Impact of Design Changes on Economic Analyses Project

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Executive Summary

The Impact of Design Changes on Economic Analysis Project (EAP) for the Consumer Expenditure Surveys is a research project conducted by the Office of Survey Methods Research (OSMR) and the Division of Consumer Expenditure Survey (DCES) of the Bureau of Labor Statistics (BLS). In this project, we analyzed various statistical models in economic analysis under a simple random subsample condition. The simple random subsample condition is akin to implementing a split questionnaire design. We selected the first quarter of Consumer Expenditure Survey (CE) 2011 Phase III data (CEQ 2011 Q1) data for this study.

The primary objective of this research is to identify specific sensitivities of the economic models when utilizing a simple random subsample to conduct the various economic analyses. The basic question is: are there particular parameters of the economic models that are compromised?

We want to evaluate the numerical impact of a simple random subsample condition on various economic analyses. To explore economic analyses of varying sophistication (basic, medium, refined and advanced models approved and/or chosen by stakeholders), we consider descriptive statistics, regression analysis, generalized logistic regression, two-stage analysis, and hierarchical modeling to identify potential sensitivities in these analyses. Recommendations are then provided for design changes and statistical methods in collecting and analyzing the CE data.

The analysis results indicate specific sensitivities in the following:

1. First, in simple univariate statistics estimation (e.g. means, percentages and standard errors or SE):
   (a) For household demographic variables, the simple random subsample produces similar demographic estimates in terms of percentage and mean as compared to the full sample, with larger SE;

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(b) For household expenditures on children, the simple random subsample produces different expenditure estimates on children in term of the mean as compared to the full sample, and generally larger SE (with a few exceptions).

2. Second, in linear regression and generalized logistic regression models, the simple random subsample produces different coefficient estimates and generally higher SE as compared to the full sample. However, the SE for some of the coefficients from the simple random subsample are smaller than the full sample.
3. Third, in a two-stage regressions Cragg's model, we found that:
   (a) The simple random subsample produces close first stage estimates, such as probability of purchase and predicted expenditure (buyers only), as compared to the full sample;
   (b) the second stage estimates, such as marginal propensity to consume and elasticity, from the simple random subsample deviate from the full sample.
4. Finally, in a two-stage Cragg's model using generalized linear mixed regressions to account for geographical region variations, we found that:
   (a) For first stage estimates, the simple random subsample produces estimates of the purchase probabilities that were close to the full sample estimates, but produces no consistent trends for predicted expenditures (buyers only), i.e. sometimes higher, sometimes lower than the full sample;
   (b) The second stage estimates, marginal propensities to consume and elasticities, from the simple random subsample deviate from the full sample; and
   (c) Compared to the classic two-stage Cragg's, the two-stage hierarchical generalized linear mixed Cragg's model generally produces higher probabilities of purchase and elasticity estimates.

To improve the estimation precision of marginal propensity to consume and elasticity under simple random sampling without replacement subsample (SRSWORSS) with a 0.5 probability of selection, we also recommend preliminary steps:

1. First, oversample groups that might result in small effective sample sizes due to the subsampling;
2. Second, implement a dynamic interview, in which groups are identified during an initial phase of data collection and oversample those groups in a subsequent phase, then apply modified weights to the data in the subsequent process to produce valid official estimates;
3. Third, consider pooling extra quarters of data to offset the individual quarterly impact;
4. In addition, apply bootstrap methodology as an option with a large number of simple random subsamples to obtain stable variance estimators with sufficient degrees of freedom and stable second stage estimates;
5. Finally, consider implementing a hierarchical model with random components as an alternative approach for a complex CE data.

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1 Introduction

The Division of Consumer Expenditure Survey (DCES) has been conducting redesign research activities for the Consumer Expenditure (CE) Surveys under the Gemini Project since 2009. The primary goal of the Gemini Project is to redesign the CE Surveys to improve data quality, through a verifiable reduction in measurement error, while not inducing extra burden on survey respondents. A key input to the redesign was proposed by Gonzalez et al. (2009). They recommended adopting a multidimensional definition of data quality based on the Total Quality Management (Brackstone, 1999) and Total Survey Error (Groves et al., 2004) paradigms, denoted as TQM and TSE, respectively. These paradigms help to characterize the quality of CE data products[1] while incorporating the needs of primary data users. Henderson et al. (2010) expanded on the multidimensional definition of data quality by summarizing the specific needs and issues of the CE data users' community.

There are diverse applications and uses of CE data products. Data users from other federal agencies, academic and research organizations, and congressional leaders conduct numerous and diverse economic analyses from CE data products. For instance, the Consumer Price Index (CPI) program is interested in obtaining detailed expenditure and demographic information for US consumer units, market basket of goods and services and their relative importance. The Department of Defense (DOD) uses CE quarterly expenditure estimates to adjust the cost of living for military personnel. Bureau of Economic Analysis (BEA) uses CE data for benchmarking, annual growth rates, and National Income and Product Accounts (NIPA). More broadly, other researchers use CE data to study consumer behavior. Regardless of the type of economic analysis, a variety of statistical models have been applied to CE data products to meet the needs of each individual data user. These include, but are not limited to, descriptive statistics, regression analysis, generalized logistic regression, two-stage analysis, and hierarchical modeling.

Staff from the Office of Survey Methods Research has been conducting a numerical evaluation of the impact of a simple random subsample condition on these types of economic analyses. This process is a crucial step in understanding how data users and their respective economic analyses might be affected by a simple random subsample condition. Going through the exercise of conducting these economic analyses under that condition will allow us to learn about the process of assessing the impact of a simple random subsample condition on data users. Furthermore, the outputs of this process will inform other DCES teams and provide beneficial inputs to the CE redesign.

[1] We use the phrase "data product" to refer to any product produced by the DCES and disseminated to the public or other entity. These include, but are not limited to, the full microdata CDs and the published tables.

The Impact of Design Changes on Economic Analyses Project (EAP) will explore economic analyses of varying sophistication (basic, medium, refined and advanced models approved and/or chosen by stakeholders). The EAP will address the numerical impact of how those economic analyses will be affected under a simple random subsample condition. The simple random subsample condition is akin to implementing a split questionnaire design (see Raghunathan and Grizzle 1995 for a definition of split questionnaire designs). The primary research objective is: What are the specific sensitivities (e.g., are there particular parameters of the economic models that are compromised?) of utilizing a simple random subsample to conduct the various economic analyses?

This document is the final deliverable in a series for the Impact of Design Changes on Economic Analyses Project. The purpose of this document is to summarize literature that used CE data to study different economic phenomena, to replicate and summarize the results of various economic analyses under a simple random subsample condition with a 0.5 probability of selection. In addition, we characterize potential sensitivities in the differences found in these analyses under simple random subsample condition. Based on these differences and sensitivities, we then provide preliminary recommendations for general changes to the design and statistical methods used to collect and analyze the CE data.

The organization of the paper is the following: In Section Two, we will provide a literature review of publications that used CE data to study different economic phenomena. In Section Three, we will describe the data set obtained for the analyses.In Section Four, we will provide the basic analysis of simple univariate statistics estimation such as means, standard errors (SE). In Section Five, we will provide the medium analysis of logistic and linear regression model coefficients and their associated SE. In Section Six, we will provide the refined analysis of two-stage regression models to compute probabilities of purchase, predicted expenditures (buyers only), marginal propensities to consume (MPC) and elasticities. In Section Seven, we will provide the advanced analysis of two-stage hierarchical generalized linear mixed models (HGLMM) that account for the variation among geographical regions to compute purchase probabilities, predicted expenditures (buyers only), MPC and elasticities. In Section Eight, we will summarize the major findings from those economic analyses, and conclude with preliminary recommendations for general changes to the design and statistical methods used to collect and analyze the CE data.

2 Literature Reviews

CE data products have been examined in different contexts, such as spending patterns, life cycle analysis, poverty, demographic subsets, savings and assets, etc. For example, life cycle is generally referred to as a period reflecting different generations of consumers according to their ages.

The life cycle hypothesis assumes that consumer unit (CU) or household expenditures change by their life cycle, and age is found to be an important factor in spending pattern of consumer expenditures. There are some types of expenditures that are considered essential for survival, e.g. housing, basic food and clothing; other types are considered optional, e.g. leisure and education. The DCES Branch of Information and Analysis (BIA) has been documenting research papers of economic analyses using CE data. In terms of total expenditure, household type has an impact on financial resources distribution (Lino 1998 pp. 12 third paragraph, cited in Omori 2010 pp. 4 right column last paragraph). However, higher income level does not always result in higher expenditure levels (Paulin and Lee 2002 Table 3, pp. 23 left column first paragraph, cited in Omori 2010 pp. 4 left column fourth paragraph). This section reviews literature referenced by BIA, among different expenditure types in education, food, medical and health care, demographics, assets and energy.

2.1 Education

Omori (2010) reviewed education expenditures and found literature suggesting disadvantages of single-parent households, especially for single-mother households, they have lower likelihood of high school graduation, higher likelihood of unsatisfactory grades, lower economical support and more social behavioral problem as compared to two-parent households (McLanahan and Sandefur 1994, Powell et al. 2006). Other literature indicated that higher income parents allocate more resources to their children than lower income parents. Omori (2010) then studied education expenditures and found that single-mother CUs have higher probability of education expenditure than married-couple CUs; higher income CUs have higher probability of children's education expenditure than lower income CUs; African and Hispanic CUs have lower probability of education expenditure than White CUs; the probability of education expenditure increases as number of children increase; single-parent CUs have higher probability of entertainment expenditure than married-couple CUs; higher income, educational attainment and occupation level are all associated with higher probability of entertainment expenditure. The major influences on children's education expenditure are household income, educational attainment and occupation level, not marital status or household type.

2.2 Food

Fan et al (2007) applied cluster analysis on CE data to classify consumers into eight groups based on food expenditure patterns. They are: (1)balanced, (2) full-service-dominated, (3) fast-food-dominated, (4) meat-eater, (5) miscellaneous-food-dominated, (6) alcohol-dominated, (7) beverages-dominated, and, (8) food-at-work-dominated. The full-service, fast-food and food-at-work dominated groups are considered as the food away from home (FAFH) dominated group. They found that higher working hours and lower income-to-needs ratio are associated with higher probability

of being in the FAFH group. Younger consumers have a higher probability of being in fast-food-dominated group as compared to older consumers; single-men consumers have a higher probability of being in the alcohol group than married consumers; Blacks and Hispanic consumers have a higher probability of being in the meat-eater group as compared to White consumers. Zan et al (2010) found that younger cohorts of consumers spend more on food away from home than older cohorts, and these cohort effects are likely due to dinning and food preferences shift among generations. U.S. consumers are likely to continue spending more on their food away from home expenditures. Those analyses on consumer food expenditures would inform the decision making of certain nutritional education and prevention.

