in terms of the amount of time (e.g. through rising traffic), would contribute to the declining frequency of shopping. The decline in the real price of gasoline since the early 1980s suggests that gasoline prices are unlikely to have been an important

[18] We can map one-to-one from the effect on time dispersion to the effect on cross-sectional dispersion as shown in section III.B.

contributor to this changing behavior. However, rising levels of traffic and the progressive "suburbanization" of U.S. cities are more difficult to rule out given the data currently available.

Another force that could lead to a falling frequency of shopping is the decline in the cost of storage. For example, increased ownership of refrigerators/freezers has allowed for more storage of food products, but this is unlikely to be an important contributor since we observe increased stocking up across a wide range of goods, not just food products. The growing size of U.S. houses, on the other hand, could induce more stocking up on the part on households. In the absence of detailed information on the changing sizes of homes across regions, it is difficult to quantify this channel precisely with our data although this would be a promising area for future research.

A final force worth considering is financial innovation. Much of the work focusing on consumption inequality has explained the flat profile found in the Interview Survey through the financial innovation channel. According to the leading hypothesis, expanded access to credit has allowed households to better smooth transitory economic shocks, thereby pushing down consumption inequality, even though the prevalence of transitory shocks, reflected in rising income inequality, has been increasing. This same financial innovation expanding credit may also have allowed households to better take advantage of bulk discounts like those available at club/warehouse stores. Interestingly, the expansion of credit may have acted to raise spending inequality through our mechanism when looking at high-frequency shopping patterns, while reducing this inequality in lower frequency data by allowing households to mitigate transitory income shocks. In future work, we intend to use data as in Gelman et al. (2016) to examine the relationship between the availability of credit and bulk shopping.

V. Conclusion

There has been growing interest in the apparent difference in trend between expenditure and income inequality documented by Slesnick (2001) and Krueger and Perri (2005). Since then, much of the literature has focused on the difficulties associated with measuring expenditure inequality (specifically, under-reporting of expenditures) and concluded that it has, in fact, increased in line with income inequality. We document another measurement issue with consumption measures, namely the infrequent timing of many expenditures, which suggests that consumption inequality has likely increased by *less* than standard measures imply.

Specifically, since households engage in infrequent purchases of many goods, when expenditures are measured at a high frequency many households will appear not to purchase these goods, leading to the appearance of high inequality in consumption, even though their consumption may in fact mirror that of households who are observed to purchase the good. We document that households are engaging in fewer shopping trips than in the past and buying larger volumes and quantities when they do make purchases. These trends will, when combined with high-frequency measures of expenditures, lead to the appearance of rising expenditure inequality even when none is present. We show that these patterns can account for much of the rise in expenditure inequality in the Diary Survey of the CEX, and that a lower frequency of aggregation of expenditures points toward little change in consumption inequality. A major force behind this changing consumption behavior appears to be the rise of club/warehouse stores which facilitate and encourage larger sized purchases. As the market for club/warehouse stores becomes more saturated and as bulk goods become more prevalent even in non-club/warehouse stores, one may expect the patterns documented here to have less of an impact on measured spending inequality in the future.

Relatedly, the growing prevalence of online retailing and home deliveries is reducing fixed costs of shopping associated with low unit prices and should therefore be pushing toward a *higher* frequency of shopping. As online retailing continues to grow in both size and scope, this implies we may observe a reversal of some of the patterns documented here. It therefore seems promising for future work to consider how these different forces will balance out so that we can better understand how to properly measure underlying trends in consumption inequality.

When interpreting our results, one should bear in mind an important caveat. Our analysis focuses on groceries and small non-durables for which we have precise measurements of spending at various frequencies and which have been routinely used in previous analyses of consumption/spending inequality. Although we find that consumption inequality for these categories changed little since the 1980s, it remains to be seen whether this result generalizes to broader measures of consumption. For example, rising income inequality can translate into greater inequality for consumption of luxury-like goods (e.g., spas, travel, jet fuel, high-end durables, and housing). Given our data constraints, we will not be able to detect such a trend but future work may have better data or use tools such as those in Aguiar and Bils (2015) to take advantage of

accurate spending data collected at high frequencies to make inferences about the evolution of consumption inequality.

This caveat also raises an important question about what measure of consumption inequality should be used for policymaking. Specifically, one may entertain the possibility that a reasonable policy objective could be to minimize inequality in the consumption of necessities so that basic needs are satisfied for a wide spectrum of population. However, it is also conceivable that inequality in conspicuous consumption may be particularly damaging for the cohesion of a society and therefore policymakers should target inequality for total consumption. We hope that future theoretical work will provide more guidance on what measure empirical research should concentrate on.

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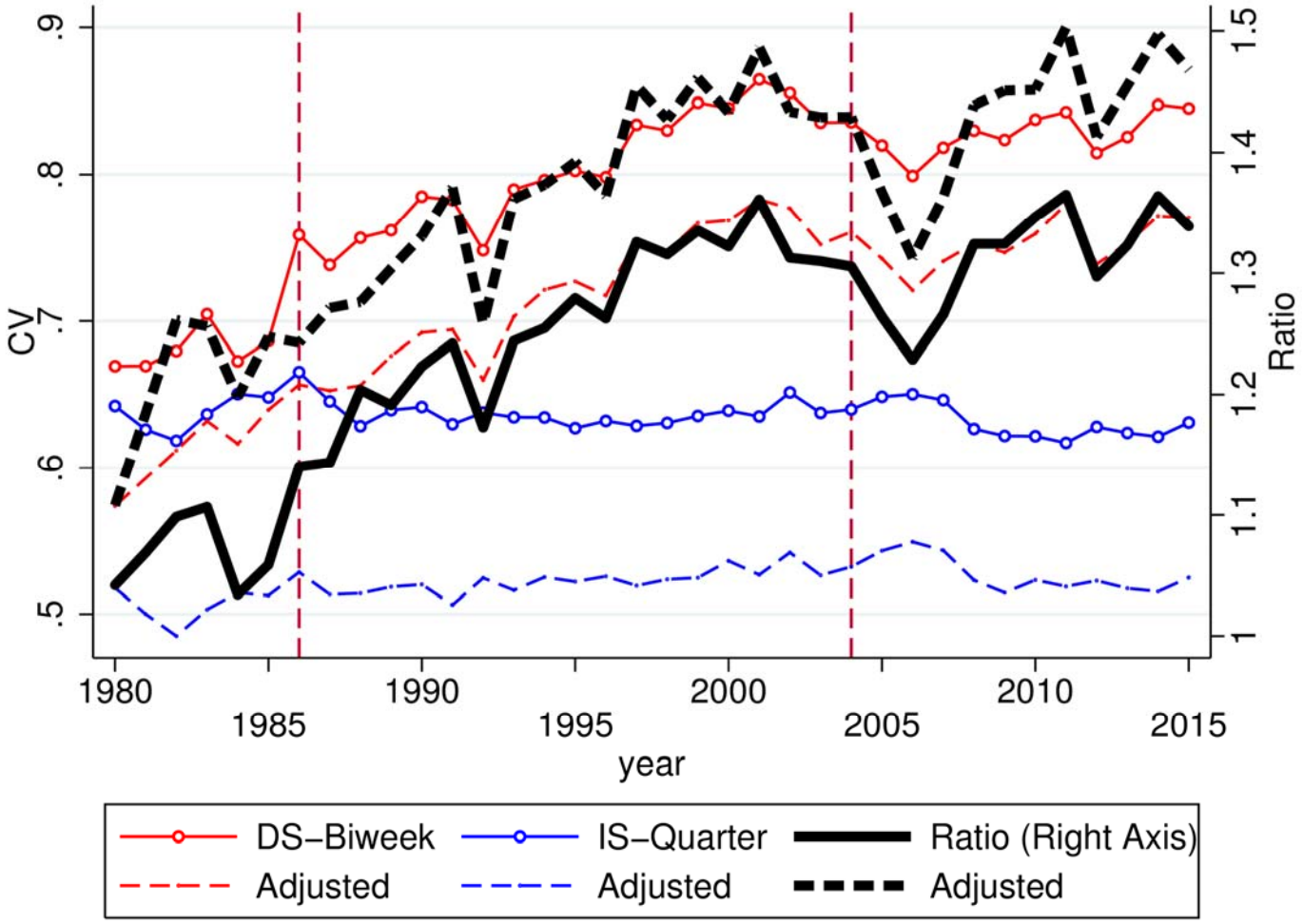
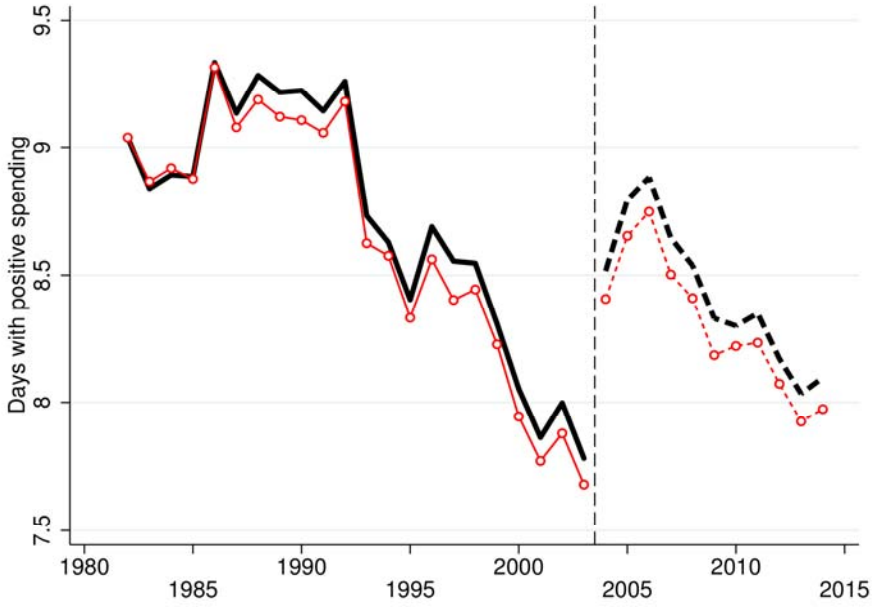
Figure 1. Spending inequality in CEX Diary Survey and CEX Interview Survey.



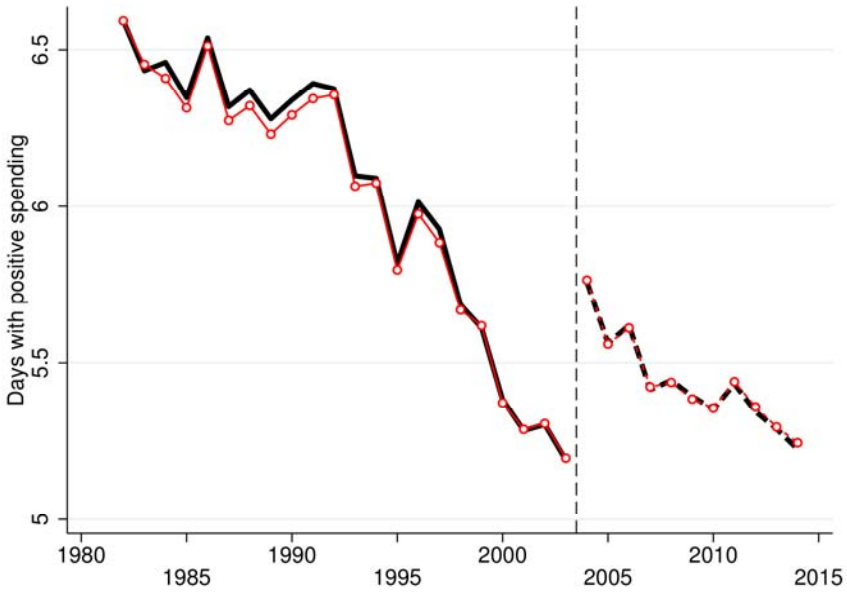
Notes: The figure plots the coefficient of variation (CV on left axis) of expenditures on non-durable goods and services across households in the Diary survey (DS-biweekly) and Interview survey (IS-quarterly) over time. See section 1 for more details on the construction of these measures. The ratio of the two DS/IS) is plotted using the bold black line and measured on the right axis. Solid lines are raw measures while dashed lines are residual measures, as described in section 1. Vertical lines indicate major structural breaks in diary survey design.

Figure 2. Frequency of shopping, CEX Diary Survey.

Panel A. All Nondurables

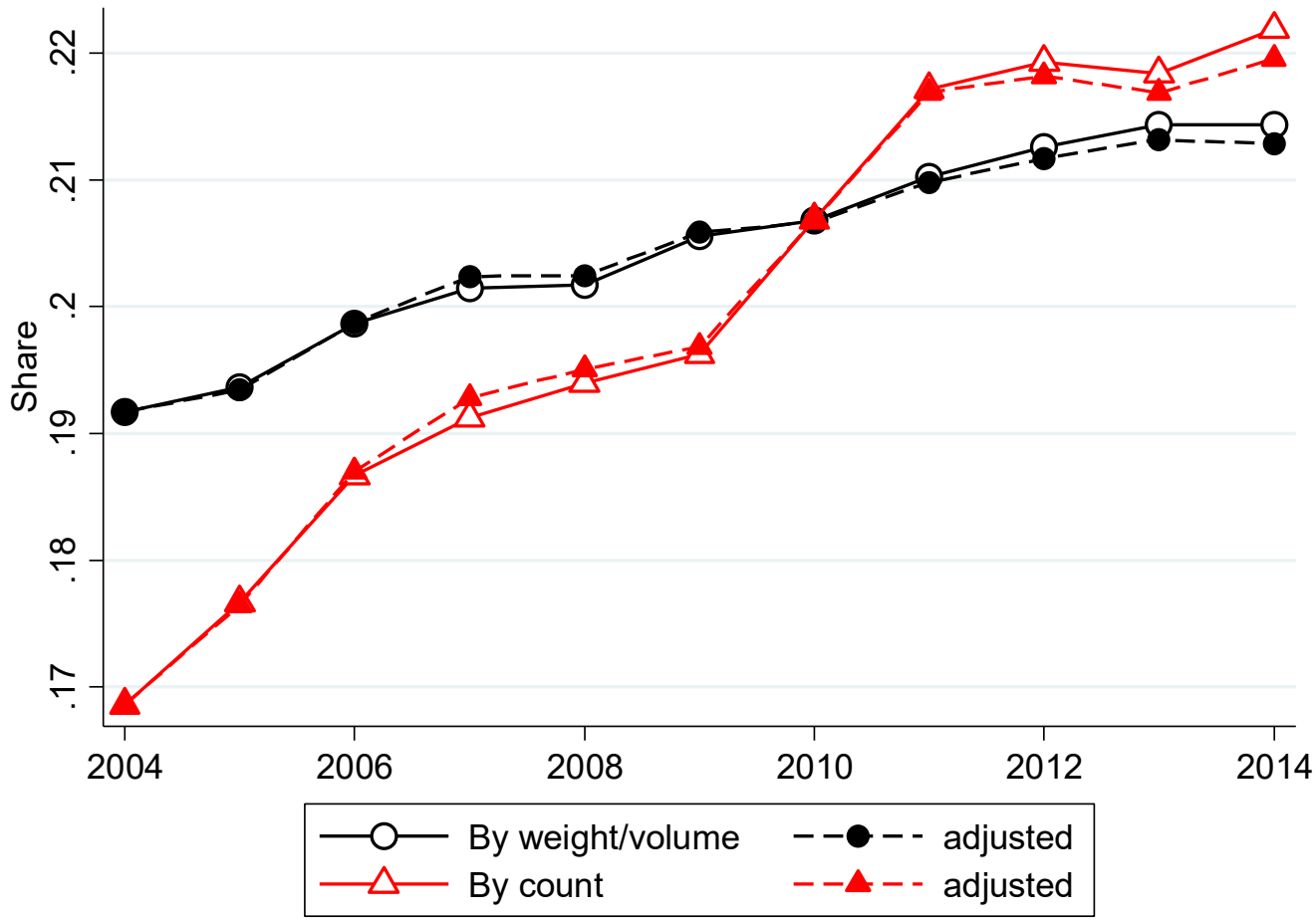


Panel B. Food at Home, Alcohol/Tobacco, and Small Nondurables



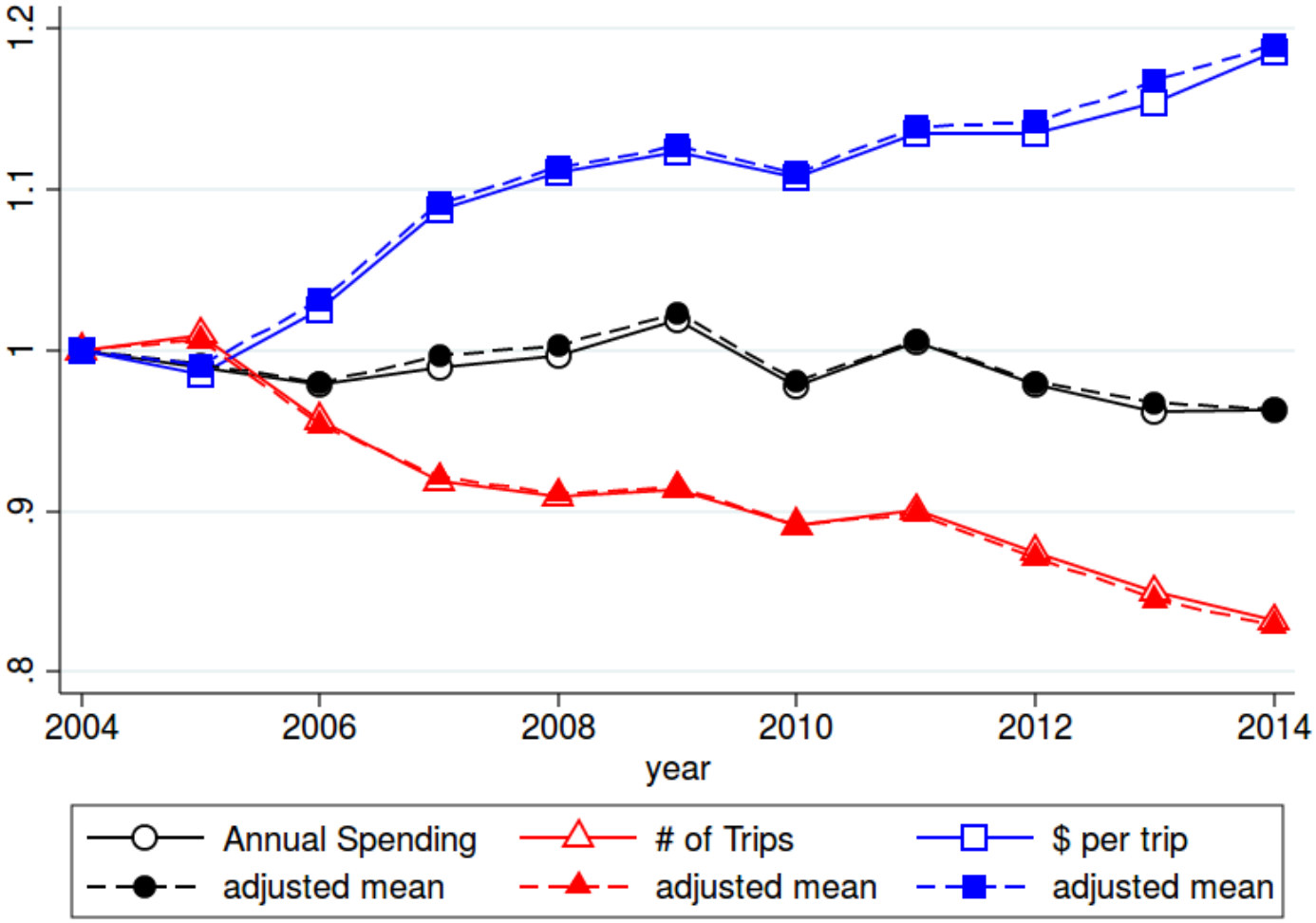
Notes: The figure plots the average number of days in which households report any positive spending in CEX (measured for 2 week periods) over time. The vertical dashed line shows the time when the CEX Diary Survey had a change in how it collects data. See section 1 for more details. In Panel A, the sample is all nondurables (see Appendix B). In Panel B, the set of goods is restricted to be common to both the CEX surveys and the Nielsen data. The included categories are food-at-home, alcohol/tobacco, and small non-durables which matches the coverage of goods in our Nielsen sample.

Figure 3. Share of large-volume purchases.



Notes: The figure shows the dynamics of the share of large-volume purchases in total purchases. Large-volume purchases are identified as purchases that exceed the 90th percentile of the distribution of the purchased weights or counts in 2004. Expenditure shares are used to weigh product modules. Sampling weights are used to aggregate across households. Solid lines with empty markers show the dynamics of the raw averages. Dashed lines with filled markers show the dynamics adjusted for changes in household characteristics (quadratic polynomial in the age of household head's age and a set of dummy variables for household size, employment status of household head and his/her spouse, number of children, and race). Approximately 55% of universal product codes (UPCs) are measured in ounces and 45% are measured in counts. See section 2 for details.

Figure 4. Consumer spending, number of shopping trips, and spending per trip in ACNielsen household panel.

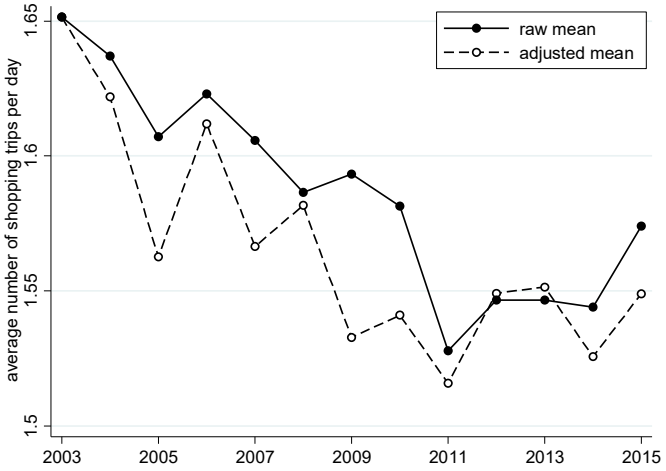


Notes: Solid lines with empty markers show the dynamics of the raw averages. Dashed lines with filled markers show the dynamics adjusted for changes in household characteristics (quadratic polynomial in the age of household head's age and a set of dummy variables for household size, employment status of household head and his/her spouse, number of children, and race). The black lines are the average log spending per year. The red lines are the average number of trips per year. The number of trips is the number of trips where the household scanned at least one UPC barcode. The blue lines are the average log spending per shopping trip in a given year. All series are normalized to one in year 2004. Spending is adjusted for inflation using the "Personal Consumption Expenditures (PCE): Chain-type Price Index" (FRED Series: PCEPI). See section 2 for details.

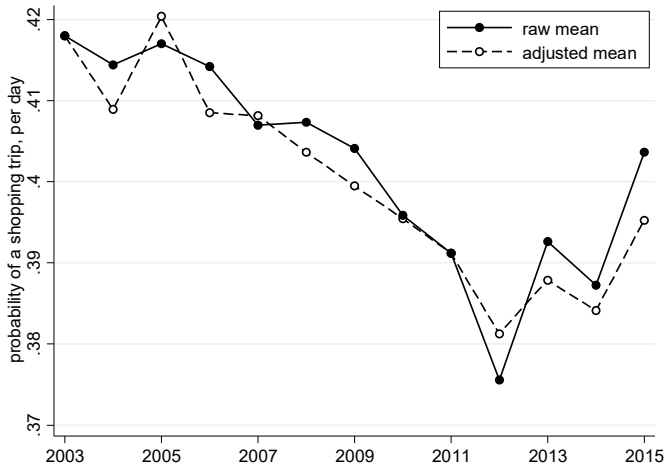
Figure 5. Shopping time.

Panel A: Shopping time for purchases of goods.

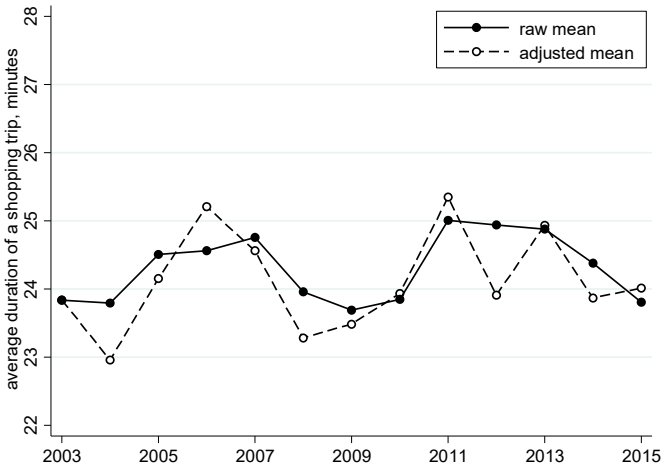
Panel B. Number of trips per day (conditional on having a trip) for purchases of goods



Panel C: Probability of a shopping trip for purchases of goods



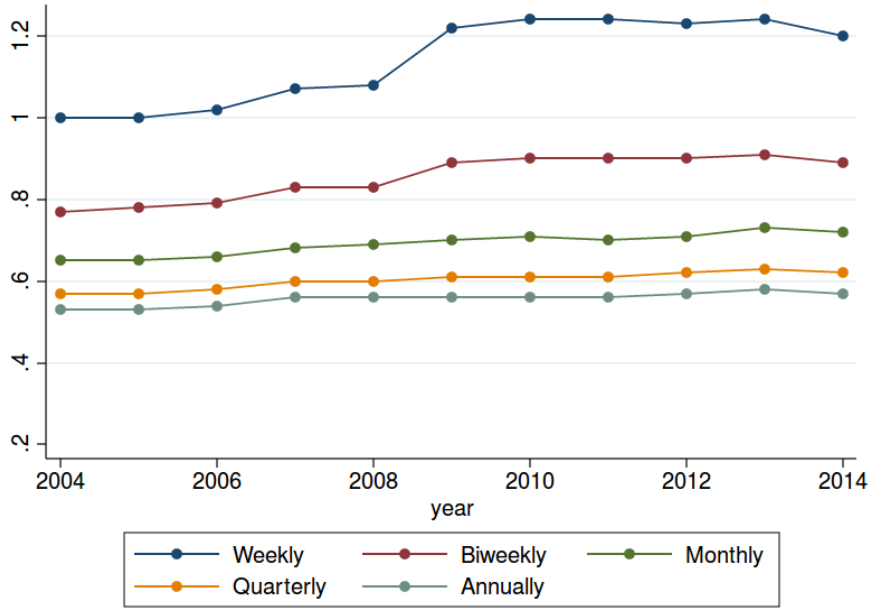
Panel D: Average duration of a shopping trip for purchases of goods



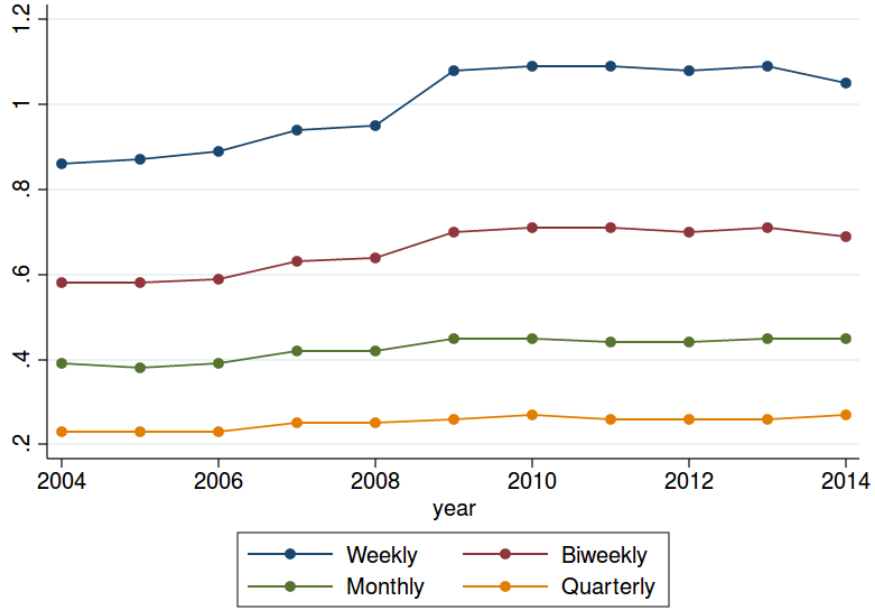
Notes: Panel A reports total shopping time (includes travel and other purchase related activities). Panel B reports the number of shopping trips per day conditional on having a shopping trip. Panel C reports the probability of having a shopping trip on a given day. Panel D reports the average duration of a shopping trip (including travel time and other purchase related activities; conditional on having a shopping trip). The black, solid line shows the raw average. The black, dashed line shows the average (regression) adjusted to demographic changes. See section 2 for details.

Figure 6. Inequality in spending by frequency of time aggregation.

Panel A: Cross-Sectional Dispersion of Expenditures

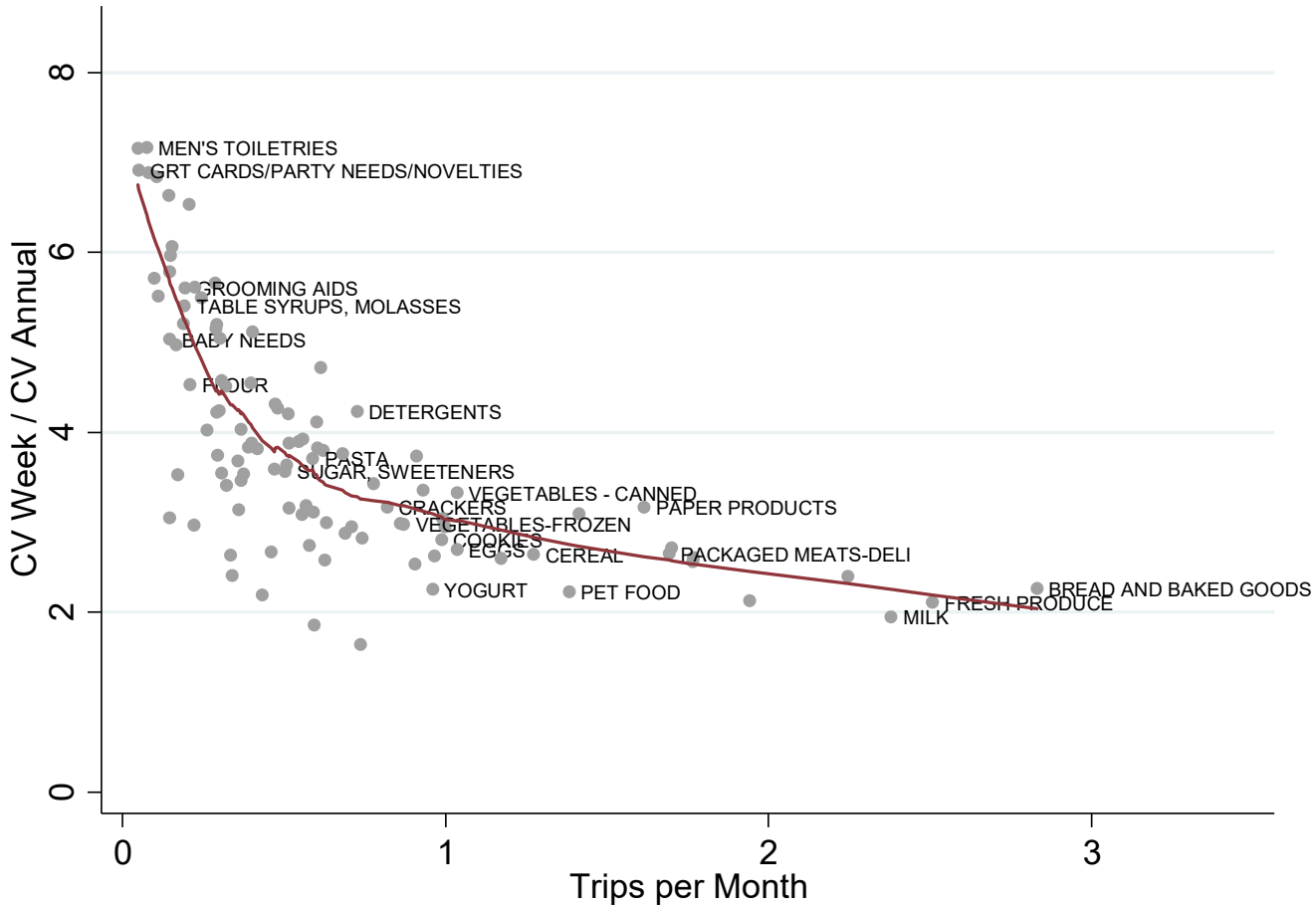


Panel B: Average Time-Series Dispersion of Expenditures



Notes: The figures plot coefficients of variation (CV) of household expenditures when average expenditures are measured at different frequencies of time aggregation ranging from weekly to annually. The left panel shows the average annual cross-sectional coefficient of variation of expenditures across households, where expenditures are measured at different time frequencies. The right panel shows the average (across households) time-series coefficient of variation of each household's expenditures over the course of the year, measuring expenditures at different frequencies. All calculations are for the Nielsen data. See section 3 for details. The corresponding figure for inequality after controlling for household characteristics are in Appendix Figure A7.

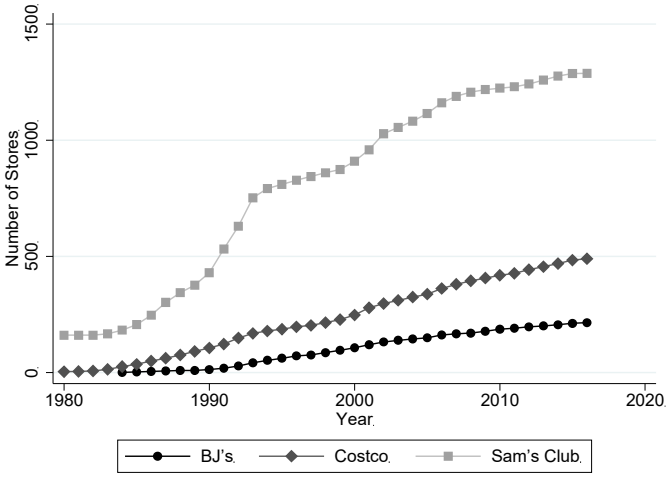
Figure 7. Cross-sectional inequality and the frequency of purchases



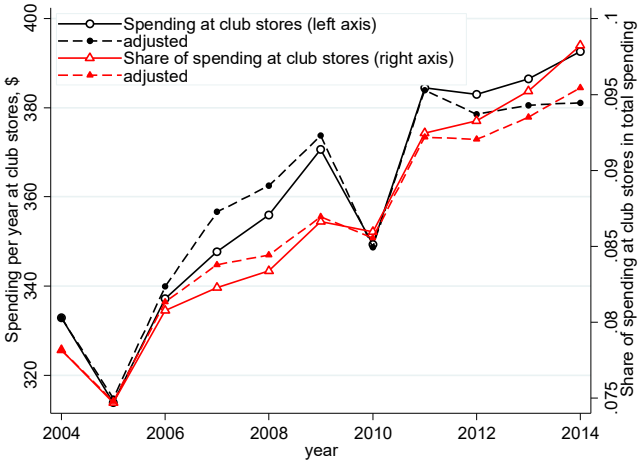
Notes: The horizontal axis shows the average number of shopping trips per month for a given module of goods in the Nielsen data. These data are from Baker and Kueng (2017). The vertical axis shows the ratio of the coefficient of variation at the weekly frequency to the coefficient of variation at the annual frequency for a given module for year 2014. Each point in the scatter plot corresponds to a module. The solid, red curve shows fitted values from the locally weighted regression (lowess).

Figure 8. Importance of club stores

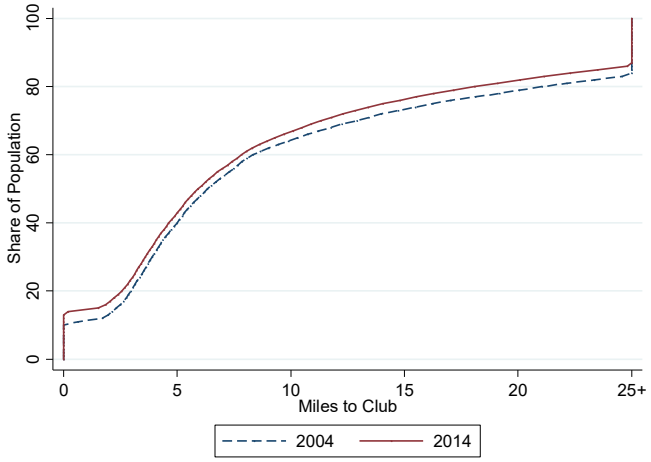
Panel A. Penetration of club stores.



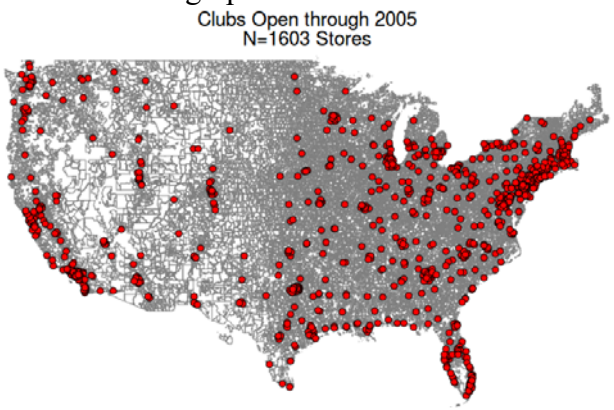
Panel B. Spending in club stores



Panel C. Distance to nearest club store



Panel D. Geographic distribution of club stores



Notes: Panel A plots the numbers of different club/warehouse stores over time. Panel B plots the average dollar amount of spending per household at club/warehouse stores and the average share of expenditures by households at these retailers for the goods covered in our sample (food-at-home, alcohol/tobacco, and small non-durables). Panel C plots the distribution of distances from the nearest club/warehouse retailer for households in Nielsen sample in 2004 and 2014. Panel D shows the distribution of club stores in our sample in 2005. See section 4 for details.

Table 1. Biweekly Spending in the CEX Diary Survey and Nielsen data

Spending category	CEX Diary				Nielsen			
	Mean	St.Dev.	IQR	Zero Share	Mean	St.Dev.	IQR	Zero Share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TOTAL SPENDING	1,475.37	1,576.94	1,519.93	0.00	161.16	125.04	151.00	0.10
SELECTED COMPARABLE CATEGORIES OF NONDURABLE GOODS								
Baby food	19.41	27.90	11.40	0.95	19.95	27.94	16.28	0.98
Pet food	25.36	28.09	22.97	0.72	19.86	21.21	20.70	0.68
Cereal	7.32	5.84	5.82	0.53	9.01	7.87	8.01	0.53
Coffee	11.14	9.23	7.64	0.69	11.67	10.93	8.98	0.77
Crackers	5.11	3.66	3.87	0.67	4.59	3.62	3.71	0.72
Eggs	4.49	3.20	3.20	0.50	3.55	2.46	2.17	0.63
Milk	7.81	6.32	6.51	0.27	6.63	5.35	5.16	0.37
Fresh meat	32.52	30.63	31.52	0.25	10.05	7.61	7.63	0.88
Detergent	10.23	8.49	9.63	0.69	7.95	7.15	7.78	0.75
Beer	26.32	23.24	21.61	0.83	24.05	23.73	19.24	0.91
Liquor	28.89	24.90	24.21	0.96	27.94	28.35	25.95	0.93
Fresh produce	23.82	22.39	24.50	0.17	9.19	9.00	8.91	0.41
Lawn and garden	29.65	51.24	20.49	0.89	11.79	12.59	10.48	0.94
Hair care products	13.06	16.65	9.51	0.79	8.04	7.76	6.93	0.82
Over the counter drugs	14.99	15.52	13.21	0.74	14.97	16.28	15.51	0.54
Oral hygiene	7.32	6.30	5.91	0.80	6.26	6.46	5.36	0.78
Shaving needs	11.47	10.91	10.36	0.94	8.55	9.53	8.40	0.93
Vitamins	24.83	33.05	17.15	0.91	19.26	19.48	17.91	0.79
MATCHED NONDURABLES	239.20	181.94	219.81	0.07	151.47	117.47	143.00	0.10
Biweekly Observations	6,241				1,199,031			

Notes: Columns (1) and (5) show the mean of spending in the CEX Diary Survey and AC Nielsen, respectively, conditional on making a purchase, over a biweekly period in 2014. Columns (2) and (6) show the standard deviation of this spending across households. Columns (3) and (7) show the interquartile range (IQR) of this spending across households. Columns (4) and (8) show the zero share of spending on the specified category in the biweekly period in 2014. For the CEX Diary survey, the sample of households is restricted to households reporting two diary weeks. By construction, the Diary Survey has no household with 0 spending in the biweekly period. For AC Nielsen, the sample of households includes only households with at least one shopping trip in each month of 2014. We aggregate daily spending to the biweekly period (weeks 1 and 2 of 2014 are one biweekly period, weeks 3 and 4 are a biweekly period, etc.) and treat the data as repeated cross-sections when calculating moments.