2.3 Medical and Health Care

Hong and Kim (2000) investigated medical expenditure and found that household health insurance coverage, liquidity, "life cycle stage, household size, self-employment status" and educational attainment all have influences on health care expenditures. More single person and single parent families are uninsured. Families with children have higher health care expenditure than couples with no children. Medicaid enrollment probably reflects smaller health care expenditure of single parent households than others. The older population has the highest financial burden compared to other groups across life cycle stages. Older people with needs of nursing homes tend to support federal subsidy programs. Families who have higher unearned incomes spend more on health care than lower level unearned income families. Self-employed people spend more on health care with high premiums and higher deductibles, and consequently, they become more likely not to purchase health insurance.

Health care expenditures are an important part of the household budget. U.S. households have been increasing their health care expenditures and elderly households have been spending a larger share of overall budget on health care than other households (BLS 2011 2(12) and 2011 1(8)). Medical expenditures comprise a larger budget share for low income households. In 2001, Census proposed "medical out-of-pocket expenses subtracted from income (MSI) and medical out-of-pocket expenditures (added) in the threshold (MIT)" as alternative poverty measures. Short and Garner (2002) compared MSI and MIT to official U.S. poverty measures. They suggested that these alternative poverty measures can be used to assess the depth of impoverished subpopulation's economic hardships and can be used to evaluate the effectiveness of government programs which provide tax incentives and transfers ("redistribution effect") to those households. As for Medicare households, it has been observed that the prescription drugs expenditure and its share in the overall health care budget were lower after the implementation of Medicare Part D (BLS 2011 2(8)).

2.4 Demographics

It has been indicated that consumer expenditures are associated with CU characteristics, such as race, occupation, and age of the household head, and are also affected by their socioeconomic class, demographics and residential location (Omori, 2010). Paulin (2008) studied generational demographics. He found that comparing to 1984-1985 generation, the later generation of 2004-2005 of single young adults has higher educational attainment and proportion of home ownership, spends a smaller share on food away from home, and spends a larger share on food at home and on housing, which is a sign of living along (Paulin 2008 pp. 35 left column second paragraph, right column first paragraph). The economic situation of the later generation of single young adults may not improve, but it does not decline. Another publication has shown that sharing expenses by young married couples does not cut costs to one person level; they do spend less per person than singles. However, they have higher per-person expenditure on transportation, health care, personal insurance and pensions than singles (BLS 2011 2(4)).

2.5 Assets

Melzer (2010) studied the impact of mortgage and debt on household expenditures and found that a substantial portion of homeowners decrease expenses on their homes due to the prospect of default. Homeowners with negative equity ("underwater") decreased their expenses on mortgage principal payments, home improvements and maintenance expenditures, by approximately 30%, regardless of their financial stress in terms of higher income, liquidity and borrowing capacity. In contrast, no change has been found on household expenditures for vehicles, furniture and appliances (non-home-related). Negative equity homeowners decreased more mortgage principal payments in non-recourse states than in recourse states where creditors were allowed to repossess homeowners' other properties as the collateral could not cover the mortgage balance. The mortgage principal reduction policy seems to encourage underwater homeowners paying their mortgage principal and investing in their properties by recovering homes' positive equity.

2.6 Energy

The CE estimates of energy expenditures has been compared to the Residential Energy Consumption Survey (RECS), sponsored by the Energy Information Administration (EIA) of the U.S. Department of Energy (BLS 2010 1(12)). Abbot (2008) conducted a regional in-depth study and found that the Southern region of the U.S. spent a smaller proportion of total expenditures on energy in 2006 as compared to 1984, a similar pattern was observed at national level and other regions. However, the South spent the largest proportion of total expenditure on energy among other regions. The Southern region had increased its electricity consumption two times when comparing to the electricity prices increase in the South. He suggested that more expenses are

expected to be transferred from non-energy transportation to energy-oriented transportation, e.g. consumers would spend more on gasoline and mass transit at the expense of shopping for cars, auto insurance and financing.

Ethridge (2009) found that the steady increase in the proportion of gasoline expenditures over total expenditures has helped to curtail the vehicle purchase expenditures during 2003-2007. Nevertheless, overall transportation expenditures did not appear to affect the spending pattern of other expenditure categories. In 2010, Gicheva et al found that the gasoline prices shock had a significant impact on consumer price sensitivity (CPS) in retail grocery spending pattern. As a consequence, consumers adapted lower price products replacement to absorb the short term income shock caused by fuel costs spike, and their primary strategy was shopping on sale items. They suggested that the gasoline prices shock might further influence CPS in terms of broader supply, demand and product expenses.

2.7 Summary

In general, CE data products have been applied for a variety of economic analyses with diverse research interests. The variaty of expenditure variables had been studied but not limited to: food, medical, health care, utility and income before tax (for income-to-poverty-threshold ratio), education, entertainment, books, children's apparel, etc. Those economic analyses also include socioeconomic and demographic characteristic variables: for member level, using reference person's record of Age (years), Sex (Male, Female), Race, Education attainment, Employment status and Occupation level; for CU level, using Geographic region (Northeast, Midwest, South, and West), Household type (married couple, single mother, single father and Cohabiting, etc.) and Household tenure (homeowner, renter). Table 1 provides the level of analyses, methods and variables for each of the different types of expenditure categories identified in the reviewed literature.

Next, we will use the 2011 first quarter CE interview data to conduct the various economic analyses in the following sections.

3 Data set construction

The analyses we replicated reflects the focus of Omori (2010) – household spending patterns for children. Previous literature suggested that there is an association between allocating resources to children and household income level (Omori 2010). So it is an important topic to study because it may have many economic and policy implications. As a preliminary and ancillary analysis tool, we provide a boxplot of income before tax by number of members in the CU in Figure 1 below. For reference, we also provide the poverty threshold for each family size (represented by a closed

circle). This graphic is useful for illustrating the overall CU incomes in CE data.

Omori (2010) pooled 2007 and 2008 CEQ public-use micro data for her analysis. She excluded CUs with missing values for demographic and expenditure variables on children (apparel, education, books and entertainment), as well as CUs with children all above 18 years old. Expenditures on gifts or for non-CU children were also excluded. She pointed out a caveat in her analysis: the current CE is structured to collect certain expenditures at the CU-level (e.g. entertainment), so it is impossible to identify whether an expenditure incurred by the CU was for a child 18 years old, or under or for the parents, etc.

To replicate the analyses, we selected the first quarter of 2011 CEQ Phase III data (denoted as, CEQ 2011 Q1). This yielded an initial sample size of 6,869 CUs. Consistent with Omori (2010), we subset these 6,869 CUs by excluding those with missing values for demographic and expenditure variables, CUs with children all above 18 years old, and expenditures on gift or for non-CU children. The final sample used for our analysis contains 2,262 CUs. Under the simple random sampling without replacement (with a 0.5 probability of selection) subsample (SRSWORSS) condition, we obtain a total of 1,131 CUs.

3.1 Discrepancies in variable definitions and limitations of the data source

In Table 2 below, we describe the components of the expenditure variables used in our analysis and offer comparisons to the definitions of these expenditure categories used in Omori (2010). Specifically, we listed the expenditure variable names, definitions provided by Omori (2010), how we constructed each variable using CEQ 2011 Q1 (including codes from CEQ dictionary) and the corresponding data file names from which the variables are contained.

In conducting the economic analyses, we acknowledge the following limitations on our data:

3.1.1 Variable definitions

We have tried as close as possible to construct the demographic variables and expenditures on children in a similar fashion to Omori (2010). However, there is some lack of documentation and ambiguity in her article on how those variables were defined and how the subsetting of data occurred. These issues might lead to discrepancies in the two data sources. Two examples are provided in the following:

1. Educational attainment in Omori (2010) Table 1 could be defined as the highest level achieved of education for the CU's reference person and as a consequence, the High School (HS) category may include persons with some college education, but no degree.

2. Occupation level was not specified with details of categorical components in Omori (2010). From the CEQ dictionary for this data, we define the occupational category "Managerial/professional" as professional, administrator, manager, either self-employed or salaried (POCC_REF = 101, 120, 201, 220) and define "Administrative" as administrative support including clerical, either self-employed or salaried (POCC_REF = 108, 208).

3.1.2 Differences in data sources

Differences in sample size, time periods, and duration between the two data sets might also contribute to the discrepancies in demographics and expenditure estimates (e.g. means, SE) on children. For example, spending patterns prior to the economic downturn experienced in late 2008 might result in differences in the spending patterns reflected in our data source because it was constructed using 2011 data.

3.1.3 Other discrepancies and and limitations

Total and ratio estimates were not provided in Omori (2010) Table 1. Even if they were, we expect similar differences and/or discrepancies due to (but not limited to) the factors described above (e.g. discrepancies in the time periods of the two data sources).

3.2 Description of expenditure variables comparing to Omori (2010): Table 2

4 Basic analysis

The purpose of this section is two-fold. First, we sought to replicate a key "basic" analysis under a simple random subsample condition with a 0.5 probability of selection. For the purpose of this research, we define a basic analysis as the lowest level of statistical sophistication which includes the calculation of simple univariate statistics such as means, standard errors (SE). In this analysis, we chose to replicate Omori (2010) Table 1: Descriptive statistics of households with children, Consumer Expenditure Interview Survey, 2007-08.

The second purpose is to characterize potential sensitivities in the differences found in this analysis under simple random subsample condition. Based on these differences and sensitivities, we provide preliminary recommendations for changes to the design and statistical methods used to collect and analyze the CE data in Section Eight.

Omori (2010) examined household expenditures on children using Consumer Expenditure Interview Survey (CEQ) 2007-2008 data. She concluded that the major influences on children's education expenditure were household's income, educational attainment and occupation level, but

not on marital status or household type.

4.1 Basic demographic and expenditure estimates: Table 3

The unweighted categorization of family type using the CEQ 2011 Q1 sample of 2,262 CUs with children 18 years old or under contains 1,574 married couple CUs, 336 single mother CUs, 59 single father CUs, and 293 cohabiting (or other family type) CUs. The unweighted family type categorization of the SRSWORSS of 1,131 CUs with children 18 years old or under contains 786 married couple CUs, 175 single mother CUs, 24 single father CUs, and 146 cohabiting CUs. In Table 3, we offer comparisons of the expenditure estimates on children and demographic characteristics derived from the following: (1) CEQ 2011 Q1 sample; (2) the SRSWORSS condition. Our primary goal is to observe the numerical impact of SRSWORSS condition. We take into account the final weight ("FINLWT21" in CE dictionary) from CE production for all estimates including mean, percentage, SE and 95% confident interval (CI) in Table 3. In addition, for SRSWORSS, the final weight is also adjusted by the subsample selection probability.

From Table 3, we identify certain differences (or "sensitivities") and similarities under the SRSWORSS condition. We describe those findings in the following statements:

4.1.1 Demographics

Demographic descriptive statistics are not different (or "sensitive") for most cases in terms of percentage and mean. The SRSWORSS demographic estimates remain similar to those in the full sample (CEQ 2011 Q1), with wider 95% CIs reflecting the larger SE. This is an expected finding since we have subsampled with 0.5 probability of selection. The exception to this trend is from the single father group. This is likely due to the small initial sample size of this group and the subsequent subsampling.

4.1.2 Expenditures on children

Expenditures on children are different in terms of means and SE. Specifically, Household children's expenditure means under the SRSWORSS condition are different than the means computed from the full sample, with wider 95% CIs which indicate larger SE (e.g. children's education expenditure of married couple and children's apparel expenditure of single mother). However, there are a few exceptions, SE of married couple's entertainment expenditures and single mother's education expenditures on children decreased under SRSWORSS condition, SE of single mother's books expenditures and cohabiting CUs education expenditures on children remained similar under SRSWORSS condition. Potential contributing factors could be: (1) temporal differences (or seasonal fluctuation) between the various data sources; (2) the weighting adjustment used in the

analysis; (3) sample sizes of those groups and the subsequent subsampling. For the single father group, large SE associated with means of children's education and apparel expenditures produce negative lower bounds for their respective 95% CIs. It is worth noting that there are a few situations in which the SE under the SRSWORSS condition decreased or remained unchanged when compared to the full sample. We conjecture that these may be outliers or simply anomalies from only drawing one subsample. One way to verify this conjecture would be to draw repeated subsamples and then calculate the empirical SE from multiple subsamples.

4.2 Summary

We found that the simple random subsample produces similar demographic estimates in terms of percentage and mean as compared to the full sample, with larger SE. One exception is the single father group which is likely due to the small initial sample size of this group and the subsequent subsampling. The simple random subsample produces different expenditure estimates on children in terms of means and SE as compared to the full sample, with larger SE.

5 Medium analysis

The purpose of this section is two-fold. First, we sought to replicate and summarize the results of a key "medium" analysis under a simple random subsample condition with a 0.5 probability of selection. For the purpose of this research, we define a medium analysis as the middle (above "basic" in Section Four) level of statistical sophistication such as analyzing logistic and linear regression model coefficient and their associated standard errors (SE). The medium analysis may also include variable transformations such as the natural logarithm (to insure model assumptions are met).

In this analysis, we replicate the following tables from Omori (2010):

1. Table 2: Logistic regression results: likelihood of expenditures on items in selected categories, Consumer Expenditure Interview Survey, 2007–08;
2. Table 3: Ordinary least squares regression results: estimates of (the natural logarithm of) quarterly expenditures on items in selected categories, Consumer Expenditure Interview Survey, 2007–08; and
3. Table A-1: Selected original and logarithmic statistics for expenditures discussed in the text.

The second purpose is to characterize potential sensitivities in the differences found in this analysis under simple random subsample condition. Based on these differences and sensitivities, we provide preliminary recommendations for changes to the design and statistical methods used

to collect and analyze the CE data in Section Eight. Omori (2010) examined household expenditures on children using Consumer Expenditure Interview Survey (CEQ) 2007–2008 data. We documented her research conclusions as references in Yang and Gonzalez (2012a).

5.1 Model specifications

Omori (2010) utilized weighted logistic regression models to estimate the odds ratio (OR) of households' reporting nonzero expenditures on children. The weight used was the final weight ("FINLWT21" in CE dictionary) from production. She also applied the same weights to a series of weighted linear regression models to analyze the households' log expenditures on children by only using households reporting nonzero expenditures on children.

For each of the four expenditure categories (education, entertainment, books, and apparel), the outcome variable of the logistic regression model is whether a household reported a nonzero expenditure on children, and the outcome variable of the linear regression model is the category-specific nonzero expenditure on children. Both logistic and linear regression models use the same set of socioeconomic and demographic characteristic covariates: household type, income percentile, education attainment, occupation level, ethnicity, number of children in the household between age 0 and 5, between age 6 and 12, between age 13 and 18, and geographic region.

In this analysis, we offer comparisons of logistic and linear regression models between the CEQ 2011 Q1 sample and the SRSWORSS condition. We take into account the final weight ("FINLWT21") for logistic regression estimates including odds ratios and 95% confident intervals (CIs), and for linear regression estimates including coefficients and their associated SE.

5.2 Comparing the Standard deviations (SD), Skewness and Kurtosis: original and log scale

Omori (2010) indicated that the sampling distributions of all four expenditure categories (education, entertainment, books and apparel) were skewed, so she adopted the logarithm transformation on nonzero expenditures for those categories. We provided Table 4 below to compare the SD, Skewness and Kurtosis between the original and log scales among different data sources. For reference, we also provide a boxplot of nonzero expenditures on children for four expenditure categories in Figure 2.

Table 4 shows that the SD under the SRSWORSS condition on the original scale are generally larger than those of the full sample. However, for entertainment nonzero expenditures on children, the original SD from the SRSWORSS condition is smaller than that of the full sample. This

is probably due to the fact that the full sample contains six households which spent from above $10,000 to $40,000 on entertainment. For nonzero expenditures on children's books, the original SD from the SRSWORSS condition decreased when compared to the full sample. These may be outliers or simply anomalies from the first quarter of 2011 CEQ data. These can be assessed via simulation techniques.

5.3 Comparing the logistic regression results for reporting nonzero expenditures on children

In Table 5 we compare the various logistic regression results for reporting nonzero expenditures on children. In this table, we use *wt* to denote weighted analyses using the final weight variable "FINLWT21." From Table 5, we identify differences (or "sensitivities") under the SRSWORSS condition in the following. The OR estimates of reporting nonzero expenditures on children's education, entertainment, books, and apparel are different than those from the full sample. The 95% CIs associated with these OR estimates under the SRSWORSS condition are generally wider than those from the full sample. These 95% CIs do not overlap between the SRSWORSS condition and the full sample. This pattern is consistent across all four expenditure categories for this particular one subsample. Except for income percentile where the SRSWORSS produces similar estimates and 95% CI as the full sample.

5.4 Comparing the linear regression results for nonzero expenditures on children

In Table 6 we compare the linear regression results for nonzero expenditures on children. From Table 6, we identify certain differences (or "sensitivities") and similarities under the SRSWORSS condition. We describe these findings as follows:

5.4.1 Under the SRSWORSS condition

In general, the regression coefficient estimates of nonzero log expenditures on children's education, entertainment, books, and apparel are different than those from the full sample. The SE of these coefficient estimates under the SRSWORSS condition are wider than those from the full sample.

5.4.2 Reduced SE under the SRSWORSS

However, it is worth noting that for children's education and books expenditure, the SE of income percentile under the SRSWORSS condition remains similar when compared to the full sample.

5.4.3 Potential contributing factors for the discrepancies could be:

1. temporal differences (or seasonal fluctuation) between the various data sources;
2. the weighting adjustment used in the analysis; and
3. sample sizes of those data sources and the subsequent subsampling.

We conjecture that these may be outliers or simply anomalies from only drawing one subsample. One way to verify this conjecture would be to draw repeated subsamples and then calculate the empirical SE from multiple subsamples.

5.5 Summary

We found that (1) the simple random subsample produces different coefficient estimates and generally higher SE as compared to the full sample; and, (2) the simple random subsample produces a few coefficients SE are smaller than the full sample.

6 Refined analysis

The purpose of this section is two-fold. First, we sought to replicate and summarize the results of a key "refined" analysis under a simple random subsample condition with a 0.5 probability of selection. For the purpose of this research, we define a refined analysis as a statistical analysis that employs sophisticated theory and/or methods to explain various phenomena such as the advanced (above "medium" in Section Five) level of statistical sophistication. For example, implementing two-stage regression models, e.g. Cragg's model to compute probability of purchase, predicted expenditure (buyers only), marginal propensity to consume (MPC) and elasticity. The refined analysis may also include variable transformations such as the natural logarithm (to insure model assumptions are met).

We had originally planned to extend Omori's research (presented in Section Five) using a refined analysis, but her research did not apply a refined model, such as a two-stage regressions model, like Cragg's model. Paulin and Duly (2002) evaluate the influence of retirement on spending in terms of marginal propensity to consume and elasticity. Here, marginal propensity to consume is defined as "the change in expenditure given a unit change in income"and income elasticity is defined as "the percent change in expenditure for a specific good given a 1-percent increase in income." Thus in this analysis, we replicate the following tables from Paulin and Duly (2002 pp. 57 left column first paragraph, right column last paragraph):

1. Table 5: Number of observations for ordinary least squares regressions; and

2. Table 7: Elasticities, and so forth under "ceteris paribus".

The second purpose is to characterize potential sensitivities in the differences found in this analysis under simple random subsample condition. Based on these differences and sensitivities, we provide preliminary recommendations for changes to the design and statistical methods used to collect and analyze the CE data in Section Eight.