Table 2. Time trends in expenditure inequality by time aggregation.

Dep. var.: Coefficient of variation	Frequency of aggregation				
	Weekly	Biweekly	Monthly	Quarterly	Annual
	(1)	(2)	(3)	(4)	(5)
	Panel A: Nielsen data, 2004-2014.				
Year	0.0272***	0.0154***	0.0078***	0.0058***	0.0046***
	(0.005)	(0.0025)	(0.0008)	(0.0006)	(0.00039)
Observations	11	11	11	11	11
	Panel B: CEX data (all nondurables), 1980-2015.				
Year	0.0056***	0.0048***		-0.0004	-0.0001
	(0.0011)	(0.0009)		(0.0003)	(0.0004)
Observations	36	36		36	36
	Panel C: CEX data (nondurables as in the Nielsen data), 1980-2015.				
Year	0.0028***	0.0020***		-0.0013**	-0.0012**
	(0.0004)	(0.0004)		(0.0002)	(0.0002)
Observations	36	36		36	36

Notes: the table reports estimated slope in the regression of coefficient of variation for a given frequency of time aggregation on time trend. Time aggregation is indicated in the top row. Panel A uses data from AC Nielsen. Panel B uses CEX data covering all non-durable goods and services: the Diary Survey for columns (1) and (2) and the Interview Survey of columns (4) and (5). For the Interview Survey of the CEX, the dependent variable in column (4) includes some expenditures that are measured at the monthly frequency. Panel C restrict the CEX data to cover only goods included in the Nielsen sample (food-at-home, alcohol/tobacco, and small non-durables). Newey-West standard errors are reported in parentheses. ***,**,* denote statistical significance at 1, 5 and 10 percent levels.

Table 3. Lumpiness of purchases and shopping at club stores

Panel A. Full Sample

Dep. var.: Coefficient of variation	Frequency of aggregation							
	Weekly		Biweekly		Monthly		Quarterly	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Club share	0.238***	0.376*	0.148***	0.220	0.066***	-0.019	0.012***	-0.059
	(0.012)	(0.222)	(0.009)	(0.165)	(0.006)	(0.128)	(0.006)	(0.093)
N	393,822	393,822	393,822	393,822	393,822	393,822	393,822	393,822
R2	0.768	0.768	0.719	0.719	0.623	0.622	0.482	0.481
1st stage *F*-stat		38.14		38.14		38.14		38.14

Panel B. Families

Dep. var.: Coefficient of variation	Frequency of aggregation							
	Weekly		Biweekly		Monthly		Quarterly	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Club share	0.224***	0.569***	0.136***	0.348**	0.057***	0.052	0.011***	0.004
	(0.014)	(0.215)	(0.011)	(0.163)	(0.008)	(0.128)	(0.006)	(0.096)
N	290,742	290,7442	290,742	290,742	290,742	290,742	290,742	290,742
R2	0.778	0.775	0.732	0.729	0.637	0.637	0.503	0.503
1st stage *F*-stat		37.45		37.45		37.45		37.45

Notes: The dependent variable is the coefficient of variation (CV) calculated as follows. For each household, we calculate i) standard deviation of spending at a given frequency (weekly, biweekly, monthly, quarterly) for a given year and ii) average spending per period (total annual spending divided by the number of periods with shopping trips). The coefficient of variation (CV) is i) divided by ii) so that CV is time-series volatility of spending for a given household in a given year. *Club share* is the share of annual spending at club stores (Sam's Club, Costco, BJ's, etc.) in total annual spending at all stores. Spending includes only food, alcohol/tobacco, and small nondurables (paper towels, toothpaste, etc.). The sample of households includes only households with at least one shopping trip in each month of a given year. For each household, the instrumental variable is the distance to the closest club store (Sam's Club, Costco, BJ's). This distance is calculated between the centroid of the zip code where a given household lives and the centroid of the zip code where the nearest club store is located. Regressions include but do not report coefficients on the following controls: year and household fixed effects, age and age squared for the household head, a set of dummy variables for household income brackets, number of children, employment status, race, educational attainment, gender of household head. Standard errors are clustered at the zip-3 level (i.e., first three digits of zip code). ***, **, * denote significance at 1, 5, and 10 percent levels. Panel A is for all households, while Panel B restricts to households with a household size of at least two persons.

WEB APPENDIX

CONSUMPTION INEQUALITY AND THE FREQUENCY OF PURCHASES

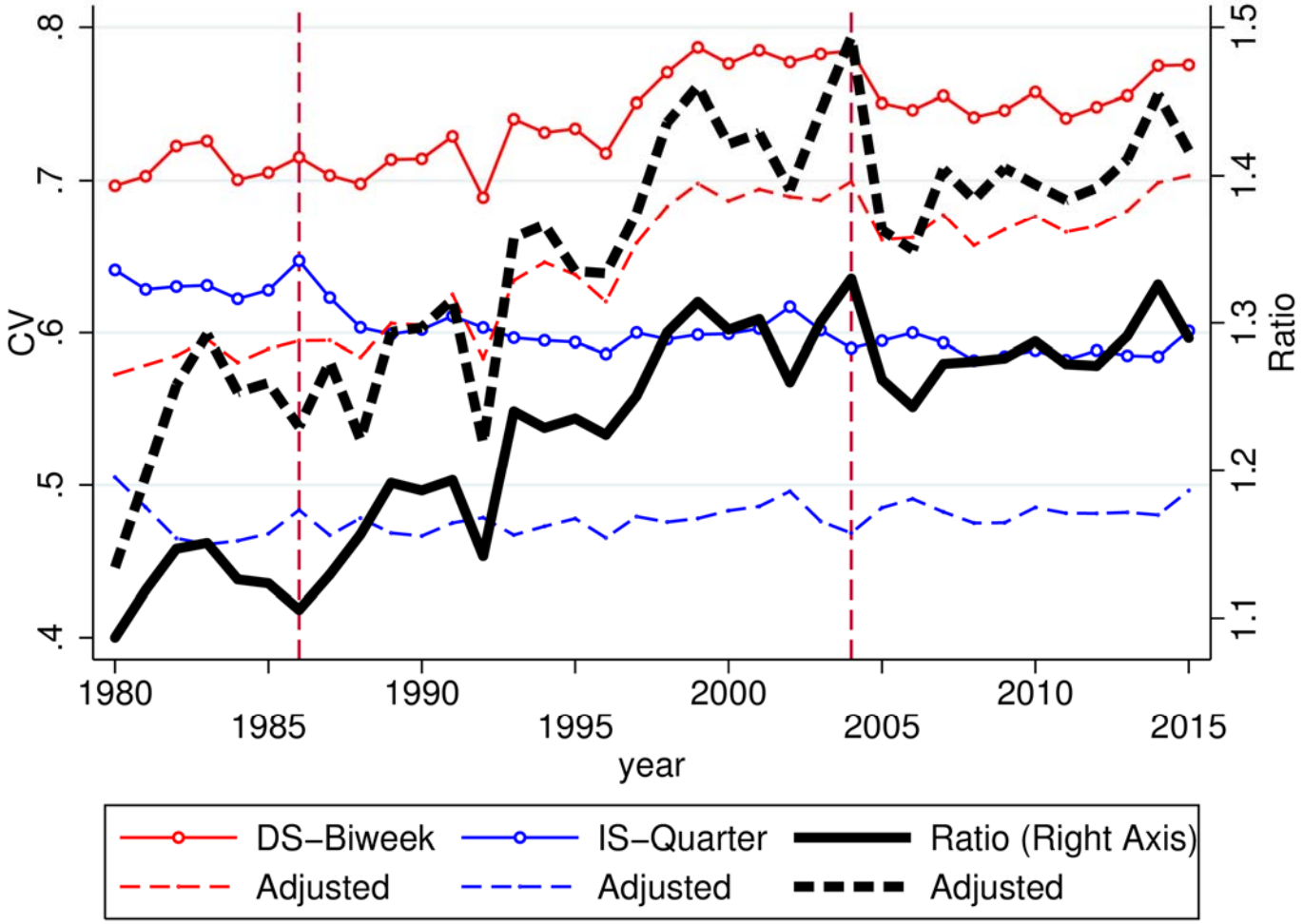
Olivier Coibion
UT Austin
and NBER

Yuriy Gorodnichenko
UC Berkeley
and NBER

Dmitri Koustas
UC Berkeley

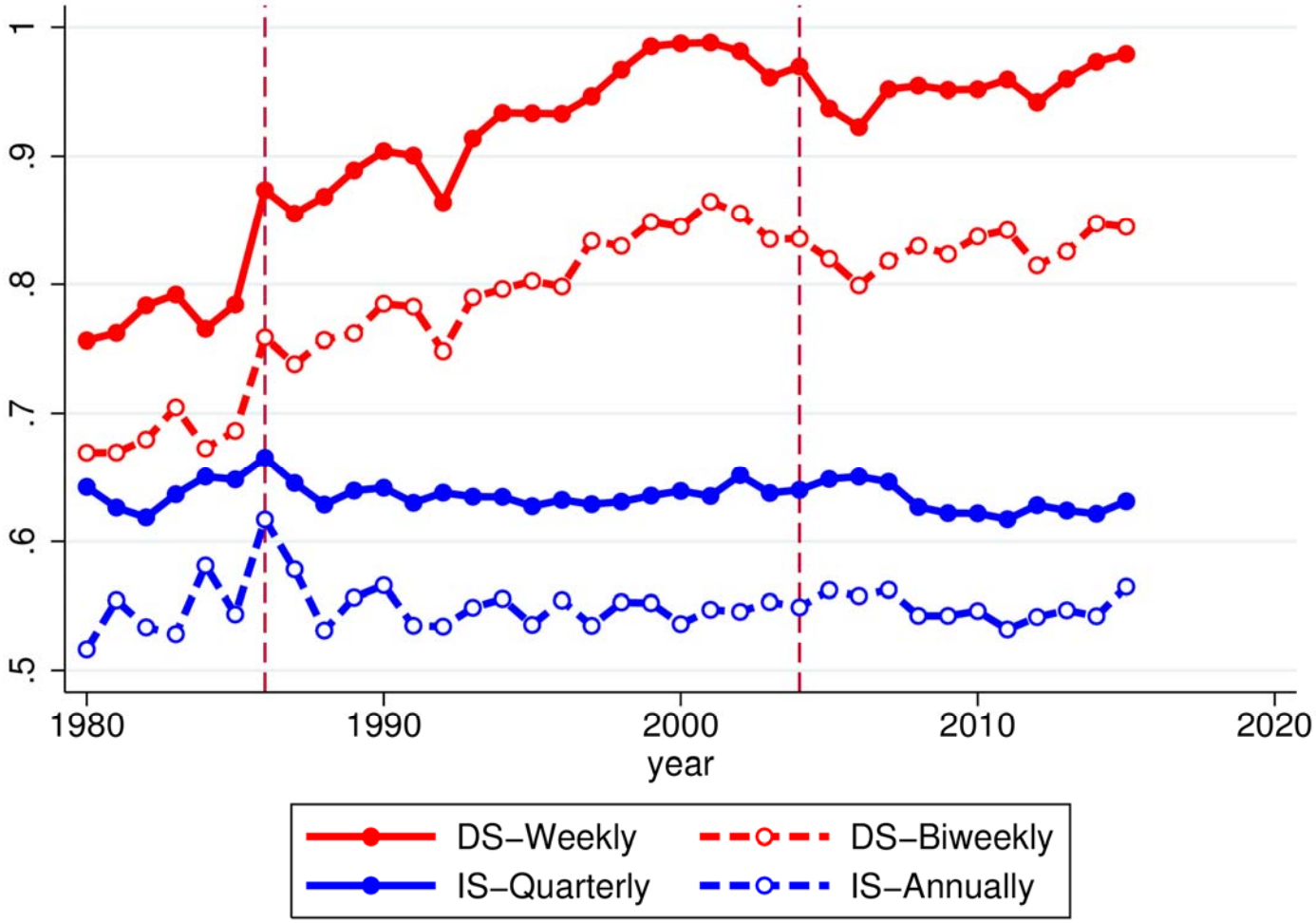
APPENDIX A. ADDITIONAL FIGURES AND TABLES

Appendix Figure A1. Expenditure inequality in the CEX for common set of products in the CEX and Nielsen data.



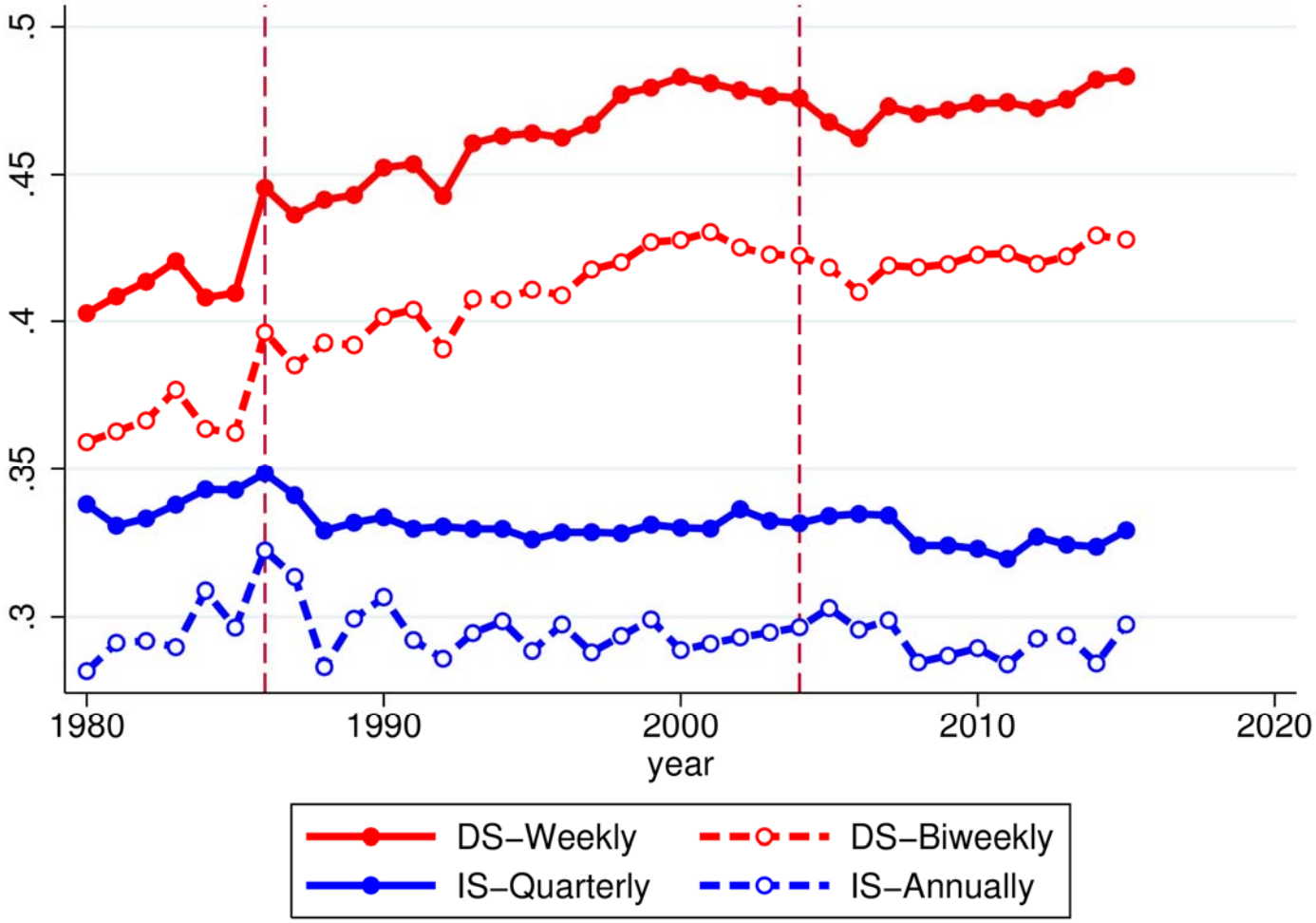
Notes: The figure plots the coefficient of variation (CV on left axis) of expenditures across households in the Diary survey (DS-biweekly) and Interview survey (IS-quarterly) over time. See section 1 for more details on the construction of these measures. The ratio of the two DS/IS) is plotted using the bold black line and measured on the right axis. Solid lines are raw measures while dashed lines are residual measures, as described in section 1. Vertical dashed lines indicate breaks in how data are collected in the CEX. Unlike in Figure 1, the set of goods included are now restricted to be common to both the CEX surveys and the Nielsen data. The included categories are food-at-home, alcohol/tobacco, and small non-durables.

Appendix Figure A2. Expenditure inequality in the CEX by the frequency of time aggregation, coefficient of variation.



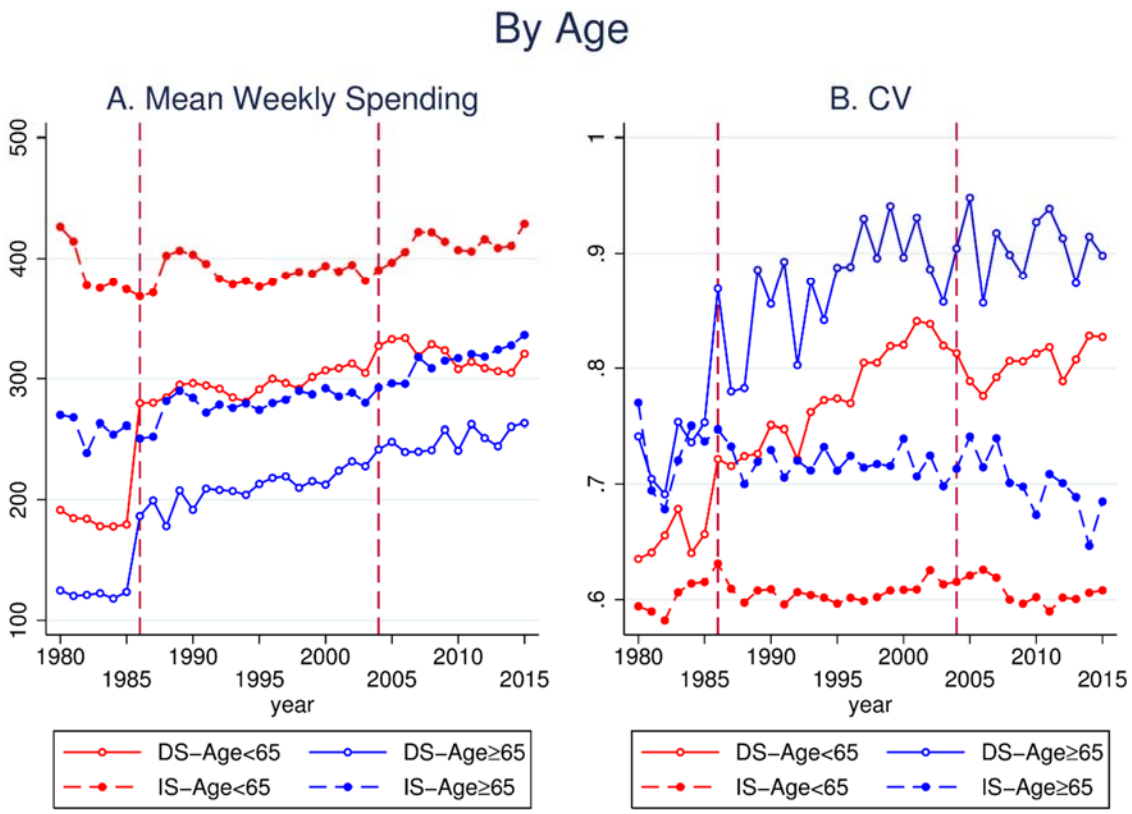
Notes: The figure plots the coefficient of variation (CV) of expenditures on nondurables and services across households in the Diary survey (DS-weekly and DS-biweekly) and Interview survey (IS-quarterly and IS-annual) over time. See section 3.1 for more details on the construction of these measures.