6.1 Data set construction for Cragg's model

The data set we used for this analysis was constructed in a similar fashion as the data set we used for replicating Omori's (2010) analysis which reflects the focus of household spending patterns for children (Yang and Gonzalez 2012a, b). This was because we wanted the procedure of our analyses from basic to the highest level of sophistication to be as consistent as possible. Also, Paulin and Duly (2002) data could not be compiled for this analysis to be completed as planned. In this analysis, we selected the first quarter of 2011 CEQ Phase III data (denoted as, CEQ 2011 Q1). This yielded an initial sample size of 6,869 CUs. Consistent with Omori (2010), we subset these 6,869 CUs by excluding those with missing values for demographic and expenditure variables, CUs with children all above 18 years old, and expenditures on gift or for non-CU children. In addition, to meet the requirement of two-stage Cragg's regressions model implemented in Paulin and Duly (2002), we further exclude CUs with non-positive annual income. The final sample used for our analysis contains 1,977 CUs. Under the simple random sampling without replacement (with a 0.5 probability of selection) subsample (SRSWORSS) condition, we obtained a total of 988 CUs (Table 1). For reference, we also described discrepancies in variable definitions and limitations of the data source in Section Three.

6.2 Model specifications

Similar to Paulin and Duly (2002), we compare the estimated averages of probability of purchase, predicted expenditure (buyers only), marginal propensity to consume and elasticity for each of the married couple, single mother, single father and cohabiting household type groups. In the first stage analysis, we implement unweighted logistic regression and ordinary least squares models to obtain probability of purchase and predicted expenditure (buyers only). For each of the four expenditure categories (education, entertainment, books, and apparel), the outcome variable of the logistic regression model is whether a household reported a nonzero expenditure on children, and the outcome variable of the linear regression model is the natural log of category-specific nonzero expenditure on children. Both logistic and linear regression models use the same set of socioeconomic and demographic characteristic covariates: household income natural logarithm, education attainment, occupation level, ethnicity, number of children in the household between

age 0 and 5, between age 6 and 12, between age 13 and 18, and geographic region. See Paulin and Duly (2002) Appendix B for computational details.

6.3 Comparing the Cragg's model results for children's expenditures

In Table 8 we compare the linear regression results for nonzero expenditures on children. From Table 8, we identify certain differences (or "sensitivities") and similarities under the full sample and SRSWORSS condition. We describe these findings as follows:

6.3.1 First stage estimates

The simple random subsample produces close results for probability of purchase and predicted expenditure (buyers only), as compared to the full sample.

6.3.2 Second stage estimates

Marginal propensity to consume and elasticity from the simple random subsample deviate from the full sample. We conjecture that these may simply be anomalies from only drawing one subsample. One way to verify this conjecture would be to draw repeated subsamples and then calculate the empirical averages from multiple subsamples.

6.3.3 Small groups

Due to the small samples in the single father and cohabiting group, the Cragg's model estimates seem unreliable for both the full sample and simple random subsample. As evident from Paulin and Duly (2002) Appendix B. (pp. 57-58), the negative coefficient estimates from logistic regression and ordinary least squares regression may produce a negative estimate of marginal propensity to consume, and lead to a negative income elasticity of demand which is associated with an inferior good (whose demand reduces as consumer income increases).

6.4 Summary

We found that (1) the simple random subsample produces close first stage estimates, such as probability of purchase and predicted expenditure (buyers only), as compared to the full sample; (2) the second stage estimates, such as marginal propensity to consume and elasticity, from the simple random subsample deviate from the full sample.

7 Advanced analysis

The purpose of this section is two-fold. First, we sought to replicate and summarize the results of a key "advanced" analysis under a simple random subsample condition with a 0.5 probability of selection. Heeringa et al (2010) categorizes generalized linear mixed models (GLMM) as an advanced modeling topic (one of the highest levels of statistical sophistication presented in the textbook). For the purposes of this research, we define an advanced analysis as a statistical analysis that employs highly sophisticated theory and/or methods to explain various phenomena (above "refined" in Section Six). There is a desire from DCES to apply a more sophisticated model to analyze consumer's marginal propensities to consume (MPC), and elasticities (Henderson 2012). One example of an advanced analysis is utilizing two-stage hierarchical generalized linear mixed models (HGLMM) that account for the variation among geographical regions to compute purchase probabilities, predicted expenditures (buyers only), marginal propensities to consume, and elasticities. This analysis may also include variable transformations such as the natural logarithm (to insure model assumptions are met).

We had originally planned to extend Omori's research (presented in Section Five) using an advanced analysis, but her research did not apply an advanced model, such as a two-stage Cragg's model using generalized linear mixed regressions to account for geographical region variations. Therefore, we chose to extend the research of Paulin and Duly (2002) in which they evaluated the influence of retirement on spending in terms of marginal propensity to consume and elasticity by using logistic regression and ordinary least squares models. In their research, marginal propensity to consume is defined as "the change in expenditure given a unit change in income"and income elasticity is defined as "the percent change in expenditure for a specific good given a 1-percent increase in income." In this analysis, we replicate Table 7: Elasticities, and so forth under "ceteris paribus" from Paulin and Duly (2002) using an HGLMM approach. The number of observations and number of reporting expenditures by household types remain the same as reported in Table 8 of Section Six (replicate of Table 5 in Paulin and Duly 2002).

The second purpose is to characterize potential sensitivities in the differences found in this analysis under simple random subsample condition. For example, would some particular parameter estimates of the models be changed after utilizing a simple random subsample to conduct the various economic analyses? Based on these differences and sensitivities, we provide preliminary recommendations for general changes to the design and statistical methods used to collect and analyze the CE data in Section Eight.

7.1 Data set construction for HGLMM Cragg's model

The data set we used for this analysis was constructed in a similar fashion as the data set we used for replicating Omori's (2010) analysis which reflects the focus of household spending patterns for children (Yang and Gonzalez 2012a). This was because we wanted the procedure of our analyses from basic to the highest level of sophistication to be as consistent as possible. And Paulin and Duly (2002) data could not be compiled for this analysis to be completed as planned. In this analysis, we selected the first quarter of 2011 CEQ Phase III data (denoted as, CEQ 2011 Q1). This yielded an initial sample size of 6,869 CUs. Consistent with Omori (2010), we subset these 6,869 CUs by excluding those with missing values for demographic and expenditure variables, CUs with children all above 18 years old, and expenditures on gift or for non-CU children. In addition, to meet the requirement of two-stage Cragg's regression models implemented in Paulin and Duly (2002), we further exclude CUs with non-positive annual income. The final sample used for our analysis contains 1,977 CUs. Under the simple random sampling without replacement (with a 0.5 probability of selection) subsample (SRSWORSS) condition, we obtained a total of 988 CUs (Table 1 in Yang and Gonzalez 2013a). For reference, we also described discrepancies in variable definitions and limitations of the data source in Section Three.

7.2 Model specifications

Similar to Paulin and Duly (2002), we compare the estimated averages of probability of purchase, predicted expenditure (buyers only), marginal propensity to consume and elasticity for each of the married couple, single mother, single father and cohabiting household type groups. In the first stage analysis, to account for the variation among geographical regions, we implement HGLMM logistic regression models to obtain probability of purchase, and HGLMM regression models to obtain predicted expenditure (buyers only). For each of the four expenditure categories (education, entertainment, books, and apparel), the outcome variable of the HGLMM logistic regression model is whether a household reported a nonzero expenditure on children, and the outcome variable of the HGLMM regression model is the natural log of category-specific nonzero expenditure on children. Both HGLMM logistic and regression models use the same set of socioeconomic and demographic characteristic covariates: natural logarithm household income, education attainment, occupation level, ethnicity, number of children in the household between age 0 and 5, between age 6 and 12, between age 13 and 18, and geographic region. See Paulin and Duly (2002) Appendix B for computational details.

7.3 Comparing the HGLMM Cragg's model results for children's expenditures

In Table 9 we compare the HGLMM regression results for nonzero expenditures on children. From Table 9, we identify certain differences (or "sensitivities") and similarities under the full

sample and SRSWORSS condition. We describe these findings as follows:

7.3.1 First stage estimates

The simple random subsample produces estimates of the purchase probabilities that were close to the full sample estimates, but provides no consistent trends for predicted expenditures (buyers only), i.e. sometimes higher, sometimes lower than the full sample.

7.3.2 Second stage estimates

Marginal propensity to consume from the simple random subsample deviate from the full sample, more deviations are observed for elasticity. We conjecture that these may simply be anomalies from only drawing one subsample. One way to verify this conjecture would be to draw repeated subsamples and then calculate the empirical averages from multiple subsamples.

7.3.3 Small groups

Due to the small samples in the single father and cohabiting group, the HGLMM Cragg's model estimates seem unreliable for both full sample and simple random subsample. We were not able to produce hierarchical linear mixed model eatimtes of predicted expenditures (buyers only) and second stage estimates for entertainment expenditure on children under the full sample, and for all children's expenditures under the simple random subsample for the single father group. In addition, as evident from by Paulin and Duly (2002) Appendix B. (pp. 57-58), the negative coefficient estimates from HGLMM logistic and regression models may produce a negative estimate of marginal propensity to consume, and lead to a negative income elasticity of demand which is associated with an inferior good (whose demand reduces as consumer income increases).

7.3.4 Impacts of accounting for the variation among geographical regions

The HGLMM Cragg's model generally produces higher probability of purchase and elasticity estimates when taking into account the random variations among U.S. regions of Northeast, South, Midwest and West, as compared to the classic two-stage Cragg's model in refined analysis (Section Six).

7.4 Summary

After accounting for the variation among geographical regions, we found that:

1. for first stage estimates, the simple random subsample produces estimates of the purchase probabilities that were close to the full sample estimates, but produces no consistent trends

for predicted expenditures (buyers only), i.e. sometimes higher, sometimes lower than the full sample;

2. the second stage estimates, marginal propensities to consume and elasticities, from the simple random subsample deviate from the full sample;

3. under the simple random subsample, we were not able to produce hierarchical linear mixed model eatimtes of predicted expenditures (buyers only) and second stage estimates for the single father group due to small sample sizes; and

4. comparing to the classic two-stage Cragg's model in refined analysis (Yang and Gonzalez 2013a), the HGLMM Cragg's model generally produces higher probabilities of purchase and elasticity estimates.

8 Conclusion

8.1 Summary of potential sensitivities from the above economic analyses under a simple random subsample condition

Our primary research objective is to characterize the potential sensitivities (e.g., are there particular parameters of the economic models that are compromised?) of utilizing a simple random subsample to conduct the various economic analyses? I this study, we investigate a series of economic analyses under a simple random subsample condition. The results indicate the following:

1. In simple univariate statistics estimation (e.g. means, percentages and SE), (1) for household demographic variables, the simple random subsample produces similar demographic estimates in terms of percentage and mean as compared to the full sample, with larger SE. The exception is the single father group which is likely due to the small initial sample size of this group and the subsequent subsampling. (2) For household expenditures on children, the simple random subsample produces different expenditure estimates on children in term of the mean as compared to the full sample, and generally larger SE (with a few exceptions).

2. In linear regression and generalized logistic regression models, we found that the simple random subsample produces different coefficient estimates and generally higher SE as compared to the full sample. However, the SE for some of the coefficients from the simple random subsample are smaller than the full sample.

3. In a two-stage regressions Cragg's model, we found that (1) the simple random subsample produces close first stage estimates, such as probability of purchase and predicted expenditure (buyers only), as compared to the full sample; (2) the second stage estimates, such as

marginal propensity to consume and elasticity, from the simple random subsample deviate from the full sample.

4. In a two-stage Cragg's model using generalized linear mixed regressions to account for geographical region variations, we found that:
   (a) For first stage estimates, the simple random subsample produces estimates of the purchase probabilities that were close to the full sample estimates, but produces no consistent trends for predicted expenditures (buyers only), i.e. sometimes higher, sometimes lower than the full sample;
   (b) The second stage estimates, marginal propensities to consume and elasticities, from the simple random subsample deviate from the full sample;
   (c) Under the simple random subsample, we were not able to produce hierarchical linear mixed model estimates of predicted expenditures (buyers only) and second stage estimates for the single father group due to small sample sizes; and
   (d) Compared to the classic two-stage Cragg's model in refined analysis (Yang and Gonzalez 2013a), the HGLMM Cragg's model generally produces higher probabilities of purchase and elasticity estimates.

8.2 Preliminary recommendations for improvement of expenditure estimates precision

Based on the inflation in 95% confidence intervals (CIs) and standard errors (SE), and differences in odds ratio (OR) estimates, coefficient estimates and mean estimates, and the Cragg's model estimates between the CEQ 2011 Q1 and the SRSWORSS, we recommend following preliminary approaches to improve the estimation precision of expenditures, marginal propensity to consume and elasticity under SRSWORSS. We have identified two broad classes of approaches – design-based (denoted as **D**, i.e. modifications to the data collection processes) and analysis-based (denoted as **A**, i.e. modifications to the methods used to process, analyze and produce official estimates from the collected data)

8.2.1 D/A. Oversampling

Oversample groups that might result in small effective sample sizes due to the subsampling. This would lead to an increase in the degrees of freedom for variance estimators.

8.2.2 D/A. Dynamic interview

Implement a dynamic interview, such as, those proposed in Gonzalez (2012) in which groups are identified during an initial phase of data collection and oversample those groups in a subse-

quent phase, then apply modified weights to the data in the subsequent process to produce valid official estimates.

8.2.3 A. Pooling additional quarters/years of data

Researchers should consider pooling extra quarters of data to offset the individual quarterly impact (e.g. minimum of 4 years data). This has the potential to result in "smoother" mean, coefficient and variance estimates, and second stage estimates, such as marginal propensity to consume and elasticity.

8.2.4 A. Implement Bootstrap

Researchers may consider bootstrap methodology as an option with a large number of simple random subsamples (e.g. 500, from Valliant and Fay 2012) to obtain stable variance estimators with sufficient degrees of freedom and stable second stage estimates.

8.2.5 A. Hierarchical modeling with random components

CE data is collected from 90 primary sampling units (PSU) across four geographical regions. Implementing a hierarchical model with random components (e.g. HGLMM) is an alternative which might reflect the complexity of CE data for the analysis. If a HGLMM Cragg's model is considered, in order to have enough households for estimation, researchers should combine at least, but not limited to one year of data to take into account the variation among geographical regions, or further to account for the variation among PSU within each region.

8.3 Future research

The results indicate sensitivities from various economic model estimations under a simple random subsample condition. The Gemini Steering Team recommend a new CE redesign proposal to collect data in two waves, 12 months apart. Each wave includes two household interview visits and a one-week electronic diary for all CU members age 15 and older. Further studies are needed to evaluate those economic models under this proposed redesign condition. Future analyses might also include drawing repeated simple random subsamples and then obtain the model parameter estimates, empirical SE and two-stage model estimates from multiple subsamples. This will be implemented by simulations to provide information about distributions of economic model parameters. Furthermore, recent developments in economics research illustrate the interest of generating a composite statistic from multi-dimensional measurements (Garner and Short 2013). Therefore, future analyses will also consider evaluating a composite measure from economics interest perspective by simulating repeated simple random subsamples.

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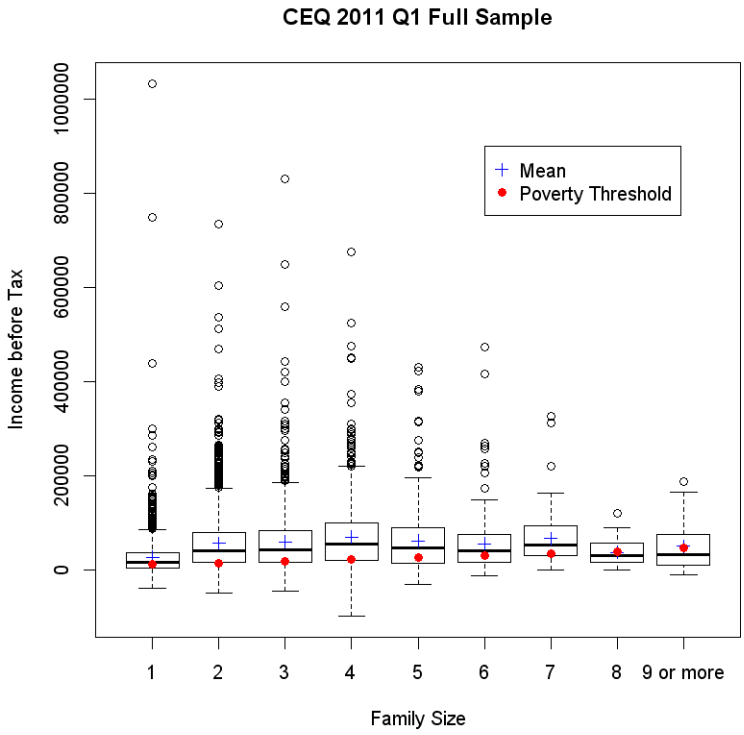

Figure 1: Household incomes before tax, poverty threshold among family size

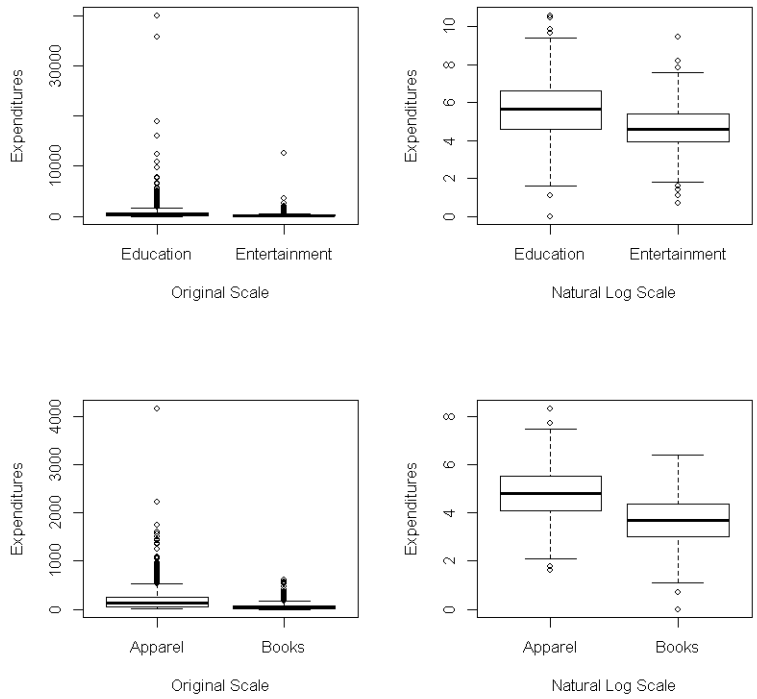

Figure 2: Box Plot of Expenditures on Children: Original Scale vs. Natural Log Scale

Table 1: Level of analyses, methods and variables for expenditure types

Types of Expenditures	Level of Analyses Sophistication	Methods	Variables
Education	Basic, Medium	mean, linear regression, logistic regression	education expenditure, proportion of reporting nonzero expenditure, educational attainment, occupation level, race, age, geographic region, household type, mean income percentile
Food	Refined	multivariate cluster analysis, multinomial logistic regression, multiple regression	food expenditure, adjust-income (after tax), sex, employment status
Medical and Health Care	Basic, Medium	mean, proportion, multiple regression	health care expenditure, health insurance expenditure, medical services expenditure, income-to-poverty-threshold ratio, prescription drugs expenditure, health insurance coverage status
Demographics	Basic, Refined	mean, two-stage regression	tuition expenditure, household tenure, transportation spending, health care, personal insurance and pensions
Assets	Medium	multiple regression	mortgage principal payments, home improvements expenditure, home maintenance expenditure, for vehicles expenditure, furniture expenditure, appliances expenditure, equity indicator
Energy	Basic, Medium	proportion, mean, time series generalized least square (GLS) model	energy expenditure, gasoline expenditure, motor oil expenditure

Table 2: Expenditure variables description

Primary expenditure categories	Omori (2010) description	EAP description	Data files (RELN)
Education	All related educational expenses: "childcare, tuition, food and board at school, schoolbooks and supplies, and the broad category 'other educational expenses."'	Condition: for CU members (EDUCGFTC=1); Include: payments for educational expenses minus reimbursements (JEDUCNET)	EDA
Entertainment	"Tickets and admissions to theaters, concerts, sporting events, health clubs, and swimming pools, as well as fees for participating in sports."	Include: participating sports fees (QPSF3MCX), spectator sports fees (QSSF3MCX), admissions paid to performances including service fees and surcharges (QEAD3MCX), admissions paid to other entertainment activities (QENT3MCX), reference period minus current month; Condition: for CU members (S17GFTCA=1); Subscriptions and memberships expenses, reference period minus current month (QSUB3MCX) for theater, concert, opera, or other musical series, season tickets; season tickets to sporting events; health clubs, fitness centers, swimming pools, weight loss centers or other sports and recreational organizations (S17CODEA=500, 600 or 830)	ENT, SUB
Books	"Subscriptions to, and purchases of, newspapers, magazines, periodicals, books, and encyclopedias."	Include: book expenses including reference books (QBR3MCX), newspaper, magazine, and periodical expenses (QNMG3MCX); reference period minus current month; Condition: for CU members (S17GFTCA=1); Include: subscriptions and memberships expense, reference period minus current month (QSUB3MCX) for subscriptions to newspapers, magazines, or periodicals including online subscriptions; books purchased from a book club; encyclopedias or other sets of reference books (S17CODEA=150, 200 or 700)	ENT, SUB
Children's apparel	"Boys' and girls' clothing" (age ¡ 18)	Condition: for non-gift (CLOGFTA=2) and child or adopted child (CU_CODE=3); Include: purchase price of clothing (CLOTHXA)	CLA, CLB
	"Infants' clothing"	Condition: for CU members (CLOGFTB=2); Include: purchase price of infant clothing (CLOTHXB) except for watches, jewelry and hairpieces, wigs or toupees (CLOTHYB=360, 370 and 380)	

[1] We select CUs with children age < 18 in MEMB data set.