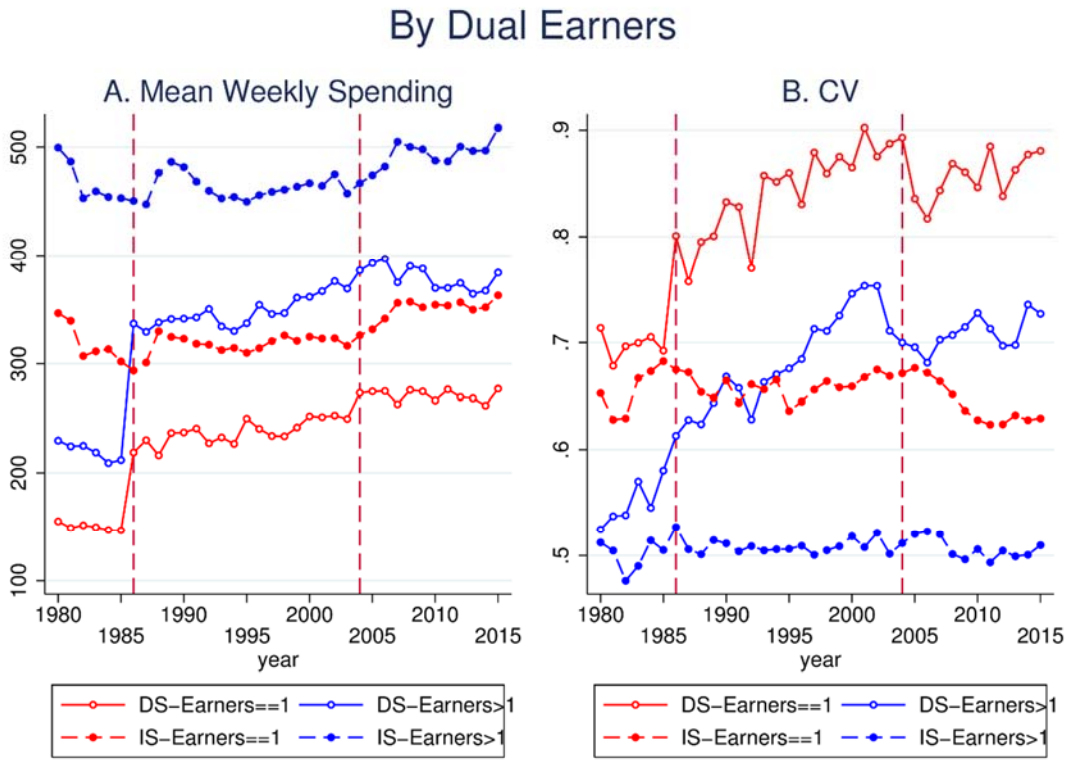
Appendix Figure A3. Expenditure inequality in the CEX by the frequency of time aggregation, Gini coefficient.



Notes: The figure plots the Gini coefficient of expenditures on nondurables and services across households in the Diary survey (DS-weekly and DS-biweekly) and Interview survey (IS-quarterly and IS-annual) over time. See section 3.1 for more details on the construction of these measures.

Appendix Figure A5. Spending inequality by demographic characteristics, CEX.





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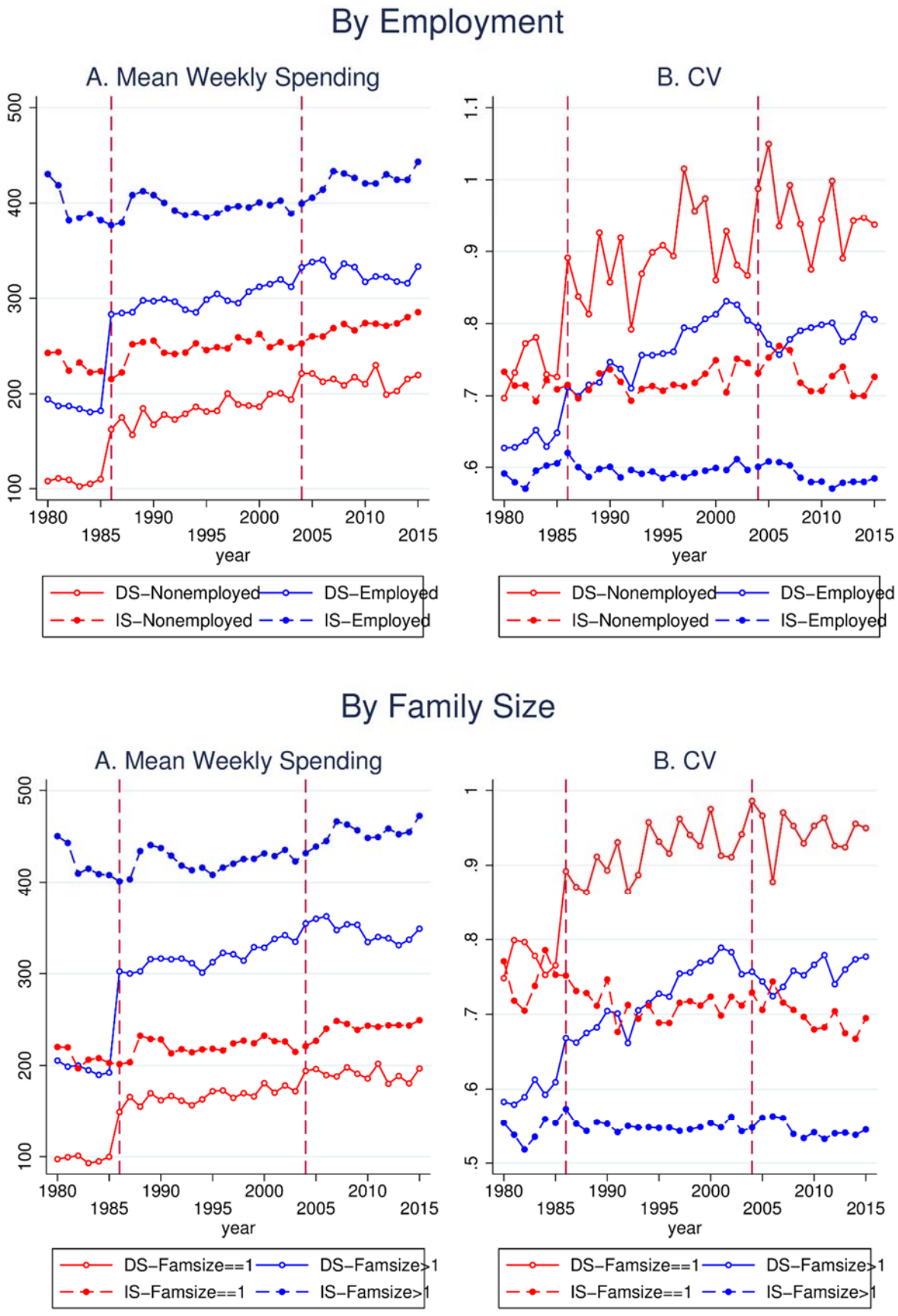
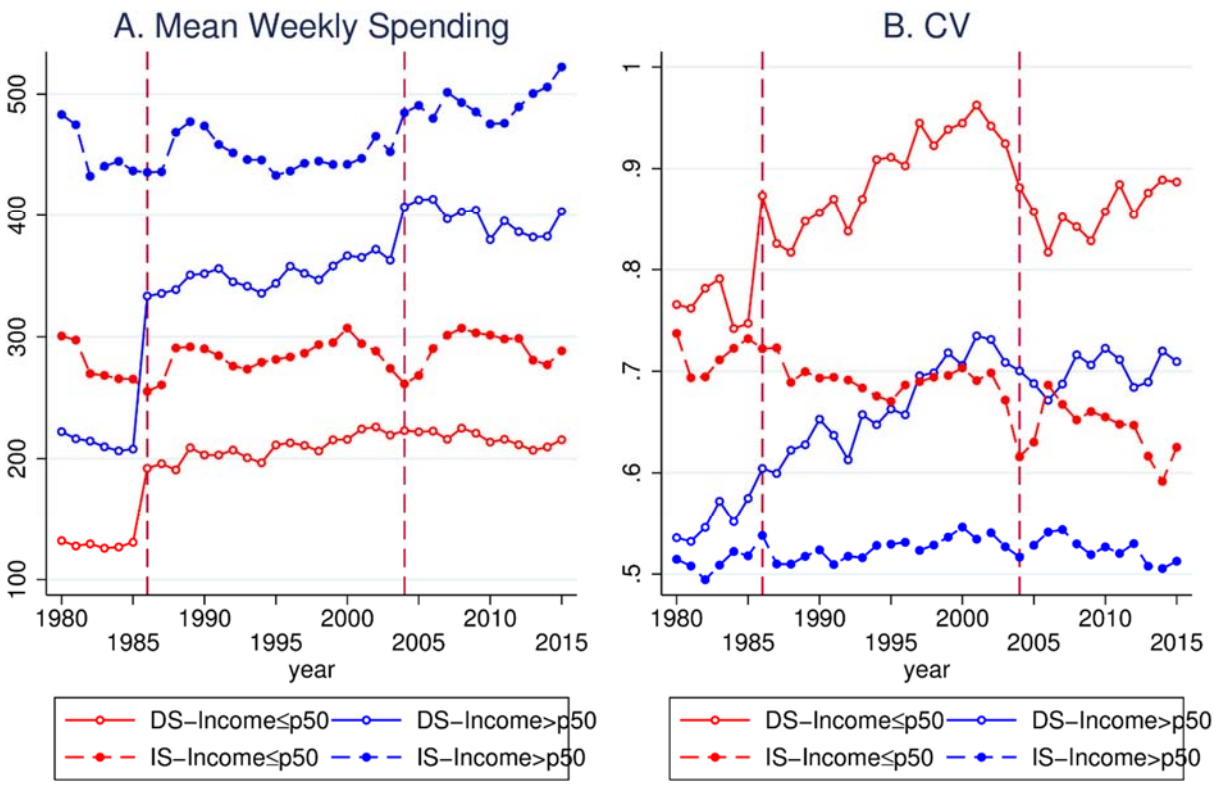
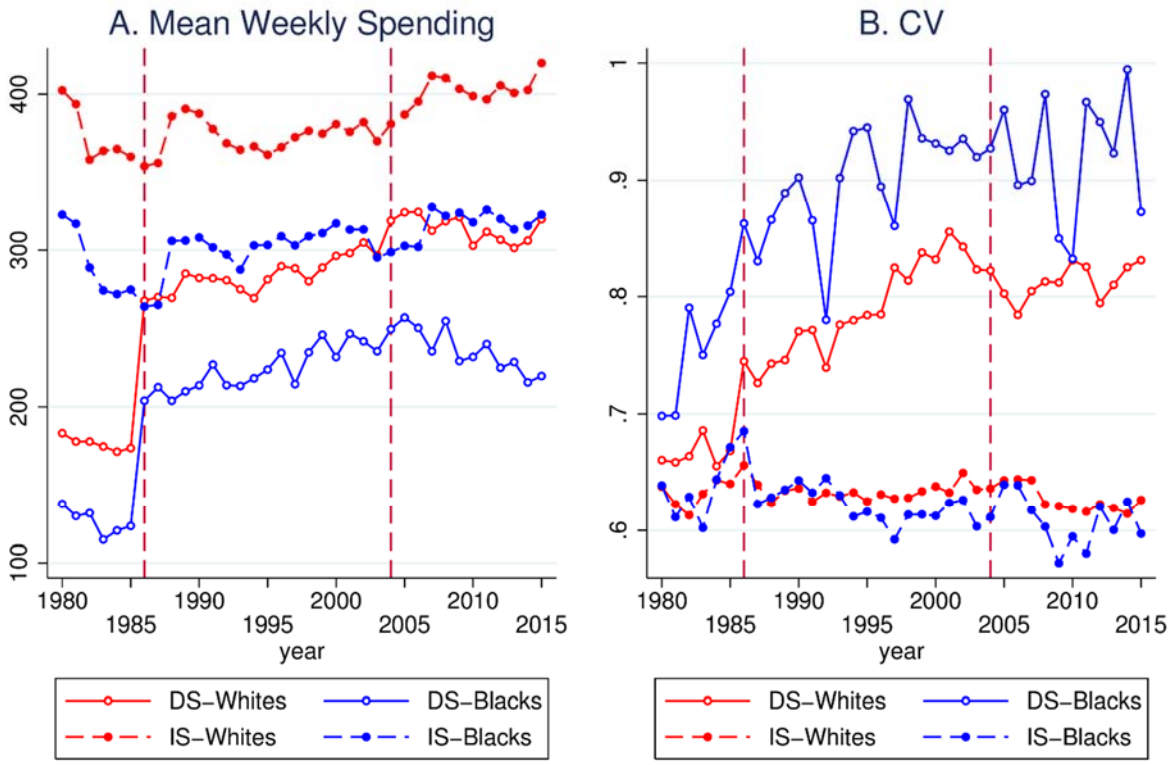


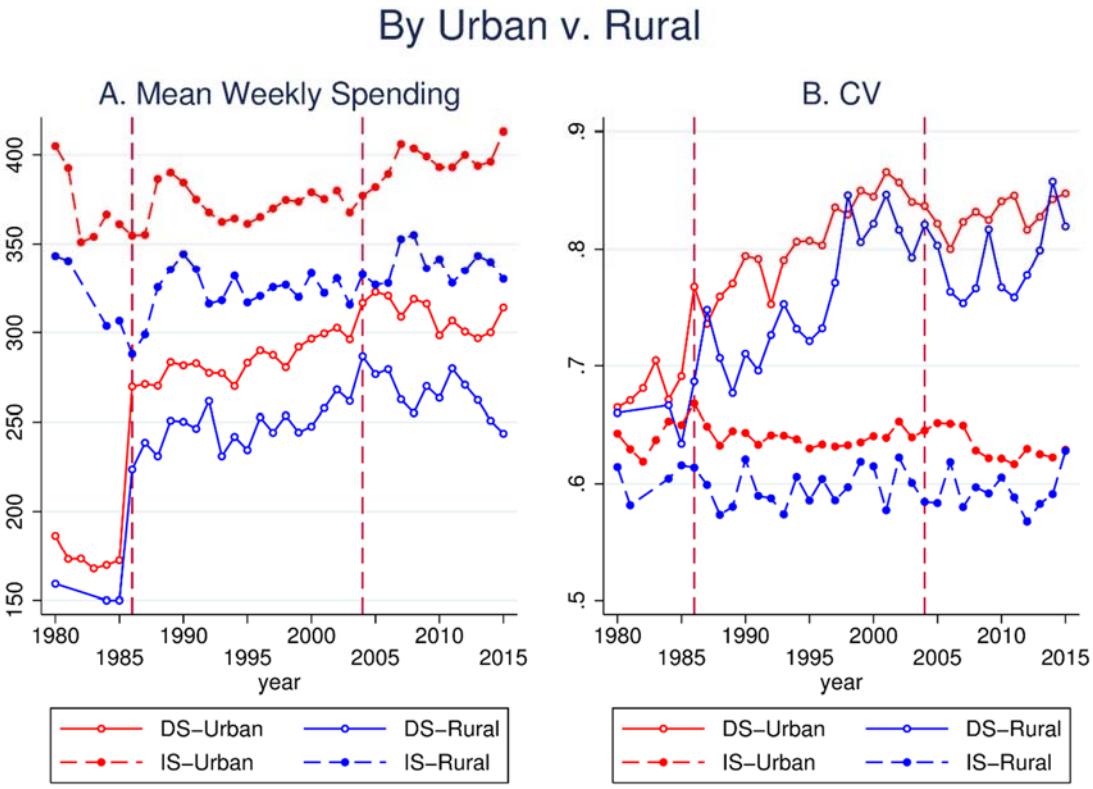
(continued on next page)

By Income



By Race

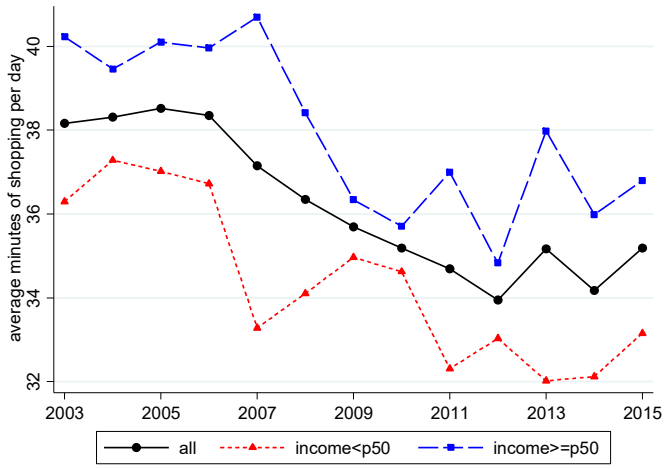




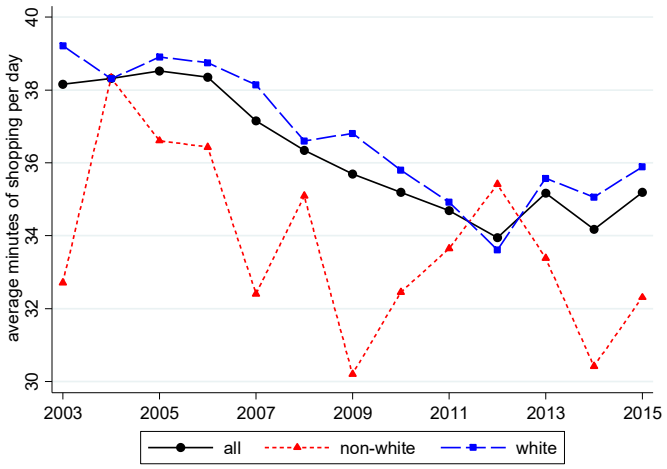
Notes: The figures report cross-sectional dispersion (coefficient of variation) for and mean of expenditures on nondurables and services spending by demographic characteristics of households in the Survey of Consumer Expenditures.

Appendix Figure A6. Shopping time by demographic groups, American Time Use Survey.