[2] Some childcare expenses are collected in Section questionnaire 19.

[3] Some combined expenditures also include infants clothing from CLA. Starting April 2011, all infants clothing is reported in CLA.

Table 3: Household expenditures on children and demographic descriptive statistics for the Consumer Expenditure Interview Survey, CEQ 2011 Q1 and its SRSWORSS. (weighted)

Parameter	Analysis	Married			Single mother			Single father			Cohabiting		
		Mean	95% CI	SE	Mean	95% CI	SE	Mean	95% CI	SE	Mean	95% CI	SE
Number of households	CEQ 2011 Q1 (wt)	1,574			336			59			293		
	SRSWORSS (wt)	786			175			24			146		
Percent reporting non-zero expenditure:[2]													
Education	CEQ 2011 Q1 (wt)	43.5			29.5			30.5			23.9		
	SRSWORSS (wt)	42.0			35.4			37.5			21.2		
Entertainment	CEQ 2011 Q1 (wt)	49.9			31.0			40.7			29.0		
	SRSWORSS (wt)	50.1			34.3			54.2			27.4		
Books[2]	CEQ 2011 Q1 (wt)	39.3			22.6			28.8			27.0		
	SRSWORSS (wt)	38.0			24.6			41.7			26.7		
Children's Apparel	CEQ 2011 Q1 (wt)	42.5			40.2			39			30.7		
	SRSWORSS (wt)	43.8			40.6			37.5			30.8		
Quarterly expenditure (dollars):[3]													
Education	CEQ 2011 Q1 (wt)	887.38	(700.28, 1074.49)	95.29	453.60	(271.73, 635.47)	91.65	282.56	(103.39, 461.72)	84.92	445.85	(264.50, 627.19)	90.90
	SRSWORSS (wt)	931.71	(658.32, 1205.09)	138.97	334.06	(210.39, 457.74)	61.85	295.77	(-46.65, 638.19)	148.49	403.91	(219.70, 588.12)	90.20
Entertainment	CEQ 2011 Q1 (wt)	212.35	(174.68, 250.02)	19.19	108.65	(78.41, 138.88)	15.25	229.78	(114.36, 345.21)	55.80	127.25	(86.95, 167.55)	20.27
	SRSWORSS (wt)	192.89	(167.12, 218.65)	13.11	113.50	(64.90, 162.11)	24.29	277.53	(87.14, 467.92)	87.38	129.14	(79.69, 178.59)	24.45
Books[2]	CEQ 2011 Q1 (wt)	70.79	(64.13, 77.44)	3.39	42.05	(30.68, 53.42)	5.71	61.84	(18.61, 105.07)	20.39	51.05	(36.74, 65.37)	7.19
	SRSWORSS (wt)	66.54	(58.07, 75.01)	4.30	49.62	(31.43, 67.80)	9.01	49.68	(4.96, 94.39)	19.77	63.81	(37.78, 89.84)	12.86
Children's apparel	CEQ 2011 Q1 (wt)	211.97	(189.64, 234.30)	11.37	169.21	(135.25, 203.18)	17.17	328.45	(179.12, 477.77)	72.00	179.50	(143.88, 215.11)	17.92
	SRSWORSS (wt)	217.95	(181.99, 253.91)	18.28	172.58	(119.55, 225.61)	26.59	303.66	(-50.12, 657.45)	153.42	169.96	(124.64, 215.29)	22.49
Income percentile	CEQ 2011 Q1 (wt)	57.35	(55.93, 58.76)	0.72	24.35	(22.06, 26.65)	1.17	42.14	(34.93, 49.34)	3.59	36.64	(33.64, 39.63)	1.52
	SRSWORSS (wt)	57.47	(55.49, 59.45)	1.01	24.29	(21.03, 27.55)	1.65	40.07	(28.27, 51.87)	5.67	35.66	(31.53, 39.80)	2.09
Education (%):													
Less than high school	CEQ 2011 Q1 (wt)	13.0			18.1			7.7			23.5		
	SRSWORSS (wt)	11.8			19.6			4.1			27.4		
High school	CEQ 2011 Q1 (wt)	21.7			28.1			26.2			26.8		
	SRSWORSS (wt)	23.4			26.4			32.6			21.6		
Some college	CEQ 2011 Q1 (wt)	29.6			38.4			44.7			36.2		
	SRSWORSS (wt)	29.9			37.5			36.4			38.7		
College and higher	CEQ 2011 Q1 (wt)	35.6			15.4			21.5			13.5		
	SRSWORSS (wt)	34.9			16.6			26.9			12.3		
Occupation (%):													
Managerial/professional	CEQ 2011 Q1 (wt)	27.2			17.9			31.2			15.9		
	SRSWORSS (wt)	26.7			20.2			42.3			15.6		
Administrative	CEQ 2011 Q1 (wt)	5.5			12.4			3.4			6.5		
	SRSWORSS (wt)	6.0			12.4			0.0			7.0		
Other occupation	CEQ 2011 Q1 (wt)	67.3			69.8			65.5			77.5		
	SRSWORSS (wt)	67.3			67.4			57.7			77.4		
Race/ethnicity (%):													
White	CEQ 2011 Q1 (wt)	64.9			41.3			71.6			48.1		
	SRSWORSS (wt)	63.9			41.7			71			43.8		
African American	CEQ 2011 Q1 (wt)	8.7			33.4			17.6			27.1		
	SRSWORSS (wt)	8.7			32.4			22.1			29.8		
Hispanic	CEQ 2011 Q1 (wt)	19.8			21.1			9.7			20.5		
	SRSWORSS (wt)	20.9			19.6			6.6			21.0		
Other	CEQ 2011 Q1 (wt)	6.6			4.2			1.1			4.4		
	SRSWORSS (wt)	6.5			6.3			0.4			5.4		
Age, years	CEQ 2011 Q1 (wt)	40.93	(40.46, 41.40)	0.24	35.83	(34.83, 36.83)	0.51	43.55	(41.50, 45.60)	1.02	41.36	(39.73, 42.99)	0.83
	SRSWORSS (wt)	40.70	(40.04, 41.36)	0.34	35.26	(33.84, 36.68)	0.72	44.59	(41.56, 47.61)	1.46	39.80	(37.60, 42.00)	1.11
Number of children:													
Ages 0–5	CEQ 2011 Q1 (wt)	0.63	(0.59, 0.67)	0.02	0.59	(0.50, 0.67)	0.04	0.21	(0.09, 0.33)	0.06	0.71	(0.61, 0.80)	0.05
	SRSWORSS (wt)	0.65	(0.60, 0.71)	0.03	0.66	(0.54, 0.78)	0.06	0.22	(0.01, 0.43)	0.10	0.77	(0.63, 0.91)	0.07
Ages 6–12	CEQ 2011 Q1 (wt)	0.73	(0.69, 0.77)	0.02	0.71	(0.61, 0.81)	0.05	0.54	(0.36, 0.72)	0.09	0.60	(0.51, 0.69)	0.05
	SRSWORSS (wt)	0.73	(0.67, 0.79)	0.03	0.66	(0.52, 0.80)	0.07	0.54	(0.23, 0.85)	0.15	0.67	(0.54, 0.80)	0.07
Ages 13–18	CEQ 2011 Q1 (wt)	0.65	(0.60, 0.69)	0.02	0.54	(0.47, 0.61)	0.04	0.74	(0.54, 0.94)	0.10	0.56	(0.47, 0.64)	0.04
	SRSWORSS (wt)	0.63	(0.57, 0.69)	0.03	0.49	(0.39, 0.60)	0.05	0.80	(0.45, 1.15)	0.17	0.46	(0.34, 0.58)	0.06
Region (%):													
Northeast	CEQ 2011 Q1 (wt)	18.3			18.1			8.3			17.2		
	SRSWORSS (wt)	18.9			14			8.7			19.0		
South	CEQ 2011 Q1 (wt)	35.0			44.3			44.2			38.7		
	SRSWORSS (wt)	33.6			45.6			34.9			39.9		
Midwest	CEQ 2011 Q1 (wt)	21.6			21.1			19.8			20.2		
	SRSWORSS (wt)	21.9			20.3			13.3			16.2		
West	CEQ 2011 Q1 (wt)	25.0			16.5			27.6			24.0		
	SRSWORSS (wt)	25.6			20.2			43.1			25.0		

[1] No confidence interval was calculated for percentages.
[2] Including other reading materials, such as magazines and newspapers.
[3] Only for those who reported a nonzero expenditure in each category.
CEQ 2011 Q1: CE interview survey 2011 1st quarter sample
SRSWORSS: simple random sampling without replacement subsample (selection probability = 0.5)
wt: weighted analysis using the final weight variable "FINLWT21"

Table 4: Selected original and logarithmic statistics for expenditures discussed in the text, CEQ 2011 Q1 and its SRSWORSS