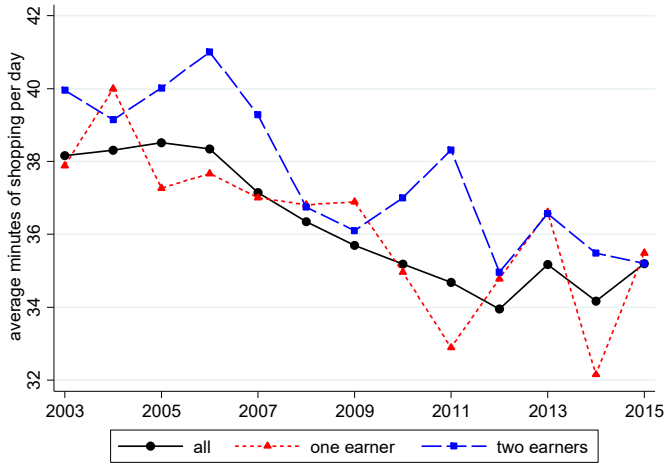
Panel A. By Family Income



Panel B. By Race

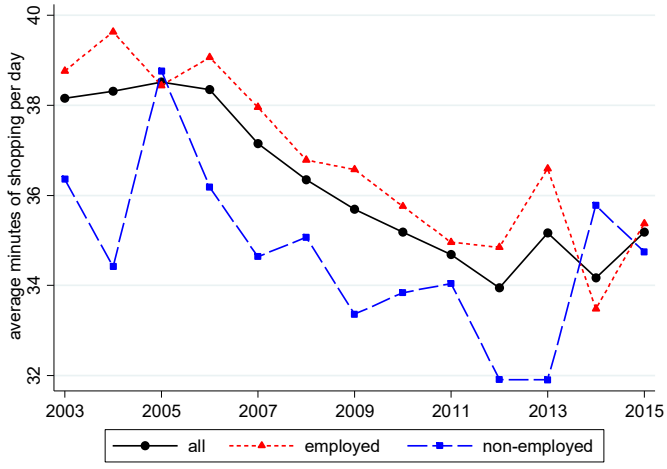


Panel C. By number of earners

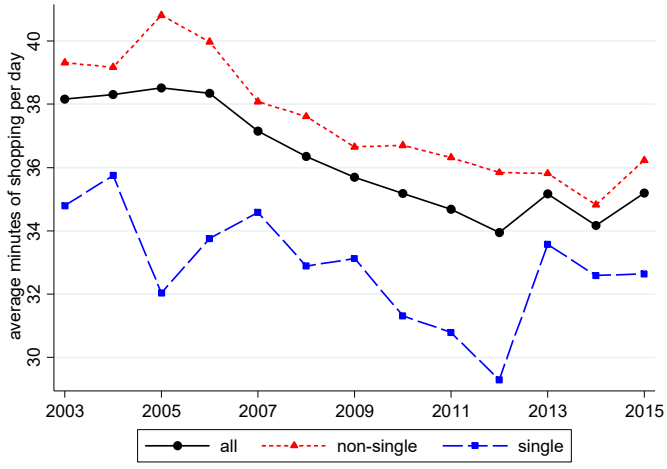


Panel D. By Age

Panel E. By Employment Status



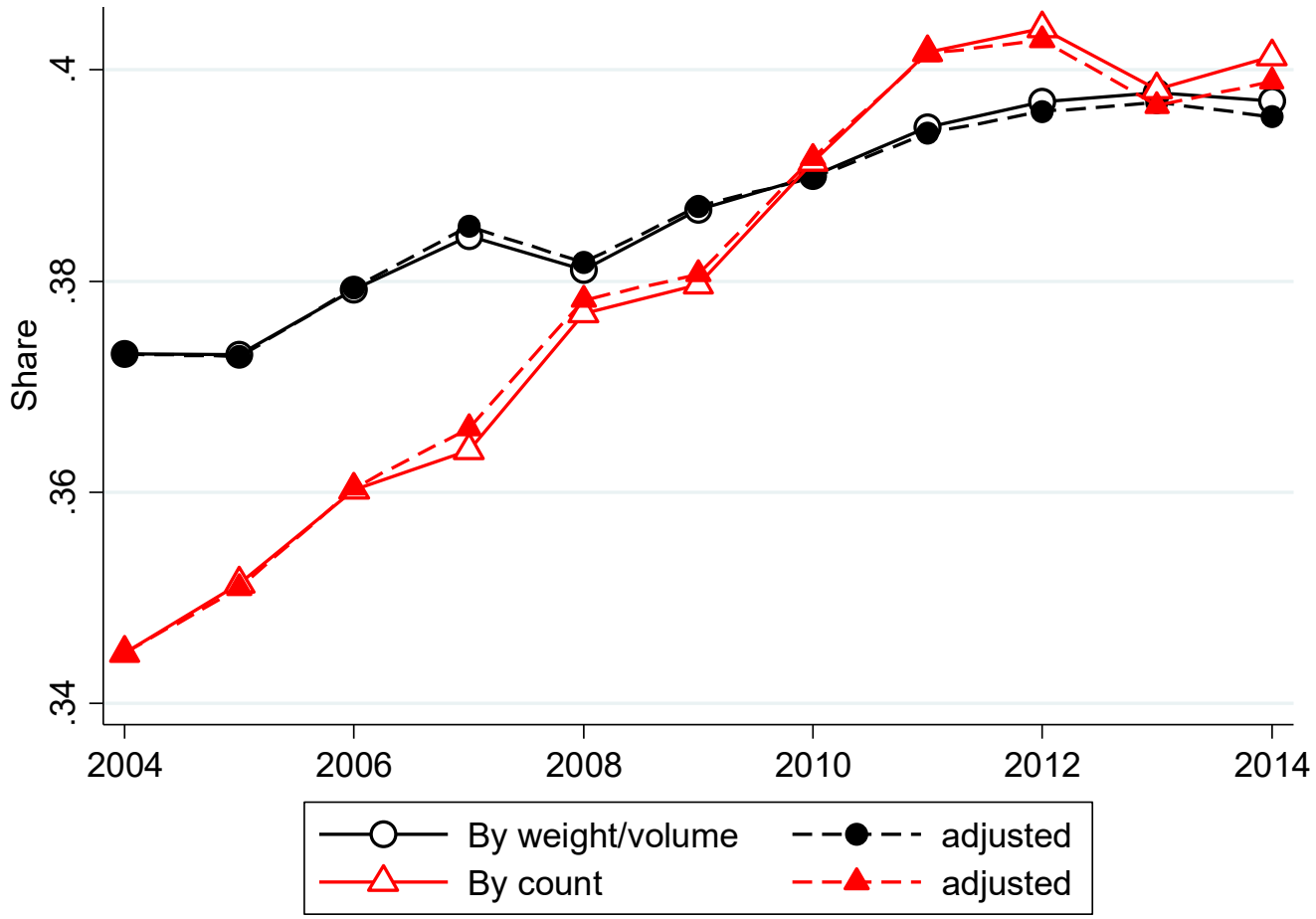
Panel F. By Household Size



Notes: Each panel report total shopping time (includes travel and other purchase related activities).

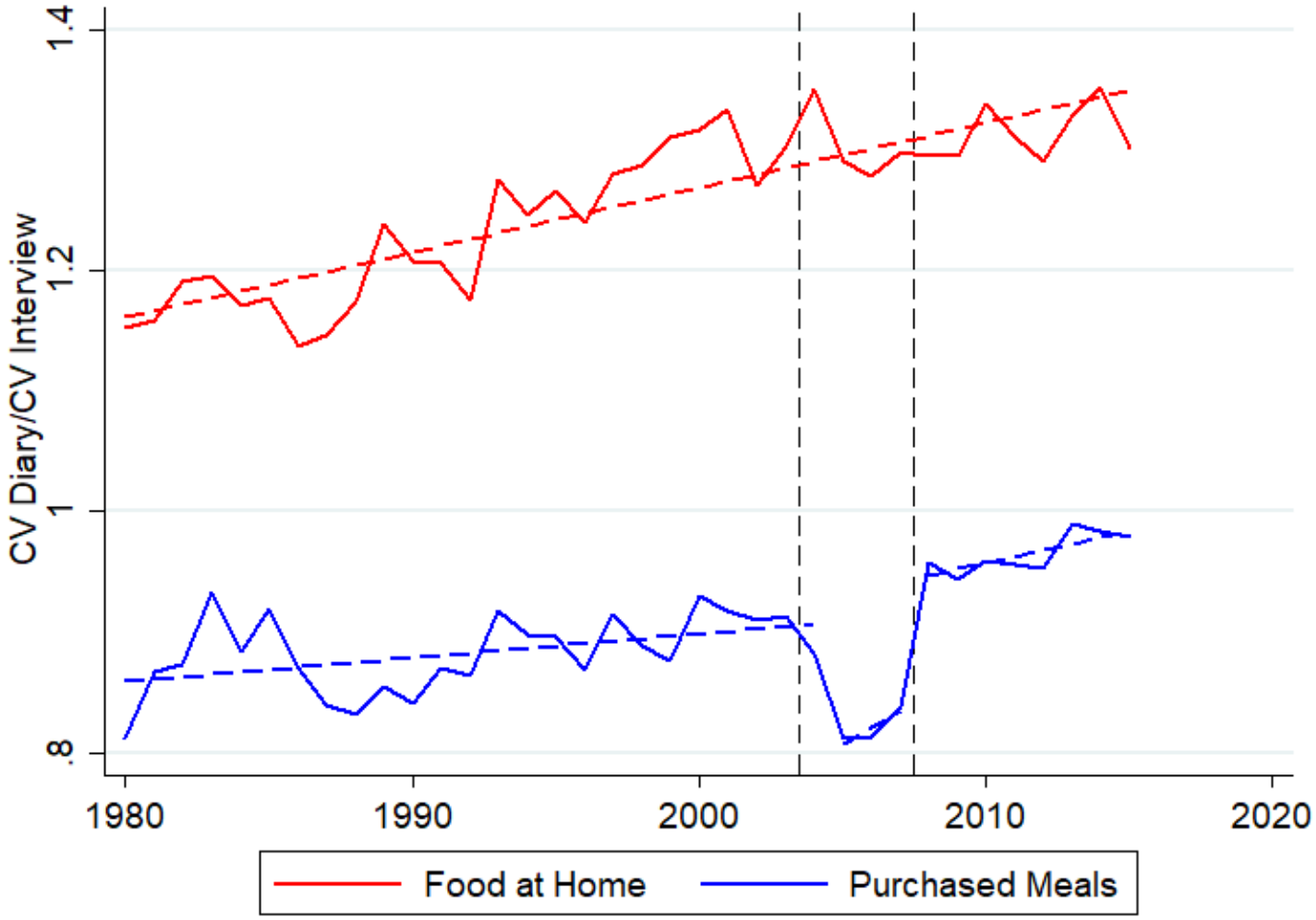
Appendix Figure A7. Share of large-volume purchases

(Alternative definition using the 75th percentile of quantity purchased in 2004)



Notes: The figure shows the dynamics of the share of large-volume purchases in total purchases. Large-volume purchases are identified as purchases that exceed the 75th percentile of the distribution of the purchased weights or counts in 2004. Expenditure shares are used to weigh product modules. Sampling weights are used to aggregate across households. Solid lines with empty markers show the dynamics of the raw averages. Dashed lines with filled markers show the dynamics adjusted for changes in household characteristics (quadratic polynomial in the age of household head's age and a set of dummy variables for household size, employment status of household head and his/her spouse, number of children, and race). Approximately 55% of universal product codes (UPCs) are measured in ounces and 45% are measured in counts. See section 2 for details.

Appendix Figure A8. Storability and differential trends in spending inequality measured at different frequencies.



Notes: the figure shows dynamics of the ratio of CV computed at the biweekly frequency (CV Diary) to CV computed at the annual frequency (CV Interview) for purchases of selected categories of goods. Vertical lines show breaks in the way data are collected in the Consumer Expenditure Survey (CEX). The first vertical line (year 2004) indicates when the U.S. Census Bureau introduced computers for CEX Diary collection. The second vertical line (year 2007) indicates when the survey question for purchased meals in the CEX Interview changed.

Appendix Table A1. Determinants of Club Store Usage

	Dep. var.:	
	Any Club Spending (Logit)	Club Share of Total Spending (OLS)
	(1)	(2)
Some High School	-0.0971	0.00238
	(1.152)	(0.00590)
Graduated High School	0.0744	0.00473
	(1.149)	(0.00347)
Some College	0.261	0.0135***
	(1.149)	(0.00287)
Graduated College	0.347	0.0253***
	(1.149)	(0.00287)
Post College Grad	0.365	0.0326***
	(1.149)	(0.00307)
Education Unknown	0.295	0.0331***
	(1.149)	(0.00378)
Black	0.152***	0.00336
	(0.0303)	(0.00200)
Hispanic	-0.231***	-0.0177***
	(0.0346)	(0.00305)
Middle Atlantic	-0.169***	-0.00216
	(0.0463)	(0.00335)
East North Central	-0.380***	-0.0184***
	(0.0442)	(0.00312)
West North Central	-0.416***	-0.0163***
	(0.0501)	(0.00336)
South Atlantic	-0.0345	0.000166
	(0.0443)	(0.00320)
East South Central	-0.506***	-0.0246***
	(0.0526)	(0.00332)
West South Central	-0.270***	-0.0101**
	(0.0477)	(0.00340)
Mountain	0.425***	0.0480***
	(0.0537)	(0.00443)

Pacific	0.803***	0.0820***
	(0.0481)	(0.00402)
Head Age	-0.0150	-0.00646
	(0.0753)	(0.00382)
Age^2	0.0000824	0.000161
	(0.00215)	(0.000105)
Age^3	0.00000677	-0.00000136
	(0.0000262)	(0.00000122)
Age^4	-6.76e-08	2.93e-09
	(0.000000115)	(5.10e-09)
Household Size==2	0.381***	0.0175***
	(0.0268)	(0.00179)
Household Size==3	0.421***	0.0232***
	(0.0339)	(0.00243)
Household Size==4	0.528***	0.0262***
	(0.0410)	(0.00314)
Household Size==6 or more	0.533***	0.0300***
	(0.0484)	(0.00381)
1 Persons <18 years old	-0.0657*	-0.00564**
	(0.0287)	(0.00205)
2 or more persons <18 years old	-0.0175	0.00228
	(0.0381)	(0.00307)
1 Persons >=65 years old	0.0468	0.000965
	(0.0312)	(0.00210)
2 or more Persons >=65 years old	0.267***	0.0102**
	(0.0460)	(0.00332)
Head Employed	-0.0499	-0.00355
	(0.0264)	(0.00194)
Female Head	0.123***	-0.00983***
	(0.0292)	(0.00190)
Employed Spouse	0.174***	0.000279
	(0.0219)	(0.00183)
Household Income b/w $5,000-$7,999	-0.503***	-0.0206***
	(0.0976)	(0.00451)

$8,000-$9,999	-0.241*	-0.0146**
	(0.0989)	(0.00496)
$10,000-$11,999	-0.107	-0.0123**
	(0.0904)	(0.00479)
$12,000-$14,999	-0.0169	-0.00971*
	(0.0849)	(0.00470)
$15,000-$19,000	0.131	-0.00487
	(0.0810)	(0.00461)
$20,000-$24,999	0.268***	-0.00238
	(0.0787)	(0.00455)
$25,000-$29,999	0.331***	0.00190
	(0.0791)	(0.00463)
$30,000-$34,999	0.511***	0.00917*
	(0.0786)	(0.00460)
$35,000-$39,999	0.651***	0.0145**
	(0.0793)	(0.00470)
$40,000-$44,999	0.714***	0.0207***
	(0.0793)	(0.00476)
$45,000-$49,999	0.814***	0.0255***
	(0.0792)	(0.00481)
$50,000-$59,999	0.870***	0.0291***
	(0.0778)	(0.00466)
$60,000-$69,999	1.044***	0.0404***
	(0.0789)	(0.00485)
$70,000-$99,000	1.222***	0.0547***
	(0.0775)	(0.00475)
$100,000+	1.426***	0.0758***
	(0.0794)	(0.00501)
Year==2005	0.0296	0.00277**
	(0.0192)	(0.00106)
2006	-0.0487*	0.00193
	(0.0225)	(0.00131)
2007	-0.0495*	0.00228
	(0.0214)	(0.00128)
2008	-0.0920***	0.00284*

	(0.0228)	(0.00140)
2009	-0.0864***	0.00457**
	(0.0236)	(0.00146)
2010	-0.0962***	0.00217
	(0.0240)	(0.00148)
2011	-0.0603*	0.00699***
	(0.0244)	(0.00155)
2012	-0.0723**	0.00930***
	(0.0237)	(0.00152)
2013	-0.0580*	0.0114***
	(0.0238)	(0.00153)
2014	-0.0330	0.0122***
	(0.0232)	(0.00150)
Constant	-1.186	0.0949
	(1.497)	(0.0504)
N	432,414	432,414

Notes: Column 1 reports the coefficients from a Logit regression of an indicator for any club store shopping on the observable demographics reported in the Table. Column 2 reports coefficients from an OLS regression of club share of Nielsen spending used in our estimation sample. Omitted categories include: Grade school, New England Census Region, Household Size==1, 0 Persons<=18, 0 Persons >=65, and Household Income under $5,000.

APPENDIX B. CONSTRUCTION OF THE CEX DIARY AND NIELSEN SAMPLES

A. CEX Data

CEX data is downloaded from the National Bureau of Economic Research (www.nber.org/ces), and, when unavailable on NBER, from ICPSR. If a household has no reported spending during the week, we see a diary with $0 in spending. If a second week diary was not reported, we only use the first diary in our analysis of weekly spending and drop this household in our analysis of biweekly spending.

B. Nielsen data

Nilesen data are made available by the Kilts Center for Marketing at the University of Chicago Booth School of Business. The public release of Nielsen data contains households that have already been filtered by Nielsen for quality. According to the Nielsen codebook:

> The household must transmit the minimum required spending dollars *per four-week period*, depending on the household size, to be considered eligible for the static. All of the households in the data meet Nielsen's 12-month static requirements for each corresponding calendar. [emphasis added]

We have noticed violations of this definition and have informed the Kilts Data Center. We impose our own filter that households must have positive spending in every month. We aggregate the Nielsen data to weekly frequency. We start numbering weeks with the first full week of the year. Because the Nielsen sample design has incomplete coverage of households in the last week of the year, we focus on the first 51 full weeks for weekly analysis, and the first 50 full weeks for biweekly analysis. We impute weeks with no reported spending as $0 spending.

C. Inflation-adjustment

All spending is converted to 2010 dollars using the Personal Consumption Expenditures: Chain-Type Price Index (Fred series PCEPI).

D. Winsorization

For all our analysis, we winsorize positive spending (after aggregating to a specified frequency of aggregation) at the 1 percent level, for the right tail of the distribution only. This winsorization is done before calculating the standard deviation and means for an indicated year. When we report the average time-series CV, this is again winsorized at the 1% level (two-sided winsorization). In our main regressions on club share, we also winsorize the club share of spending and distance to club stores (right tail only).

E. Crosswalk between CEX and AC Nielsen

For the crosswalk between the CEX Interview Survey (IS) and CEX Diary Survey (DS), we being with the crosswalk already developed in Bee et al. (2012)'s Appendix 1. We update it to include UCCs since 2010 and expand it to be comprehensive of all UCC codes referring to spending that ever appear in the Diary or Interview Survey. For a discussion about differences in time-varying spending coverage and quality across the two CEX surveys, see Bee et al. (2012, 2015).

Our main CEX analysis focuses on the UCCs for nondurable goods and services and excludes the "Durable Goods" as well as gasoline (due to its inconsistent coverage). We denote categories excluded from our analysis using the CEX with a "*" in the table below. UCCs with a "†" are UCCs that we add to the Bee et al. (2012) crosswalk.

Appendix Table B1: Crosswalk between CEX IS and CEX DS

Category	CEX IS UCC Code	CEX DS UCC Code
*Durable Goods**		
New motor vehicles	*1980:* 450110 450116 450210 450216 †870101 870102 870301 450220 870302 870601 870602 870605 870608	*1986:* 450110 *1986-2006*: 450210
New vehicle accessories and parts	*1980:* 480110 480213 490501 *2005-2010*: 480212 870501 870502	*1986:* 480110 480212 480213 600903
†Used vehicles	460110 870201 870202 460901 460902	460903
Furniture and furnishings	*1980:* 290110 290120 290210 290310 290320 290410 290420 290440 320901 290430 340904 680320 320220 690242 690241 690243 320120 280210 *1980-2006*: 320210 320231 *2007-2010*: 320233 *1980-1998*: 220511 220614 230132 320110 320162 *1999-2010*: 220616 230133 320111 †320230	*1986:* 290110 290120 290210 290310 290320 290410 290420 290440 320901 290430 340904 320220 690242 690241 690243 230130 320110 320120 280210 *1986-2006*: 320210 320231 *2007-2010*: 320233
Household appliances	*1980:* 230117 230118 300111 300112 300211 300212 300221 300222 300311 300312 300321 300322 320150 300331 300332 300411 300412 320511 320512 320522 690245 690244 320521 †220612 220613 300216 300217 320221	*1986:* 230117 230118 300110 300210 300220 300310 300320 320150 300330 300410 320511 320512 300900 320522 320521 †320221 300218
Glassware, tableware, and household utensils	*1980:* 320310 320320 320330 320340 320350 320370 320360 †320345	*1986:* 320320 320340 320350 320370 320380 320310 320330 320360 † 320345
Outdoor equipment and supplies	*1980:* 320410	*1986:* 320410
†Hardware/ Tools	320420 320902	*1980*: 320430 320906 *1986:* 240120
Televisions	*1980-2004:* 310110 310120 310130 *2005-2010*: 310140	*1986-2004:* 310110 310120 310130 *2005-2010*: 310140
Audio/Video equipment	*1980:* 480214 310311 310313 310315 310320 490502 *2005-2010:* 310314 *1980-1998:* 310312 *1996-2010:* 310333 *1980-1995:* 310330 *1980-1993*: 480211 490500 †310210 310334 480215 310316	*1986:* 480214 310311 310312 310313 310315 310320 310331 310332 *2005-2010:* 310314 †310902 310903 310900 310334 310335 310316
†Computers and accessories	*1982-:* 690110 690230 690111 690112 *2011*: 310400 690119 690120	690119 690120
†Video games	*1982-:* 310230 310231 310232	310231 310232
Recording media	*1980:* 310220 *1980-2004:* 310341 310342 *2005-2010*: 310340	*1986:* 310340 310220
Photographic equipment	*1980:* 610230	*1986:* 610230 610903
Sporting equipment, supplies, guns, and ammunition	*1980:* 600142 600144 600210 600410 600420 600430 610120 *1980-1993:* 610900 *1994-2010*: 600901 600902 †600900	*1986:* 600130 600210 600410 600420 600430 600901 610120 610901
†Toys Games Hobbies	610110 610140	620913

Bicycles and accessories	*1980:* 600310	*1986:* 600310
Pleasure boats	*1980:* 600121 600132 600110 600138 600127 870401 870402 870701 870702	*1986:* 600120 600130 600110
Other recreational vehicles	*1980:* 600122 600128 *1980-1993:* 600131 600137 *1994-2010*: 600141 600143 †870801 870804	[none]
Recreational books	*1980:* 590220 590230 660310	*1986:* 590220 590230 660310
†Other books	660110 660210 660900 660901 660902 660410	
Musical instruments	*1980:* 610130	*1986:* 610130
Jewelry and watches	*1980:* 430110 430120	*1986:* 430110 430120
Telephone and facsimile equipment	*1980:* 320232 690210	*1986:* 320232 690210
†Medical Equipment	550330	550320 550330 550340
†Property	790710 790720 810101 810102 810201 810202	*1986:* 220400
†Capital improvement materials	220512 220513 240112 240113 240122 240123 240212 240213 240214 240220 240222 240223 240312 240313 240322 240323 320612 320613 990930 990940 990950 320625 320626	*1986:* 240110 240310 240320 240900 320620 320630 320627
†Other electronics	690220 520560 690115 690117 690118	690115 690117 690118
†Luggage	430130	
†Misc Durables	430130 320130 640420 320904	480211 480213
Nondurable goods		
Food purchased for off-premises consumption	*1980-2006:* 790220 790230 *2007-2010:* 790240 †790210	*1980:* 010110 010120 010210 010310 010320 020110 020210 020510 020610 020810 020310 020410 020620 020710 020820 030110 030210 030310 030410 030510 030610 030710 030810 040110 040210 040310 040510 040410 040610 050110 050210 050310 050410 050900 060110 060210 060310 070110 070230 070240 090110 090210 100210 100410 100510 160310 080110 160320 160211 160212 100110 160110 110110 110210 110310 110410 110510 120110 120210 120310 120410 130310 140110 140210 140220 140230 140320 140330 140340 140310 130320 150110 150211 150212 150310 180210 180220 180110 180310 180320 180410 180420 180510 180520 180620 180710 180611 180612 *1994-2010:* 070210 070220 130120 130210 160210 180610 †190904 180720 550410
Nonalcoholic beverages purchased for off-premises consumption	[none]	*1980:* 170520 170310 170410 130121 140410 140420 130122 130110 170110 170210 170510 170531 170532 130211 130212 *2007-2010:* 170533 *2006-2010:* 170530
Alcoholic beverages purchased for off-premises consumption	*1980-2006:* 790310 790320 *2007-2010:* 790330	*1980:* 200210 200410 200533 200310 200523 200111 200513 †200110
Women's and girls' clothing	*1980:* 380110 380210 380311 380312 380313 380320 380331 380332 380340 380410 380420 380430 380510 380901 380902	*1986:* 380110 380210 380311 380312 380313 380320 380331 380332 380340 380410 380420 380430 380510 380901 380902 390110 390120 390210

	380903 390110 390120 390210 390221 390222 390230 390310 390321 390322 390901 390902 *1980-2006:* 380331 380332 390221 390222 *2007-2010*: 380333 390223 †380315	390221 390222 390230 390310 390321 390322 390901 *1980-2006:* 380331 380332 390221 390222 *2007-2010:* 380333 390223 †380315
Men's and boys' clothing	*1980:* 360110 360120 360210 360311 360312 360320 360330 360340 360350 360410 360511 360512 360901 360902 370110 370120 370130 370211 370212 370213 370220 370311 370312 370313 370902 *1980-2006:* 360511 360512 370312 370313 *2007-2010:* 360513 370314 *1980-1994:* 370901 *1995-2010*: 370903 370904 †360420 370125	*1986:* 360110 360120 360210 360311 360312 360320 360330 360340 360350 360410 360511 360512 360901 370110 370120 370130 370211 370212 370213 370220 370311 370312 370313 370901 370904 *1986-2006:* 360511 360512 370312 370313 *2007-2010:* 360513 370314 †360420 370125
†Baby clothes	410111 410112 410121 410122 410131 410132 410141 410142 410901 410902 410903 410905 410904	*1986:* 410110 410120 410130 410140
Clothing materials	*1980:* 420110 420120	*1986:* 420110 420120
Shoes and other footwear	*1980:* 400110 400210 400310 400220	*1986:* 400110 400210 400310 400220
*Gasoline and other energy goods	*1980:* 470111 470112 470113 470211 470212 470220 250111 250112 250113 250114 250211 250212 250213 250214 250901 250902 250903 250904 250911 250912 250913 250914 250221 250222 250223 250224	*1980-1981, 1986:* 470111 470112 470114 470211 470220 250110 250210 250900 250220
Pets and related products	*1980:* 610320	*1986:* 610310 610320
Film and photographic supplies	*1980:* 610210	*1986:* 610210 610220
Household cleaning products	*1980:* 330511 *1980-1998*: 990910	*1980:* 320140 330110 330210 330610
Household paper products	[none]	*1980:* 330310
†Stationary/Gift Wrap, etc.		330410 660000
Household linens	*1980:* 280110 280120 280130 280220 280900 320904 †280140	*1986:* 280110 280120 280130 280220 280900 320904 †280140
Sewing items	*1980:* 280230 †420115	*1986:* 280230 †420115
Personal care products	*1980:* 640130 640420 †640430	*1985-2010:* 640110 640120 640130 640210 640220 640410 640310 640420 *1986:* 320130 †550210 550310 640430
Tobacco	*1980:* 630110 630210	*1980:* 630110 630210 630900 630220
Recreational Drugs		550900
Newspapers and periodicals	*1980:* 590310 590410 *1980-1993:* 590110 590210 *1994-2010:* 590111 590112 590211 590212	*1986:* 590110 590210 590900
†Eyeglasses	550110	550110
†Flowers/plants	320903	
†Prescription Drugs	540000	

Misc. nondurable goods not elsewhere classified		*1986:* 320610 610902 320905 330510
Services		
Rent and utilities	*1980:* 800710 210110 230121 230141 230150 240111 240121 240211 240221 240311 240321 320611 320621 270211 270212 270213 270214 270411 270412 270413 270414 260111 260112 260113 260114 260211 260212 260213 260214 *1980-1998:* 230131 *1999-2010:* 230134 320163 *1980-1993*: 230111 †210210 210310 210901 210902 230121 240111 320161 680905 320624 790690 990920 320631	*1986:* 800710 210110 270210 270410 260110 260210 270905
†Mortgage Payments	830101 830102 790910	9000
Imputed rental of owner-occupied nonfarm housing	*1980:* 910060 910070 *1980-2006:* 910100 *2007-2010:* 910101 910102 910103 *1993-2010*: 910050 †910080 910090 910104 910105 910106 910107	[none]
Other motor vehicle services	*1980:* 450312 450412 520511 520512 520521 520522 520902 520905 520904 620907 520541 520542 *1980-1993:* 620907 *1994-2010:* 620921 620922 *1980-1990:* 520530 620902 *1991-2010:* 520531 520532 620909 620919 450310 450313 450314 450410 450413 450414 †220900 220901 220902 520550 450116 450216 450226 450906 460116 460907 460908 460909 450352 450350 450351 450353 450354 520516 520517	*1986:* 450310 450410 520511 520521 520902 520904 520531 520541 †450350 530903 520516
†Other Transportation	530110 530210 530311 530312 530411 530412 530510 530901 530902	
Cable and satellite television and radio services	*1980:* 270310 270311	*1986:* 270310 270311
Photo processing	*1980:* 620330	*1986:* 620330
Photo studios	*1999-2010*: 620320	*1980:* 620320
Gambling	*2001-2010:* 620926	*2001-2010:* 620926 *1984-2000:* 620911 *1980-1981:* 620901
†Entertainment	620122 620211 620212 620221 620222 620310 620903 680310 620115 620213 620214	*1996:* 620510 620610 620115 620213 620214
†Medical Care Services	560110 560210 560310 560320 560330 560900 570110 570210 570220 570230 560400 570240 570111	*1986:* 570000
Veterinary and other services for pets	*1980:* 620410 620420	*1986:* 620410 620420
Purchased meals and beverages	*1980:* 190901 190902 190903 790410 790420 790430 200900	*1998-2010:* 190111 190211 190311 190321 190911 190921 190112 190212 190312 190322 190912 190922 190113 190213 190313 190323 190913 190923

		190114 190214 190314 190324 190914 190924 190115 190215 190315 190325 190915 190925 190116 190216 19031 190326 190916 190926 200511 200512 200516 200521 200522 200526 200531 200532 200536 *1980-1997:* 190110 190210 190310 190320 190901 190902 200510 200520 200530 †190316 200514 200524 200534
Food supplied to civilians	*1980:* 800700	*1986:* 800700
Communication	*1980:* 270104 620930 310350 690116 270105 690114 *1980-2005:* 270103 *2005-2010:* 310240F *1980-1997:* 270510 270610 *1980-1990:* 270000 *1991-2010*: 270101 270102 †270106	*1986:* 270000 340110 340120 310241 310242 620930 310351 310352 690116 690114
Legal services	*1980:* 680110	*1986:* 680110
Accounting and other business services	*1980:* 680902 001400 680903	*1986:* 680902 680903
Funeral and burial services	*1980:* 680140 680901	*1986:* 680140 680901
Personal care services	*1980:* 440150 620115 *1980-1998:* 650110 650210 650900 *2005-2010:* 680904 *1999-2010:* 650310 †440130	*1980:* 650900 650110 650210 *1986:* 440150 *2005-2010:* 680904
Repair and hire of footwear	*1980:* 440110	*1986:* 440110
Child care	*1980-1992:* 340210 *1993-2010*: 340211 340212	*1986:* 340210
†Elder care	340906 340910	
Household maintenance	*1980:* 340310 340510 440900 340630 340620 230142 340901 340907 990900 270901 270902 270903 270904 340420 340903 340914 340911 340912 790640 340915 340410 790600 †220611 220615 230112 230113 230114 230115 230116 230119 230122 230123 320622 320623 320632 790610 790611 320633 230151 230152	*1986:* 340310 340510 440900 340630 340620 230140 340901 340907 340913 270900 340903 340410 †220000 230000 230120 230140 230900 270900 340913 230110 220610
†Auto repair	490110 490211 490212 490220 490231 490232 490311 490312 490313 490314 490315 490411 490412 490413 490900 490317 490318 490319 490221 490300	*1986:* 490000 490316 490300
†Rental and Other Repair Services	340610 340902 340905 340908 440140 520903 520906 520907 570901 620904 620905 620906 620908 680210 620912 690113 570903 620916 620917 620918	*1986:* 570902 620915 340909 620810
†Real Estate Services	*1980:* 230901 230902 790730 790830 790840 810301 810302 820301 820302 820401 790620 820402	1986: 9900 999000 (?)
†Education Services	670110 670210 670310 670901 670410 670903	670903
†Other Misc. Services	340520 340530 440120 440210 670902 690310 690320 690330 690340 690350 850216	
**Non-Consumption*		

†Insurance	1980-: 220111 220112 220121 220122 350110 500110 580110 580210 580310 580901 580902 700110 580111 580112 580113 580114 580311 580312 580903 580904 580905 585906 580400 580907 580115 580116	1986: 2120 2100 220110 220120 580000
†Taxes	220210 220211 220212 950024	*1986:* 999900 950024
†Fees/Licenses	520110 520310 520410 520901 620110 620121 790630 840101 840102 450311 450411	*1986:* 520111 520112 620710
†Memberships/Clubs	620111 620112 620113 620114	620114
†Interest Payments/Finance Charges	220311 220312 510110 510901 510902 680220 710110 850300 220313 220314 880110 880210 880310	
†Penalties/Fines	220321 220322	620925
†Child Support/Alimony	800111 800121	5000
†Cash gifts / Contributions	800800 800803 810400 800804 800811 800821 800831 800841 800851 800861	4100 4190
Unidentifiable items		*1986:* 999935

F. Crosswalk between CEX and AC Nielsen

The crosswalk between the DS and AC Nielsen (Nielsen) was developed for this project, and, to the best of our understanding, has yet to be undertaken at our level of disaggregation. The smallest unit of aggregation for spending in the DS and IS is known as a Universal Classification Code (UCC). Approximately 600 UCC codes appear in the DS and IS survey across years, although some are overlapping. AC Nielsen (Nielsen) data contain over 2 million unique Universal Product Categories (UPC) codes. These codes correspond to the product's barcode, essentially representing a unique product identifier. UPCs are categorized into 1,075 product modules, 125 product groups in 10 departments. Our approach is to match the 125 Nielsen product groups to the DS UCC codes.

Our main analysis reported in the paper focuses on *non-durable* goods that have the potential to be sold in bulk. We exclude durables and clothes/soft goods, since these goods are not well represented or well-reported in Nielsen, and, while many of these goods can also be purchased at club stores, they are typically not sold or purchased in bulk. Another concern is that because these goods are relatively expensive, such purchases could inflate the club share of spending.

Note: Because Nielsen households scan the barcodes of purchases made in stores, non-barcoded items will not generally be recorded. This mainly affects fresh produce, which will be underreported in Nielsen.

The following Table provides a crosswalk between Diary UCC codes and Nielsen Product Groups used in Table 1. We indicate Nielsen Product Groups that are excluded from the Nielsen analysis with a "*."

Appendix Table C1: Crosswalk between CEX DS and AC Nielsen

CEX DS UCC Code	AC Nielsen Product Group
20110 WHITE BREAD 20210 BREAD OTHER THAN WHITE 20310 FRESH BISCUITS, ROLLS, MUFFINS 20410 CAKES AND CUPCAKES 20710 DOUGHNUTS,SWEETROLLS,COFFECAKE 20820 FRESH PIES, TARTS, TURNOVERS	1501 BREAD AND BAKED GOODS
30110 GROUND BEEF EXCLUDE CANNED 30210 CHUCK ROAST 30310 ROUND ROAST 30410 OTHER ROAST 30510 ROUND STEAK 30610 SIRLOIN STEAK 30710 OTHER STEAK 30810 OTHER BEEF (EXCLUDE CANNED) 40110 BACON 40210 PORK CHOPS 40310 HAM (EXCLUDE CANNED) 40410 OTHER PORK 40510 PORK SAUSAGE 50410 LAMB AND ORGAN MEATS 50900 MUTTON, GOAT, GAME 60110 FRESH & FROZEN WHOLE CHICKEN 60210 FRESH OR FROZEN CHICKEN PARTS 60310 OTHER POULTRY 70210 FRESH AND FROZEN SHELLFISH (1984-85) 70220 FRESH AND FROZEN FISH (1984-85) 70230 FRESH FISH & SHELLFISH	3501 FRESH MEAT
40610 CANNED HAM 50110 FRANKFURTERS 50210 BOLOGNA, LIVERWURST, SALAMI 50310 OTHER LUNCHMEAT	3002 PACKAGED MEATS-DELI
80110 EGGS	2505 EGGS
90110 FRESH MILK ALL TYPES 90210 CREAM	2506 MILK
100110 BUTTER 160110 MARGARINE	2501 BUTTER AND MARGARINE
100210 CHEESE	2502 CHEESE
100510 OTHER DAIRY PRODUCTS	2503 COT CHEESE, SOUR CREAM, TOPPINGS 2507 PUDDING, DESSERTS-DAIRY 2508 SNACKS, SPREADS, DIPS-DAIRY 2510 YOGURT
110110 APPLES 110210 BANANAS 110310 ORANGES 110410 OTHER FRESH FRUITS 110510 CITRUS FRUITS EXCL. ORANGES 120110 POTATOES 120210 LETTUCE 120310 TOMATOES 120410 OTHER FRESH VEGETABLES 140340 OTHER VEGETABLES MISC	4001 FRESH PRODUCE [Note: this is only packaged fresh produce, since it must have a barcode]
130110 FROZEN ORANGE JUICE 130122 FROZEN FRUIT JUICES	2006 JUICES, DRINKS-FROZEN
130121 FROZEN FRUITS 130120 FROZEN FRUIT, OTH. FRUIT JUICE (1984)	2003 DESSERTS/FRUITS/TOPPINGS-FROZEN
130211 FRESH FRUIT JUICE 130210 FRSH/CANNED/BOTTLED FRUT JUICE (1984) 130212 CANNED/BOTTLE FRUIT JUICE 140420 FRESH & CANNED VEGETABLE JUICES	507 JUICE, DRINKS - CANNED, BOTTLED

170510 NONCARB FRUT FLAV/LEMADE NONFROZ	
140320 OTHER PEAS 140330 OTHER BEANS	1021 VEGETABLES AND GRAINS - DRIED
180610 PREPARED SALADS/DESSERTS 180611 PREPARED SALADS	3001 DRESSINGS/SALADS/PREP FOODS-DELI
180710 MISC. PREPARED FOODS	510 PREPARED FOOD-READY-TO-SERVE
10110 FLOUR	1009 FLOUR
10120 PREPARED FLOUR MIXES	511 PREPARED FOOD-DRY MIXES 1001 BAKING MIXES 1002 BAKING SUPPLIES
10210 CEREAL	1005 CEREAL 1004 BREAKFAST FOOD
10310 RICE	1021 VEGETABLES AND GRAINS – DRIED
10320 PASTA CORNMEAL OTH CEREAL PRODS	1013 PASTA
20510 COOKIES	1505 COOKIES
20610 CRACKERS 20620 BREAD AND CRACKER PRODUCTS	1506 CRACKERS
20810 FROZEN & REFRIG. BAKERY PROD.	2001 BAKED GOODS-FROZEN 2504 DOUGH PRODUCTS
70110 CANNED FISH AND SEAFOOD	512 SEAFOOD – CANNED
70240 FROZEN FISH & SHELLFISH	2009 UNPREP MEAT/POULTRY/SEAFOOD-FRZN
100410 ICE CREAM AND RELATED PRODUCTS	2005 ICE CREAM, NOVELTIES
130310 CANNED FRUITS	504 FRUIT - CANNED
130320 DRIED FRUITS	1010 FRUIT - DRIED
140110 FROZEN VEGETABLES 140410 FROZEN VEGETABLE JUICES	2010 VEGETABLES-FROZEN
140210 CANNED BEANS 140220 CANNED CORN 140230 CANNED VEGETABLES MISC 140310 OTHER PROCESSED VEGETABLES	514 VEGETABLES - CANNED
150110 CANDY AND CHEWING GUM	503 CANDY 505 GUM
150211 SUGAR 150212 ARTIFICIAL SWEETENERS	1018 SUGAR, SWEETENERS
150310 OTHER SWEETS	1008 DESSERTS, GELATINS, SYRUP 1019 TABLE SYRUPS, MOLASSES
160210 OTH FATS/OILS/SALAD DRESSINGS 160211 FATS & OILS	1016 SHORTENING, OIL
160212 SALAD DRESSINGS	1015 SALAD DRESSINGS, MAYO, TOPPINGS
160310 NON-DIARY CREAM SUBSTITUTES	1012 PACKAGED MILK AND MODIFIERS
160320 PEANUT BUTTER	506 JAMS, JELLIES, SPREADS
170110 COLA DRINKS 170210 OTHER CARBONATED DRINKS	1503 CARBONATED BEVERAGES
170310 ROASTED COFFEE 170410 INSTANT/FREEZE DRIED COFFEE	1006 COFFEE
170520 TEA	1020 TEA
170530 OTHER NONCARB. BEVERAGES/ICE 170531 OTHER NONCARB. BEVERAGE/ICE 170532 BOTTLED WATER 170533 SPORTS DRINKS	1508 SOFT DRINKS-NON-CARBONATED 2004 ICE
180210 FROZEN MEALS 180220 FROZ/PREP. FOOD OTH THAN MEALS	2008 PREPARED FOODS-FROZEN 2002 BREAKFAST FOODS-FROZEN 2007 PIZZA/SNACKS/HORS DOEURVES-FRZN
180310 POTATO CHIPS AND OTHER SNACKS	1507 SNACKS
180320 NUTS	1011 NUTS
180410 SALT/OTHER SEASONINGS & SPICES	1017 SPICES, SEASONING, EXTRACTS
180420 OLIVES, PICKLES, RELISHES	1014 PICKLES, OLIVES, AND RELISH
180510 SAUCES AND GRAVIES 180520 OTHER CONDIMENTS	1007 CONDIMENTS, GRAVIES, AND SAUCES 2509 YEAST
180612 PREPARED DESSERTS	1501 BREAD AND BAKED GOODS