Expenditure category	Analysis	N	Original value			Natural logarithm of original value		
			SD	Skewness	Kurtosis	SD	Skewness	Kurtosis
Education	CEQ 2011 Q1	871	2281.238	11.377	168.436	1.533	-0.181	0.131
	SRSWORSS	432	2340.502	11.975	184.435	1.479	-0.203	0.297
Entertainment	CEQ 2011 Q1	999	479.475	18.150	448.323	1.158	0.029	0.080
	SRSWORSS	507	264.734	3.363	14.353	1.168	-0.078	-0.150
Books	CEQ 2011 Q1	791	79.717	3.073	12.613	1.085	-0.260	0.123
	SRSWORSS	391	73.887	2.769	10.936	1.083	-0.243	-0.025
Apparel	CEQ 2011 Q1	917	276.346	5.227	52.159	1.089	-0.122	-0.216
	SRSWORSS	469	310.571	6.097	60.694	1.109	-0.103	-0.098
SD: Standard Deviation								

Table 5: Logistic regression results: likelihood of expenditures on items in selected categories, CEQ 2011 Q1 and its SRSWORSS (weighted)

Parameter	Analysis	Education		Entertainment		Books[1]		Apparel	
		Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Household type:[2]									
Single mother	CEQ 2011 Q1 (wt)	1.023	(1.021, 1.026)	0.987	(0.985, 0.989)	0.935	(0.933, 0.938)	1.090	(1.088, 1.092)
	SRSWORSS (wt)	1.438	(1.433, 1.442)	1.081	(1.078, 1.085)	0.971	(0.967, 0.974)	1.144	(1.141, 1.148)
Single father	CEQ 2011 Q1 (wt)	0.756	(0.753, 0.760)	0.582	(0.580, 0.585)	0.613	(0.610, 0.616)	0.943	(0.939, 0.947)
	SRSWORSS (wt)	1.138	(1.130, 1.145)	1.040	(1.033, 1.047)	1.083	(1.076, 1.090)	0.750	(0.745, 0.755)
Cohabiting	CEQ 2011 Q1 (wt)	0.640	(0.638, 0.641)	0.697	(0.695, 0.699)	0.907	(0.905, 0.909)	0.690	(0.689, 0.692)
	SRSWORSS (wt)	0.607	(0.605, 0.609)	0.686	(0.683, 0.688)	1.069	(1.066, 1.073)	0.699	(0.697, 0.701)
Income percentile	CEQ 2011 Q1 (wt)	1.012	(1.012, 1.012)	1.020	(1.020, 1.020)	1.016	(1.016, 1.017)	1.008	(1.008, 1.008)
	SRSWORSS (wt)	1.011	(1.011, 1.011)	1.016	(1.016, 1.016)	1.012	(1.012, 1.012)	1.009	(1.009, 1.009)
Education:[3]									
High school	CEQ 2011 Q1 (wt)	1.391	(1.387, 1.395)	1.509	(1.505, 1.513)	1.232	(1.229, 1.235)	1.202	(1.200, 1.205)
	SRSWORSS (wt)	1.840	(1.832, 1.847)	1.306	(1.301, 1.310)	1.327	(1.322, 1.332)	1.120	(1.117, 1.124)
College and higher	CEQ 2011 Q1 (wt)	2.443	(2.437, 2.449)	2.412	(2.406, 2.418)	1.750	(1.746, 1.755)	1.084	(1.082, 1.086)
	SRSWORSS (wt)	3.574	(3.561, 3.588)	2.623	(2.613, 2.632)	1.538	(1.533, 1.544)	1.106	(1.103, 1.110)
Occupation:[4]									
Managerial/professional	CEQ 2011 Q1 (wt)	1.285	(1.283, 1.287)	1.546	(1.544, 1.549)	1.411	(1.409, 1.413)	0.933	(0.931, 0.934)
	SRSWORSS (wt)	1.466	(1.463, 1.470)	1.562	(1.559, 1.566)	1.442	(1.438, 1.445)	0.992	(0.990, 0.994)
Administrative	CEQ 2011 Q1 (wt)	0.916	(0.914, 0.919)	1.088	(1.085, 1.091)	0.928	(0.925, 0.931)	1.156	(1.153, 1.159)
	SRSWORSS (wt)	0.971	(0.967, 0.974)	1.259	(1.254, 1.264)	0.956	(0.952, 0.960)	0.892	(0.888, 0.895)
Race/ethnicity:[5]									
African American	CEQ 2011 Q1 (wt)	0.630	(0.629, 0.631)	0.449	(0.448, 0.450)	0.608	(0.606, 0.609)	0.864	(0.862, 0.866)
	SRSWORSS (wt)	0.718	(0.716, 0.721)	0.470	(0.468, 0.471)	0.543	(0.541, 0.545)	0.803	(0.801, 0.805)
Hispanic	CEQ 2011 Q1 (wt)	0.567	(0.566, 0.569)	0.646	(0.644, 0.647)	0.514	(0.512, 0.515)	1.052	(1.050, 1.054)
	SRSWORSS (wt)	0.689	(0.687, 0.691)	0.830	(0.828, 0.833)	0.567	(0.565, 0.569)	0.910	(0.908, 0.912)
Other	CEQ 2011 Q1 (wt)	1.290	(1.286, 1.294)	0.306	(0.305, 0.307)	0.766	(0.764, 0.768)	1.064	(1.061, 1.067)
	SRSWORSS (wt)	1.968	(1.960, 1.976)	0.323	(0.322, 0.325)	1.320	(1.315, 1.326)	0.793	(0.790, 0.796)
Age	CEQ 2011 Q1 (wt)	1.007	(1.007, 1.007)	1.004	(1.004, 1.004)	1.013	(1.013, 1.013)	0.989	(0.989, 0.989)
	SRSWORSS (wt)	1.015	(1.015, 1.016)	1.009	(1.009, 1.009)	1.005	(1.005, 1.005)	0.990	(0.990, 0.990)
Number of children:									
Ages 0–5	CEQ 2011 Q1 (wt)	1.251	(1.249, 1.252)	0.772	(0.771, 0.773)	0.924	(0.922, 0.925)	0.842	(0.841, 0.842)
	SRSWORSS (wt)	1.205	(1.203, 1.207)	0.740	(0.739, 0.741)	0.889	(0.887, 0.890)	0.773	(0.772, 0.774)
Ages 6–12	CEQ 2011 Q1 (wt)	1.116	(1.115, 1.117)	1.017	(1.016, 1.018)	1.024	(1.023, 1.025)	1.002	(1.001, 1.003)
	SRSWORSS (wt)	1.062	(1.060, 1.063)	0.949	(0.948, 0.950)	0.921	(0.920, 0.922)	1.077	(1.076, 1.078)
Ages 13–18	CEQ 2011 Q1 (wt)	0.965	(0.964, 0.966)	1.037	(1.036, 1.038)	0.986	(0.985, 0.987)	1.108	(1.107, 1.109)
	SRSWORSS (wt)	0.892	(0.890, 0.893)	1.059	(1.057, 1.060)	1.048	(1.046, 1.049)	1.105	(1.103, 1.106)
Region:[6]									
South	CEQ 2011 Q1 (wt)	0.822	(0.820, 0.823)	0.877	(0.875, 0.879)	0.901	(0.899, 0.903)	0.745	(0.743, 0.746)
	SRSWORSS (wt)	0.811	(0.809, 0.813)	0.762	(0.760, 0.764)	1.111	(1.108, 1.114)	0.679	(0.677, 0.681)
Midwest	CEQ 2011 Q1 (wt)	0.898	(0.896, 0.900)	1.074	(1.071, 1.076)	1.018	(1.015, 1.020)	0.833	(0.831, 0.835)
	SRSWORSS (wt)	0.724	(0.722, 0.726)	0.994	(0.990, 0.997)	1.481	(1.476, 1.485)	0.761	(0.759, 0.763)
West	CEQ 2011 Q1 (wt)	0.948	(0.946, 0.950)	1.333	(1.330, 1.336)	1.013	(1.011, 1.016)	0.708	(0.706, 0.709)
	SRSWORSS (wt)	0.870	(0.867, 0.872)	1.048	(1.045, 1.052)	1.067	(1.064, 1.071)	0.666	(0.664, 0.668)
N	CEQ 2011 Q1	2,262		2,262		2,262		2,262	
	SRSWORSS	1,131		1,131		1,131		1,131	

[1] Including other reading materials, such as magazines and newspapers.
[2] Reference class: married-couple households.
[3] Reference class: less than high school.
[4] Reference class: other occupations.
[5] Reference class: White.
[6] Reference class: Northeast.

Table 6: Ordinary least squares regression results: estimates of (the natural logarithm of) quarterly expenditures on items in selected categories, CEQ 2011 Q1 and its SRSWORSS (weighted)