180620 BABY FOOD	501 BABY FOOD
180720 VITAMIN SUPPLEMENTS 550410 NONPRESCRIPTION VITAMINS	6018 VITAMINS 6005 DIET AIDS
200110 BEER AND ALE AT HOME 200111 BEER AND ALE AT HOME 200112 NON ALCOHOLIC BEER	5001 BEER
200210 WHISKEY AT HOME 200410 OTHER ALCOHOLIC BEV. AT HOME	5002 LIQUOR
200310 WINE AT HOME	5003 WINE
630110 CIGARETTES 630210 OTHER TOBACCO PRODUCTS 630220 SMOKING ACCESSORIES	4510 TOBACCO & ACCESSORIES
330110 SOAPS AND DETERGENTS	4501 DETERGENTS
330210 OTHER LAUNDRY /CLEANING PRODS. 320140 LAUNDRY AND CLEANING EQUIP.	4506 LAUNDRY SUPPLIES 4504 HOUSEHOLD CLEANERS 4503 FRESHENERS AND DEODORIZERS
330310 PAPER TOWELS/NAPKINS/TOILET TI	4507 PAPER PRODUCTS
330510 MISC HOUSEHOLD PRODUCTS 320610 MISC. SUPPLIES AND EQUIPMENT 320905 MISC. HOUSEHOLD EQUIP/PARTS	4505 HOUSEHOLD SUPPLIES 5502 BATTERIES AND FLASHLIGHTS
550210 OVER-THE-COUNTER DRUGS 640430 ADULT DIAPERS	6012 MEDICATIONS/REMEDIES/HEALTH AIDS 6003 COUGH AND COLD REMEDIES 6017 SKIN CARE PREPARATIONS 6008 FIRST AID
610310 PET FOOD	508 PET FOOD
610320 PET-PURCHASE/SUPPLIES/MEDICINE	4509 PET CARE
640110 HAIR CARE PRODUCTS	6011 HAIR CARE 6006 ETHNIC HABA
640210 ORAL HYGIENE PRODUCTS,ARTICLES	6014 ORAL HYGIENE
640220 SHAVING NEEDS	6016 SHAVING NEEDS
640310 COSMETICS, PERFUME, BATH PREP	6002 COSMETICS 6009 FRAGRANCES – WOMEN 4508 PERSONAL SOAP AND BATH ADDITIVES
640120 NON-ELEC ARTICLES FOR THE HAIR	6010 GROOMING AIDS
640410 DEOD,FEM HYG, MISC. PERS. CARE	6004 DEODORANT 6007 FEMININE HYGIENE 6013 MEN'S TOILETRIES 6001 BABY NEEDS 6015 SANITARY PROTECTION 4502 DISPOSABLE DIAPERS
360311 MENS UNDERWEAR 360312 MENS HOSIERY 370211 BOYS UNDERWEAR 370213 BOYS HOSIERY 380420 WOMENS UNDERGARMENTS 380430 WOMENS HOSIERY 390321 GIRLS HOSIERY 410110 INFANT COAT/JACKET/SNOWSUIT 410120 INFANT DRESSES/OUTERWEAR 410130 INFANT UNDERGARMENTS 410140 INFANT NIGHTWEAR/LOUNGEWEAR 410901 INFANTS ACCESSORIES 280110 BATHROOM LINENS 280120 BEDROOM LINENS 280130 KITCHEN AND DINING ROOM *LINENS 280210 CURTAINS AND DRAPES 280220 SLIPCOVERS/DECORATIVE PILLOWS 280900 OTHER LINENS 280140 KITCHEN/DINING ROOM/OTHR LINENS	*5521 SOFT GOODS *5512 HOSIERY/SOCKS

280230 SEWING MATERIALS 420120 SEWING NOTIONS, PATTERNS	5519 SEWING NOTIONS
300110 REFRIGERATOR, HOME FREEZER 300210 WASHERS 300220 DRYERS 300310 STOVES, OVENS 300320 MICROWAVE OVENS 300330 PORTABLE DISHWASHERS 300410 WINDOW AIR CONDITIONERS 300900 MISC. HOUSEHOLD APPLIANCES 310110 BLACK AND WHITE TV 310120 COLOR TV - CONSOLE 310130 COLOR TV - PORTABLE/TABLE MOD 310140 TELEVISIONS 310210 VCRS/VIDEO DISC PLAYERS 310220 VIDEO CASSETTES/TAPES/DISCS 310230 VIDEO GAME HARDWARE/SOFTWARE 310230 VIDEO GAME CARTRIDGES, TV COMPUTER GAMES AND SOFTWARE, ATARI CARTRIDGES AND SUPPLIES, COMPUTER JOYSTICK, GAMES, AND GAME CARTRIDGES 310231 VIDEO GAME SOFTWARE 310232 VIDEO GAME HARDWARE AND ACCESSORIES 310311 RADIOS 310312 PHONOGRAPHS 310313 TAPE RECORDERS AND PLAYERS 310314 DIGITAL AUDIO PLAYERS 310320 COMPONENTS/COMPONENT SYSTEMS 310331 MISC SOUND EQUIPMENT 310332 SOUND EQUIP ACCESSORIES 310335 Miscellaneous video equipment 310340 RECORDS TAPES NEEDLES STYLI CLUBS 310900 ACCESS. FOR ELECTRONIC EQUIP. 320210 CLOCKS 320130 INFANTS EQUIPMENT 320232 TELEPHONES AND ACCESSORIES 320233 Clocks and other household decorative items 320511 ELECTRIC FLOOR CLEANING EQUIP 320512 SEWING MACHINES 320521 SMALL ELECTRIC KITCHEN APPLIANCES 320522 PORTABLE HEATING/COOLING EQUIP 640420 ELECTRIC PERSONAL CARE APPL. 690110 COMPUTER, COMP HRDWR NON *BUS USE 690110 Computers for non-business use, hardware and software excluding video games 690115 PERSONAL DIGITAL ASSISTANTS 690117 PORTABLE MEMORY 690118 Digital book readers 690119 Computer software 690120 Computer accessories 690210 TELEPHONE ANSWERING DEVICES 690220 CALCULATORS 690230 TYPWRITS/OTH OFF MACH NON-BUS USE 310316 RADIOS/SPEAKERS/SOUND COMP SYSTMS 320221 LAMPS/LIGHT FIXTURES/CEILING FANS 310315 Digital media players and recorders	*5507 ELECTRONICS/RECORDS/TAPES *5513 HOUSEWARES/APPLIANCES/ELECTRONICS *5516 LIGHT BULBS, ELECTRIC GOODS
320120 WINDOW COVERINGS 320231 OTH HOUSEHOLD DECORATIVE ITEMS 320231 Other household decorative items, including fireplace equipment and accessories 320420 POWER TOOLS 320430 OTHER HARDWARE 320902 HAND TOOLS	*5511 HARDWARE, TOOLS [Household accessories are included here too]

320904 CLOSET AND STORAGE ITEMS	
320220 TABLEWARE/NON-ELEC. KITWARE 320380 TABLEWARE/NON-ELEC. KITWARE 320310 PLASTIC DINNERWARE 320320 CHINA AND OTHER DINNERWARE 320330 FLATWARE 320340 GLASSWARE 320350 SILVER SERVING PIECES 320360 OTHER SERVING PIECES 320345 DISHES/CUPS/GLASSES/SERVING PIECS	*5509 GLASSWARE, TABLEWARE *5515 KITCHEN GADGETS *5504 CANNING, FREEZING SUPPLIES
320370 NONELECTRIC COOKWARE	*5506 COOKWARE
330610 LAWN AND GARDEN SUPPLIES	5508 FLORAL, GARDENING 5514 INSECTICDS/PESTICDS/RODENTICDS
330410 STATIONERY, GIFTWRAP, ETC. 660000 SCHOOL SUPPL., ETC. - UNSPEC. 660110 SCHOOL BK/SUPL/EQUIP FOR COLLEGE 660210 SCHOOL BK/SUPL/EQUIP FOR ELEM/HS	4511 WRAPPING MATERIALS AND BAGS 5522 STATIONERY, SCHOOL SUPPLIES 5510 GRT CARDS/PARTY NEEDS/NOVELTIES
430110 WATCHES	*9599 UNGROUPED ITEMS
480211PARTS/EQUIP/ACCESSORIES 480212 VEHICLE PRODUCTS 480213 PARTS/EQUIP/ACCESSORIES	*5501 AUTOMOTIVE
590110 NEWSPAPERS 590210 MAGAZINES 590220 BOOKS THRU BOOK CLUBS 590230 BOOKS NOT THRU BOOK CLUBS	*5503 BOOKS AND MAGAZINES
600210 GENERAL SPORT/EXCERCISE EQUIP 600310 BICYCLES 600410 CAMPING EQUIPMENT 600420 HUNTING, FISHING EQUIPMENT 600430 WINTER SPORT EQUIPMENT 600900 WATER SPORT EQUIPMENT 610110 TOYS GAMES HOBBIES TRICYCLES 610130 MUSIC INSTRUMENTS/ACCESSORIES	*5524 TOYS & SPORTING GOODS
610210 FILM 610220 OTHER PHOTOGRAPHIC SUPPLIES	5517 PHOTOGRAPHIC SUPPLIES
No comparable diary category	*5518 SEASONAL
No comparable diary category	*5523 SUNGLASSES
250900 MISC. FUELS	*5505 CHARCOAL, LOGS, ACCESSORIES
440110 SHOE REPAIR, OTH SHOE SERVICE	*5520 SHOE CARE
1000 STOCKS, BONDS, MUTUAL FUNDS 1100 PRECIOUS METALS 1200 MISCELLANEOUS INVESTMENTS 1400 EMPLOY. COUNSELING & FEES 2100 INSUR. OTH THAN HEALTH/VEHICLE 2200 RETIREMENT PLANS 4000 CONTRIBUTIONS 4100 CASH GIFTS 4190 GIFTS NOT SPECIFIED 5000 ALIMONY AND CHILD SUPPORT 9000 MORTGAGE PAYMENT 9900 PROPERTY ASSESSMENT 190110 LUNCH 190110 Lunch at restaurants, cafes, etc... 190111 Lunch at Fast Food 190112 Lunch at Full Service 190113 Lunch at Vending Machine 190114 Lunch at Employer 190115 Lunch at Board 190116 Lunch at Catered Affairs 190210 DINNER 190210 Dinner at restaurants, cafes, etc...	*No comparable Nielsen category

190211 Dinner at Fast Food	
190212 Dinner at Full Service	
190213 Dinner at Vending Machine	
190214 Dinner at Employer	
190215 Dinner at Board	
190216 Dinner at Catered Affairs	
190310 Snacks and non alcoholic beverages, including tip	
190311 Snacks at Fast Food	
190312 Snacks at Full Service	
190313 Snacks at Vend Machine	
190314 Snacks at Employer	
190315 Snacks at Board	
190316 Snacks at Catered Affairs	
190320 BREAKFAST AND BRUNCH	
190320 Breakfast and brunch at restaurants, cafes, etc...	
190321 Breakfast at Fast Food	
190322 Breakfast at Full Service	
190323 Breakfast at Vending Machine	
190324 Breakfast at Employer	
190325 Breakfast at Board	
190326 Breakfast at Catered Affairs	
190901 BOARD (INCLUD AT SCHOOL)	
190901 Food or board, at school and rooming/boarding houses	
190902 CATERED AFFAIRS	
190911 Board at Fast Food	
190912 Board at Full Service	
190913 Board at Vending Machine	
190914 Board at Employer	
190915 Board at Board	
190916 Board at Catered Affairs	
190921 Catered Affairs at Fast Food	
190922 Catered Affairs at Full Service	
190923 Catered Affairs at Vending Machine	
190924 Catered Affairs at Employer	
190925 Catered Affairs at Board	
190926 Catered Affairs at Catered Affairs	
200510 BEER AND ALE AWAY FROM HOME	
200511 Beer at Fast Food	
200512 Beer at Full Service	
200513 Beer at Vending Machine	
200514 Beer at Employer	
200515 Beer at Board	
200516 Beer at Catered Affairs	
200520 Wine away from home	
200520 WINE AWAY FROM HOME	
200521 Wine at Fast Food	
200522 Wine at Full Service	
200523 Wine at Vending Machine	
200524 Wine at Employer	
200525 Wine at Board	
200526 Wine at Catered Affairs	
200530 Other alcoholic beverages away from home	
200531 Alcoholic Beverage Excluding Beer/Wine Fast Food	
200532 Alcoholic Beverage Excluding Beer/Wine Full Service	
200533 Alcoholic Beverage Excluding Beer/Wine Vending Machine	
200534 Alcohoic Beverage Excluding Beer/Wine at Employer	
200535 Alcohoic Beverage Excluding Beer/Wine at Board	
200536 Alcoholic Beverage Excluding Beer/Wine Catered Affairs	
210110 RENT OF DWELLING	
210210 LODGING AWAY FROM HOME	
210310 HOUSING FOR SOMEONE AT SCHOOL	

210900 GROUND OR LAND RENT	
220000 CAPITAL IMPROVEMENTS - N/SPEC.	
220110 FIRE/EXTENDED COVERAGE INSUR	
220120 HOMEOWNERS INSURANCE	
220210 PROPERTY TAXES	
220310 CONTRACTED MORTGAGE INTEREST	
220400 PURCHASE OF PROPERTY	
220410 HOME PURCHASE	
220510 CAPITAL IMPROVEMENTS - COMMOD	
220610 CAPITAL IMPROVEMENTS - SERVICE	
220900 PARKING-OWNED DWELLING	
230000 REPAIR/MAINT/IMPROV. N/SPEC.	
230110 MAINTENANCE OF PROPERTY	
230120 INSTALLED HARD SURFACE FLOORIN	
230130 INSTALLED WALL-TO-WALL CARPET	
230140 REPAIR-DISPL/DISHR/RANG HD	
230900 MAINTENANCE FEES	
240110 PAINT, WALLPAPER AND SUPPLIES	
240120 TOOLS/EQUIP. FOR PAINTG,PAPERG	
240210 LUBER,PANLING,TILE,AWNING,GLAS	
240220 BLACKTOP AND MASONRY MATERIALS	
240310 PLUMBING SUPPLIES AND EQUIP.	
240320 ELEC HEATG/A.C. SUPP. EQUIP	
240900 SOFT SURFACE FLOOR COVERING	
250110 FUEL OIL	
250210 BOTTLED OR TANK GAS	
250220 COAL	
260110 ELECTRICITY	
260210 UTILITY - NATURAL GAS	
270000 TELEPHONE SERVICE NOT SPEC.	
270210 WATER AND SEWERAGE MAINTENANCE	
270310 COMMUNITY ANTENNA OR CABLE TV	
270311 Cable/Satellite/Com Antenna Serv	
270410 GARBAGE/TRASH COLLECTION	
270510 TELEPHONE INTERSTATE CALLS	
270510 Telephone interstate calls	
270610 TELEPHONE INTRASTATE CALLS	
270610 Telephone intrastate calls	
270900 SEPTIC TANK CLEANING	
270905 STEAM HEAT	
290110 MATTRESS AND SPRINGS	
290120 OTHER BEDROOM FURNITURE	
290210 SOFAS	
290310 LIVING ROOM CHAIRS	
290320 LIVING ROOM TABLES	
290410 KITCHEN/DINING ROOM FURNITURE	
290420 INFANTS FURNITURE	
290430 OUTDOOR FURNITURE	
290440 WALL UNITS, CABINETS, OCCAS FURN	
300218 WASHERS AND DRYERS	
310241 STREAMING VIDEO FILES	
310242 DOWNLOADING VIDEO FILES	
310334 Satellite dishes	
310351 STREAMING AUDIO FILES	
310352 DOWNLOADING AUDIO FILES	
320110 FLOOR COVERINGS (NON-PERM.)	
320150 OUTDOOR EQUIPMENT	
320410 LAWN AND GARDEN EQUIPMENT	
320620 PERM HARD SURFACE FLR COVERING	
320627 FLOORING INSTALL/REPAIR/REPLACE	
320630 LANDSCAPING ITEMS	
320901 OFFICE FURNITURE HOME USE	

320903 INDOOR PLANTS, FRESH FLOWERS	
340110 POSTAGE	
340120 DELIVERY SERVICES	
340210 BABYSITTING	
340310 DOMESTIC SERVICE	
340410 GARDENING/LAWN CARE SERVICE	
340510 MOVING, STORAGE,FREIGHT EXPRES	
340520 HSHLD LNDRY,DRYCLN NOT COIN-OP	
340530 COIN-OP HSHLD LNDRY, DRY CLN	
340610 REPAIR OF TV/RADIO/SOUND EQUIP	
340620 REPAIR OF HOUSEHOLD APPLIANCES	
340630 REUPHOLSTERY OF FURNITURE	
340901 RENTAL/REPAIR-TOOLS,LAWN/GARDEN	
340903 MISC. HOME SERVICES	
340904 RENTAL OF FURNITURE	
340906 CARE OF INVALIDS, ELDERLY, ETC	
340907 RENTAL OF HOUSEHOLD EQUIPMENT	
340908 RNTL OFF EQUIP NON-BUS USE	
340909 RENTAL OF TV/RADIO SOUND EQUIP	
340913 REPAIR OF MISC HSHLD EQ/FSHGS	
350110 TENANTS INSURANCE	
360110 MENS SUITS	
360120 MENS SPORTCOATS/TAILORED JACKETS	
360210 MENS COATS AND JACKETS	
360320 MENS NIGHTWEAR/LOUNGEWEAR	
360330 MENS ACCESSORIES	
360340 MENS SWEATERS AND VESTS	
360350 MENS ACTIVE SPORTSWEAR	
360410 MENS SHIRTS	
360420 MENS SWEATERS/SHIRTS/VESTS	
360511 MENS PANTS	
360511 Men's pants	
360512 MENS SHORTS/SHORTS SETS	
360512 Men's shorts and shorts sets, excluding athletic	
360513 Men’s pants and shorts	
360901 MENS UNIFORMS	
370110 BOYS COATS AND JACKETS	
370120 BOYS SWEATERS	
370125 BOYS SWEATERS/SHIRTS/VESTS	
370130 BOYS SHIRTS	
370212 BOYS NIGHTWEAR	
370220 BOYS ACCESSORIES	
370311 BOYS SUITS, SPORTCOATS,VESTS	
370312 BOYS PANTS	
370312 Boys' pants	
370313 BOYS SHORTS, SHORTS SETS	
370313 Boys' shorts and shorts sets, excluding athletic	
370314 Boys’ pants and shorts	
370901 BOYS UNIFORMS/ACTIVE SPORTSWE	
380110 WOMENS COATS AND JACKETS	
380210 WOMENS DRESSES	
380311 WOMENS SPORTCOATS, TAIL. JKTS	
380312 WOMENS VESTS AND SWEATERS	
380313 WOMENS SHIRTS, TOPS,BLOUSES	
380315 WOMENSSWEATERS/SHIRTS/TOPS	
380320 WOMENS SKIRTS	
380331 WOMENS PANTS	
380331 Women's pants	
380332 WOMENS SHORTS,SHORTS SETS	
380332 Women's shorts and shorts sets, excluding athletic	
380333 Women’s pants and shorts	
380340 WOMENS ACTIVE SPORTSWEAR	

380410 WOMENS SLEEPWEAR	
380510 WOMENS SUITS	
380901 WOMENS ACCESSORIES	
380902 WOMENS UNIFORMS	
390110 GIRLS COATS AND JACKETS	
390120 GIRLS DRESSES, SUITS	
390210 GIRLS SHIRTS/BLOUSES/SWEATERS	
390221 GIRLS SKIRTS AND PANTS	
390221 Girls' skirts, culottes, and pants	
390222 GIRLS SHORTS, SHORTS SETS	
390222 Girls' shorts and shorts sets, excluding athletic	
390223 Girls' pants and shorts	
390230 GIRLS ACTIVE SPORTSWEAR	
390310 GIRLS UNDERWEAR AND SLEEPWEAR	
390322 GIRLS ACCESSORIES	
390901 GIRLS UNIFORMS	
400110 MENS FOOTWEAR	
400210 BOYS FOOTWEAR	
400220 GIRLS FOOTWEAR	
400310 WOMENS FOOTWEAR	
420110 MATERIAL FOR MAKING CLOTHES	
420115 SEWING/NDLWRK/QUILT MATRLS/ITEMS	
430120 JEWELRY	
430130 LUGGAGE	
440120 COIN-OP APPAREL LDRY/DRY CLNG	
440130 ALTER/REPAIR OF APPAREL, ACCESS	
440140 CLOTHING RENTAL	
440150 WATCH AND JEWELRY REPAIR	
440210 APPAREL LNDRY/DRY CLNG N/COIN-OP	
440900 CLOTHING STORAGE	
450110 NEW CARS	
450210 NEW TRUCKS	
450220 NEW MOTORCYCLES	
450310 CAR LEASE PAYMENTS	
450350 CAR/TRUCK LEASE PAYMENTS	
450410 TRUCK LEASE PAYMENTS	
450900 AIRCRAFT	
460110 USED CARS	
460901 USED TRUCKS	
460902 USED MOTORCYCLES	
460903 USED AIRCRAFT	
470111 GASOLINE	
470112 DIESEL FUEL	
470114 GASAHOL	
470211 MOTOROIL	
470220 COOLANT/ADDITIVES/BRK/TRNS FLD	
480110 TIRES PURCHASED/REPLACED/INSTALL	
480214 VEHICLE AUDIO EQ. EXCL. LABOR	
490000 MISC. AUTO REPAIR/SERVICING	
490110 BODY WORK AND PAINTING	
490211 CLUTCH, TRANSMISSION REPAIR	
490212 DRIVE SHAFT AND REAR-END REPAIR	
490220 BRAKE WORK	
490231 REPAIR TO STEERING OR FRONT END	
490232 REPAIR TO ENGINE COOLING SYSTEM	
490300 VEHICLE OR ENGINE REPAIRS	
490311 MOTOR TUNE-UP	
490312 LUBE, OIL CHANGE AND OIL FILTERS	
490313 FRNT END ALIGN, WHEEL BAL/ROTAT	
490314 SHOCK ABSORBER REPLACEMENT	
490315 BRAKE ADJUSTMENT	
490316 GAS TANK REPAIR,REPLACEMENT	

490411 EXHAUST SYSTEM REPAIR 490412 ELECTRICAL SYSTEM REPAIR 490413 MOTOR REPAIR/REPLACEMENT 490900 AUTO REPAIR SERVICE POLICY 500110 VEHICLE INSURANCE 520110 STATE OR LOCAL VEHICLE REGISTRATION 520111 VEHICLE REGISTRATION STATE 520112 VEHICLE REGISTRATION LOCAL 520310 DRIVERS LICENSE 520410 VEHICLE INSPECTION 520511 AUTO RENTAL 520516 AUTO/TRUCK RENTAL 520521 TRUCK RENTAL 520530 PARKING FEES 520531 PRKNG FEE IN HME CITY EXCL RSDNC 520541 TOLLS 520550 TOWING CHARGES 520560 GLOBAL POSITIONING SERVICES 520901 DOCKING/LANDING FEES 520902 MOTORCYCLE RENTAL 520903 AIRCRAFT RENTAL 520904 RENTAL NON-CAMPER TRAILER 530110 AIRLINE FARES 530210 INTERCITY BUS FARES 530311 INTRACITY MASS TRANSIT FARES 530412 TAXI FARES 530510 INTERCITY TRAIN FARES 530901 SHIP FARES 530902 SCHOOL BUS 530903 CAR/VAN POOL & NON-MOTOR TRANS 540000 PRESCRIPTION DRUGS 550110 EYEGLASSES AND CONTACT LENSES 550310 TOPICALS AND DRESSINGS 550320 MEDICAL EQUIP. FOR GENERAL USE 550330 SUPPORTIVE/CONVAL MED. EQUIP. 550340 HEARING AIDS 560110 PHYSICIANS SERVICES 560210 DENTAL SERVICES 560310 EYECARE SERVICES 560320 SERVICE BY OTH THAN PHYSICIANS 560330 LAB TESTS, X-RAYS 560400 SERV BY PROS OTH THAN PHYSICIANS 560900 NURSE/THERAPY/MISC. MEDIC SERV 570000 HOSPITAL CARE NOT SPECIFIED 570220 CARE IN CONVL OR NURSING HOME 570230 OTHER MEDICAL CARE SERVICE 570901 RENTAL OF MEDICAL/SURGICAL EQUIP 570902 REPAIR OF MEDICAL EQUIPMENT 570903 RENTAL OF SUPORTIVE/CONVAL EQUIP 580000 HEALTH INSURANCE NOT SPEC. 580110 COMMERCIAL HEALTH INSURANCE 580210 BLUECROSS/BLUE SHIELD 580310 HEALTH MAINTENANCE PLANS 580901 MEDICARE PAYMENTS 590900 NEWSLETTERS 600110 OUTBOARD MOTOR 600120 UNPOWERED BOATS, TRAILERS 600130 POWERED SPORTS VEHICLES 600903 GLOBAL POSITIONING SYSTEM DEVICES 610120 PLAYGROUND EQUIPMENT 610140 STAMP AND COIN COLLECTING 610230 PHOTOGRAPHIC EQUIPMENT	

610901 FIREWORKS	
610902 SOUVENIRS	
610903 VISUAL GOODS	
620110 CLUB MEMBERSHIP DUES AND FEES	
620111 SOCIAL/RECRE/CIVIC CLUB MEMBRSHP	
620112 CREDIT CARD MEMBERSHIPS	
620113 AUTOMOBILE SERVICE CLUBS	
620114 AUTO SERVICE CLUBS/GPS SERVICES	
620121 FEES FOR PARTICIPANT SPORTS	
620211 MOVIE, THEATER, OPERA, BALLET	
620213 TKTS TO PLAY/THEATR/OPERA/CONCERT	
620214 TKTS TO MOVIE, PARK, MUSEUMS	
620221 ADMISSION TO SPORTING EVENTS	
620310 FEES FOR RECREATIONAL LESSONS	
620320 PHOTOGRAPHER FEES	
620330 FILM PROCESSING	
620410 PET SERVICES	
620420 VET SERVICES	
620510 ADMISSIONS MISC	
620610 MISC. ENTERTAINMENT SERVICES	
620710 CAMP FEES	
620810 REN/REP SPT/PHOT/MUSIC EQUP	
620911 MISC FEES,PARIMUTEL LOSSES	
620911 Miscellaneous fees, pari-mutuel losses, and taxidermist fees	
620912 RNTL VIDEO CASS/TAPES/DISCS/FILMS	
620913 PINBALL/ELECTRONIC VIDEO GAMES	
620915 PASSPORT FEES	
620925 Lotteries and Parimutuel Losses	
620926 Miscellaneous Fees	
620930 ONLINE ENTERTAINMENT SERVICES	
640130 WIGS AND HAIRPIECES	
650110 PERS. CARE SERV FOR FEMALES	
650210 PERS. CARE SERV FOR MALES	
650900 REPAIR OF PERS. CARE APP.	
660310 ENCYL. OTH SETS OF REFRNCE BKS	
660900 SCH BK/SUP/EQ-DAY CARE,NURS,OTH	
670110 COLLEGE TUITION	
670210 ELEM./H.S. TUITION	
670310 DAY CARE/NURS/PRSCH EXP INCL TUIT	
670410 VOC/TECH SCHOOL TUITION	
670901 OTHER SCHOOL TUITION	
670902 OTH SCH EXPENSES INCLUD RENTALS	
670903 UNDOCUMENTED?	
680110 LEGAL FEES	
680140 FUNERAL EXPENSE	
680210 SAFE DEPOSIT BOX RENTAL	
680220 CHECK ACCTS / OTH BANK SERV CHGS	
680901 CEMETERY LOTS,VAULTS,MAINT FEES	
680902 ACCOUNTING FEES	
680903 MISC. PERS. SERVICES	
680904 DATING SERVICES	
690114 COMPUTER INFORMATION SERVICES	
690116 INTERNET SERVICES AWAY FROM HOME	
950024 VEHICLE PERSONAL PROPERTY TAXES	

References

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Bee, Adam, Bruce D. Meyer and James X. Sullivan. 2015. "The Validity of Consumption Data: Are the Consumer Expenditure Interview and Diary Surveys Informative?" in *Improving the Measurement of Consumer Expenditures* (2015), Christopher D. Carroll, Thomas F. Crossley, and John Sabelhaus, editors (p. 204 - 240).

APPENDIX C. A MODEL OF CONSUMER EXPENDITURES

Suppose consumers have a "target" level of consumption C_i (in dollars) per T units of time (e.g., T is the number of weeks in a year) for household i. The task of consumers is to minimize the cost of this consumption bundle.

$$cost = \frac{\delta_i d_i^{\beta} C_i}{2N} + F_i N C_i^{\alpha} + d_i C_i$$

where F_i is the fixed cost of a trip to a store (this cost depends on parameter α: with $\alpha = 1$ this is an icerberg cost, with $\alpha = 0$ this is a fixed cost), N is the number of shopping trips, d_i is the price discount (the baseline model reported in the paper imposes $d_i = 1$), δ_i is the storage cost of the average inventory (the average inventory is $p_i^{\beta}\bar{C}_i/2N$). We can use different values of β to obtain different interpretations of the storage cost. With $\beta = 0$, storage cost is measured in physical units but δ can be interpreted as a price. With $\beta = 1$, we have storage cost is measured in dollars with δ being a "depreciation" rate (rather than price). While assumptions about storage costs, discounts, etc. may be important for specific applications, we will show below that for our analysis we do not need to take a stand on exact functional forms, particular interpretations, or certain parameter values. For example, whether δ captures storage costs or depreciation is not material for us. As a result, we can consider a general form for the cost function.

The optimality condition implies that

$$N_i^* = \sqrt{\frac{\delta_i d_i^{\beta} C_i^{1-\alpha}}{2F_i}}.$$

The size of the purchase is $X_i = d_i C_i / N_i^*$ (if there is a purchase; this happens N_i^*/T fraction of times) or 0 (no purchase; this happens $1 - N_i^*/T$ fraction of time). Note that for this household the time-series mean is

$$E_t(X_{it}) = \frac{d_i C_i}{N_i^*} * \frac{N_i^*}{T} + 0 * \left(1 - \frac{N_i^*}{T}\right) = \frac{d_i C_i}{T} \equiv \bar{X}_i$$

The time-series variance of purchases for household i is

$$var_i(X_{it}) = \frac{N_i^*}{T}\left(\frac{d_i C_i}{N_i^*} - \frac{d_i C_i}{T}\right)^2 + \left(1 - \frac{N_i^*}{T}\right)\left(-\frac{d_i C_i}{T}\right)^2 = \left(\frac{d_i C_i}{T}\right)^2 \left(\frac{T}{N_i^*} - 1\right) = (\bar{X}_i)^2 \left(\frac{T}{N_i^*} - 1\right)$$

Hence the time-series coefficient of variation is given by

$$CV_T(X_{it}) = \frac{\sqrt{var_i(X_{it})}}{\bar{X}_i} = \sqrt{\frac{T}{N_i^*} - 1}$$

Using the delta method, we can find that the average (across households) time-series coefficient of variation is

$$\overline{CV_T} = E_i[CV_T(X_{it})] = E\left[\sqrt{\frac{T}{N_i^*} - 1}\right] \approx$$

Define the cross-sectional average of the desired per-week consumption as

$$\bar{\bar{X}} = E(X_{it}) = E\big(E(X_{it}|i)\big) = E_i\left(\frac{d_i C_i}{T}\right) = E_i \bar{X}_i.$$

Now consider the cross-sectional variance

$$var(X_{it}) = E\left[\left(X_{it} - \bar{\bar{X}}\right)^2\right] = E_i\left[E\left\{\left(X_{it} - \bar{\bar{X}}\right)^2 | i\right\}\right].$$

For household i, we have

$$E\left(X_{it}-\bar{\bar{X}}\right)^2=\frac{N_i^*}{T}\left(\frac{d_iC_i}{N_i^*}-\bar{\bar{X}}\right)^2+\left(1-\frac{N_i^*}{T}\right)\left(-\bar{\bar{X}}\right)^2=$$

$$=\frac{N_i^*}{T}\left(\frac{d_iC_i}{N_i^*}-\frac{d_iC_i}{T}+\frac{d_iC_i}{T}-\bar{\bar{X}}\right)^2+\left(1-\frac{N_i^*}{T}\right)\left(\frac{d_iC_i}{T}-\bar{\bar{X}}-\frac{d_iC_i}{T}\right)^2$$

$$=\frac{N_i^*}{T}\left(\frac{d_iC_i}{N_i^*}-\frac{d_iC_i}{T}\right)^2+\frac{N_i^*}{T}\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)^2+2\frac{N_i^*}{T}\left(\frac{d_iC_i}{N_i^*}-\frac{d_iC_i}{T}\right)\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)$$
$$+\left(1-\frac{N_i^*}{T}\right)\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)^2+\left(1-\frac{N_i^*}{T}\right)\left(\frac{d_iC_i}{T}\right)^2-2\left(1-\frac{N_i^*}{T}\right)\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)\left(\frac{d_iC_i}{T}\right)$$

$$=\frac{N_i^*}{T}\left(\frac{d_iC_i}{N_i^*}-\bar{X}_i\right)^2+\left(1-\frac{N_i^*}{T}\right)(\bar{X}_i)^2+\frac{N_i^*}{T}\left(\bar{X}_i-\bar{\bar{X}}\right)^2+\left(1-\frac{N_i^*}{T}\right)\left(\bar{X}_i-\bar{\bar{X}}\right)^2$$
$$+2\frac{N_i^*}{T}\left(\frac{d_iC_i}{N_i^*}-\frac{p_iC_i}{T}\right)\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)-2\left(1-\frac{N_i^*}{T}\right)\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)\left(\frac{d_iC_i}{T}\right)$$

$$=var_i(X_{it})+\left(\bar{X}_i-\bar{\bar{X}}\right)^2+2\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)\left\{\frac{N_i^*}{T}\left(\frac{d_iC_i}{N_i^*}-\frac{p_iC_i}{T}\right)-\left(1-\frac{N_i^*}{T}\right)\left(\frac{d_iC_i}{T}\right)\right\}$$

$$=var_i(X_{it})+\left(\bar{X}_i-\bar{\bar{X}}\right)^2+2\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)\left\{\frac{d_iC_i}{T}-\frac{N_i^*}{T}\frac{d_iC_i}{T}-\frac{d_iC_i}{T}+\frac{N_i^*}{T}\frac{d_iC_i}{T}\right\}$$

$$=\ var_i(X_{it})+\left(\bar{X}_i-\bar{\bar{X}}\right)^2$$

If we take an average across households in this group, we have

$$E_i\left[E\left\{\left(X_{it}-\bar{\bar{X}}\right)^2|i\right\}\right]=E_i\left\{\left(\frac{d_iC_i}{T}\right)^2\left(\frac{T}{N_i^*}-1\right)+\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)^2\right\}$$

$$=E_i\left\{\left(\frac{d_iC_i}{T}\right)^2\left(\frac{T}{N_i^*}-1\right)\right\}+\ E_i\left\{\left(\frac{d_iC_i}{T}-\bar{\bar{X}}\right)^2\right\}=E_i\left\{\left(\frac{d_iC_i}{T}\right)^2\left(\frac{T}{N_i^*}-1\right)\right\}+var\left(\frac{d_iC_i}{T}\right)$$

$$=\overline{var_T(X_{it})}+\ var\left(\frac{d_iC_i}{T}\right)\approx\ E\left\{\left(\frac{d_iC_i}{T}\right)^2\right\}E\left\{\left(\frac{T}{N_i^*}-1\right)\right\}+\ var\left(\frac{d_iC_i}{T}\right).$$

The coefficient of variance for the cross-section is then

$$CV(X_{it})=\frac{\sqrt{E\left(X_{it}-\bar{\bar{X}}\right)^2}}{\bar{\bar{X}}}=\frac{\sqrt{var\left(\frac{d_iC_i}{T}\right)+\overline{var_T(X_{it})}}}{E\left(\frac{d_iC_i}{T}\right)}$$

$$=\sqrt{\frac{var\left(\frac{d_iC_i}{T}\right)}{\left[E\left(\frac{d_iC_i}{T}\right)\right]^2}+\frac{\overline{var_T(X_{it})}}{\left[E\left(\frac{d_iC_i}{T}\right)\right]^2}}=\sqrt{CV(\bar{X}_i)^2+\frac{\overline{var_T(X_{it})}}{\left[E\left(\frac{d_iC_i}{T}\right)\right]^2}}$$

$$\approx\sqrt{CV(\bar{X}_i)^2+\frac{E\left\{\left(\frac{d_iC_i}{T}\right)^2\right\}E\left\{\left(\frac{T}{N_i^*}-1\right)\right\}}{\left[E\left(\frac{d_iC_i}{T}\right)\right]^2}}=\sqrt{CV(\bar{X}_i)^2+\frac{E\left\{\left(\frac{d_iC_i}{T}\right)^2\right\}}{\left[E\left(\frac{d_iC_i}{T}\right)\right]^2}*\overline{CV_T}^2}$$

$$= \sqrt{CV(\bar{X}_i)^2 + \frac{E\left\{\left(\frac{d_i C_i}{T}\right)^2\right\} - \left[E\left(\frac{d_i C_i}{T}\right)\right]^2 + \left[E\left(\frac{d_i C_i}{T}\right)\right]^2}{\left[E\left(\frac{d_i C_i}{T}\right)\right]^2} \overline{CV_T}^2}$$

$$= \sqrt{CV(\bar{X}_i)^2 + \frac{var\left(\frac{d_i C_i}{T}\right) + \left[E\left(\frac{d_i C_i}{T}\right)\right]^2}{\left[E\left(\frac{d_i C_i}{T}\right)\right]^2} \overline{CV_T}^2}$$

$$= \sqrt{CV(\bar{X}_i)^2 + (CV(\bar{X}_i)^2 + 1)\overline{CV_T}^2} = CV(\bar{X}_i)\sqrt{1 + \left(\frac{1}{CV(\bar{X}_i)^2} + 1\right)\overline{CV_T}^2}$$

where $CV(\bar{X}_i)$ is the cross-sectional CV if there is not shopping heterogeneity (i.e. households spend the same amount every week). Note that while deriving this formula, we used only N_i^* without specifying what parameter (e.g., δ, d, F, β) determines it. Thus, our formula holds under general conditions that allow a variety of functional forms and parameter values.