Parameter	Analysis	Education		Entertainment		Books[1]		Apparel	
		Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	CEQ 2011 Q1 (wt)	4.456	[7]0.378	3.145	[7]0.268	2.558	[7]0.291	4.106	[7]0.265
	SRSWORSS (wt)	4.950	[7]0.502	3.164	[7]0.367	3.035	[7]0.395	4.365	[7]0.375
Household type:[2]									
Single mother	CEQ 2011 Q1 (wt)	-0.337	[9]0.165	-0.228	0.119	-0.164	0.135	0.056	0.111
	SRSWORSS (wt)	-0.634	[8]0.210	-0.200	0.161	-0.047	0.182	0.115	0.162
Single father	CEQ 2011 Q1 (wt)	-0.659	0.340	0.210	0.235	-0.146	0.269	0.608	[8]0.229
	SRSWORSS (wt)	-0.938	[9]0.442	0.321	0.312	-0.488	0.353	0.491	0.384
Cohabiting	CEQ 2011 Q1 (wt)	-0.229	0.181	-0.237	0.124	-0.069	0.130	0.083	0.126
	SRSWORSS (wt)	-0.171	0.250	-0.175	0.176	0.079	0.179	0.081	0.183
Income percentile	CEQ 2011 Q1 (wt)	0.006	[8]0.002	0.006	[7]0.001	0.009	[7]0.002	0.004	[8]0.001
	SRSWORSS (wt)	0.007	[8]0.002[†]	0.006	[7]0.002	0.008	[7]0.002[†]	0.003	0.002
Education:[3]									
High school	CEQ 2011 Q1 (wt)	0.494	[9]0.218	0.118	0.156	0.169	0.167	0.085	0.127
	SRSWORSS (wt)	0.154	0.318	0.285	0.220	0.040	0.225	0.091	0.188
College and higher	CEQ 2011 Q1 (wt)	0.971	[7]0.200	0.378	[9]0.146	0.240	0.153	0.076	0.121
	SRSWORSS (wt)	0.736	[8]0.293	0.443	[9]0.207	0.157	0.210	0.024	0.176
Occupation:[4]									
Managerial/professional	CEQ 2011 Q1 (wt)	0.317	[8]0.110	0.287	[7]0.077	0.096	0.084	0.105	0.088
	SRSWORSS (wt)	0.183	0.146	0.401	[7]0.110	0.204	0.122	0.242	0.125
Administrative	CEQ 2011 Q1 (wt)	-0.053	0.205	0.052	0.138	-0.014	0.158	-0.037	0.137
	SRSWORSS (wt)	-0.194	0.269	-0.099	0.187	-0.042	0.218	0.045	0.202
Race/ethnicity:[5]									
African American	CEQ 2011 Q1 (wt)	-0.153	0.166	-0.241	0.127	-0.202	0.136	0.070	0.114
	SRSWORSS (wt)	-0.398	0.216	-0.328	0.176	-0.161	0.195	0.025	0.163
Hispanic	CEQ 2011 Q1 (wt)	-0.517	[8]0.157	-0.014	0.107	-0.163	0.124	0.075	0.101
	SRSWORSS (wt)	-0.565	[8]0.199	0.037	0.143	-0.131	0.169	-0.032	0.142
Other	CEQ 2011 Q1 (wt)	0.196	0.185	0.035	0.172	0.155	0.157	-0.100	0.150
	SRSWORSS (wt)	0.125	0.231	0.380	0.239	0.137	0.198	-0.128	0.220
Age	CEQ 2011 Q1 (wt)	0.005	0.006	0.012	[8]0.004	0.011	[9]0.004	0.005	0.005
	SRSWORSS (wt)	0.001	0.008	0.008	0.006	0.004	0.006	0.002	0.006
Number of children:									
Ages 0–5	CEQ 2011 Q1 (wt)	0.174	[9]0.076	0.119	0.062	0.022	0.063	0.093	0.059
	SRSWORSS (wt)	0.233	[8]0.101	0.097	0.086	-0.030	0.087	0.061	0.089
Ages 6–12	CEQ 2011 Q1 (wt)	-0.120	[9]0.060	0.182	[7]0.044	0.006	0.048	0.114	[9]0.046
	SRSWORSS (wt)	-0.126	0.083	0.185	[8]0.062	-0.082	0.067	0.108	0.063
Ages 13–18	CEQ 2011 Q1 (wt)	-0.034	0.069	0.207	[7]0.050	0.095	0.056	0.227	[7]0.051
	SRSWORSS (wt)	-0.073	0.097	0.198	[8]0.069	0.136	0.076	0.284	[7]0.072
Region:[6]									
South	CEQ 2011 Q1 (wt)	-0.338	[9]0.138	-0.130	0.099	-0.300	[8]0.108	-0.198	[9]0.098
	SRSWORSS (wt)	-0.162	0.186	-0.150	0.140	-0.376	[9]0.163	-0.213	0.142
Midwest	CEQ 2011 Q1 (wt)	-0.346	[9]0.150	-0.087	0.106	-0.292	[9]0.115	-0.275	[9]0.108
	SRSWORSS (wt)	-0.417	[9]0.207	-0.087	0.149	-0.380	[9]0.166	-0.511	[8]0.155
West	CEQ 2011 Q1 (wt)	-0.385	[8]0.148	0.008	0.103	-0.087	0.114	-0.342	[8]0.109
	SRSWORSS (wt)	-0.251	0.196	-0.018	0.143	-0.044	0.168	-0.455	[8]0.152
N	CEQ 2011 Q1	871		999		791		917	
	SRSWORSS	432		507		391		469	
R^2	CEQ 2011 Q1 (wt)	0.159		0.135		0.132		0.064	
	SRSWORSS (wt)	0.191		0.162		0.144		0.090	

[1] Including other reading materials, such as magazines and newspapers.
[2] Reference class: married-couple households.
[3] Reference class: less than high school.
[4] Reference class: other occupations.
[5] Reference class: White.
[6] Reference class: Northeast.
[7] $p < 0.001$.
[8] $p < 0.01$.
[9] $p < 0.05$.
[†] SE(SRSWORSS) < SE(CEQ 2011 Q1).

Table 7: Number of observations and number of reporting expenditures by household types

Expenditure	Analysis	Married couple	Single mother	Single father	Cohabiting
Overall	CEQ 2011 Q1	1367	304	52	254
	SRSWORSS	682	155	22	129
Education	CEQ 2011 Q1	612	91	15	59
	SRSWORSS	287	58	8	26
Entertainment	CEQ 2011 Q1	703	100	21	77
	SRSWORSS	342	57	11	37
Books	CEQ 2011 Q1	566	73	14	72
	SRSWORSS	270	41	8	35
Apparel	CEQ 2011 Q1	610	131	20	76
	SRSWORSS	311	68	7	38

Table 8: Cragg's model probability of purchase, predicted expenditure (buyers only), marginal propensity to consume and elasticity, and so forth under "ceteris paribus"

Expenditure, Ceteris paribus criteria	Analysis	Married couple	Single mother	Single father	Cohabiting
Education					
Probability of purchase	CEQ 2011 Q1	0.45	0.30	0.29	0.23
	SRSWORSS	0.42	0.37	0.36	0.20
Predicted expenditure (buyers only)	CEQ 2011 Q1	336.91	203.54	329.97	220.81
	SRSWORSS	394.8	190.57	319.75	350.61
Marginal propensity to consume	CEQ 2011 Q1	0.06	0.01	0.05	0*
	SRSWORSS	0.01	0.01	0.01	0
Elasticity	CEQ 2011 Q1	0.15	0.11	0.64	0.1
	SRSWORSS	0.22	0.24	0.66	-0.03
Entertainment					
Probability of purchase	CEQ 2011 Q1	0.51	0.33	0.40	0.30
	SRSWORSS	0.50	0.37	0.50	0.29
Predicted expenditure (buyers only)	CEQ 2011 Q1	120.81	73.9	153.1	80.86
	SRSWORSS	125.7	79.8	231.82	93.85
Marginal propensity to consume	CEQ 2011 Q1	0.05	0	0	0
	SRSWORSS	0.01	0	-0.03	0
Elasticity	CEQ 2011 Q1	0.30	0.06	0.09	0.13
	SRSWORSS	0.30	0.14	-2.56	0.31
Books					
Probability of purchase	CEQ 2011 Q1	0.41	0.24	0.27	0.28
	SRSWORSS	0.40	0.26	0.36	0.27
Predicted expenditure (buyers only)	CEQ 2011 Q1	47.61	28.4	50.28	33.66
	SRSWORSS	47.38	30.14	54.13	47.49
Marginal propensity to consume	CEQ 2011 Q1	0.01	0	0	0
	SRSWORSS	0	0	-0.01	0
Elasticity	CEQ 2011 Q1	0.21	0.13	-0.07	0.09
	SRSWORSS	0.16	0.27	-3.18	0.18
Apparel					
Probability of purchase	CEQ 2011 Q1	0.45	0.43	0.38	0.30
	SRSWORSS	0.46	0.44	0.32	0.29
Predicted expenditure (buyers only)	CEQ 2011 Q1	128.15	111	303.01	126.76
	SRSWORSS	127.06	116.4	382.57	136.83
Marginal propensity to consume	CEQ 2011 Q1	0.01	0	0.01	0
	SRSWORSS	0	0	-0.14	0
Elasticity	CEQ 2011 Q1	0.09	0.01	0.14	-0.03
	SRSWORSS	0.10	0.04	-8.75	-0.02

* Rounded at two decimal places.

Table 9: Hierarchical Generalized Linear Mixed (HGLMM) Cragg's model probability of purchase, predicted expenditure (buyers only), marginal propensity to consume and elasticity, and so forth under "ceteris paribus"

Expenditure, Ceteris paribus criteria	Analysis	Married couple	Single mother	Single father	Cohabiting
Education					
Probability of purchase	CEQ 2011 Q1	0.61	0.57	0.57	0.56
	SRSWORSS	0.60	0.59	0.59	0.55
Predicted expenditure (buyers only)	CEQ 2011 Q1	335.6	198.31	305.60	220.17
	SRSWORSS	389.45	178.52	–	339.98
Marginal propensity to consume	CEQ 2011 Q1	0.05	0.01	0.08	0.01
	SRSWORSS	0.01	0.01	–	-0.01
Elasticity	CEQ 2011 Q1	0.17	0.18	1.05	0.22
	SRSWORSS	0.27	0.33	–	-0.16
Entertainment					
Probability of purchase	CEQ 2011 Q1	0.62	0.58	0.60	0.57
	SRSWORSS	0.62	0.59	0.62	0.57
Predicted expenditure (buyers only)	CEQ 2011 Q1	120.54	72.60	–	79.03
	SRSWORSS	124.95	76.93	–	92.95
Marginal propensity to consume	CEQ 2011 Q1	0.04	0*	–	0
	SRSWORSS	0	0	–	0
Elasticity	CEQ 2011 Q1	0.32	0.10	–	0.17
	SRSWORSS	0.33	0.21	–	0.49
Books					
Probability of purchase	CEQ 2011 Q1	0.60	0.56	0.57	0.57
	SRSWORSS	0.60	0.57	0.59	0.57
Predicted expenditure (buyers only)	CEQ 2011 Q1	47.39	27.94	50.42	33.07
	SRSWORSS	46.94	29.91	–	46.66
Marginal propensity to consume	CEQ 2011 Q1	0.01	0	0	0
	SRSWORSS	0	0	–	0
Elasticity	CEQ 2011 Q1	0.26	0.25	-0.03	0.13
	SRSWORSS	0.20	0.48	–	0.29
Apparel					
Probability of purchase	CEQ 2011 Q1	0.61	0.61	0.59	0.57
	SRSWORSS	0.61	0.61	0.57	0.57
Predicted expenditure (buyers only)	CEQ 2011 Q1	127.49	110.67	289.03	126.15
	SRSWORSS	125.78	115.29	–	133.27
Marginal propensity to consume	CEQ 2011 Q1	0.01	0	0.01	0
	SRSWORSS	0	0	–	0
Elasticity	CEQ 2011 Q1	0.10	0.02	0.18	-0.04
	SRSWORSS	0.11	0.07	–	-0.05

* Rounded at two decimal places.

– Not Avaliable. (The estimate is not able to be produced for a hierarchical linear mixed model)