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# LIFE-CYCLE CONSUMPTION EXPENDITURE AND INEQUALITY

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# Life-cycle Consumption Expenditure and Inequality

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**Abstract:**
We study the evolution of consumption expenditure and its distribution over the life-cycle. We estimate age and cohort effects relying on household-level consumption survey data, reaching several conclusions. First, we find significant differences in durable and nondurable life-cycle consumption profiles. While the former remains relatively stable until middle age and decreases afterward, the latter displays a hump-shaped profile. Second, only a few subclasses of nondurable consumption exhibit hump-shaped profiles. This group includes work-related subclasses such as clothing and personal care, food away, and transport. Third, we find that inequality in durable and nondurable consumption increases sharply around middle age.

**JEL:** D14, D15
**Keywords:** cohorts, consumption, consumption profiles, life-cycle, inequality

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# 1 Introduction

In this paper, we study the evolution of consumption expenditure and its distribution over the life-cycle. We pay special attention to variations in life-cycle profiles across different consumption components. For this purpose, we consider thirteen consumption classes, which jointly account for total household durable and nondurable consumption expenditure. We begin by analyzing the profiles of durable and nondurable consumption expenditure. We then focus in detail on different subclasses of nondurable consumption expenditure.

We rely on repeated cross-sections of household-level survey data to construct the life-cycle profiles. Concretely, we use the Household Budget Survey (HBS) data from the Czech Statistical Office covering the 1993-2016 period. The main strength of the HBS is that, instead of relying on recall questions to record household consumption expenditure, it followed households throughout an entire year. This feature of the HBS enables us to study detailed consumption classes while limiting the issues caused by infrequently consumed items. We combine the HBS with the Deaton & Paxson (1993) and Deaton (1997) methodological approach to recover the age and cohort effects.

First, we find significant differences in the consumption profiles of durable and nondurable consumption items. Durable consumption expenditure peaks before middle age and then declines until the end of the life-cycle. Alessie & De Ree (2009) and Fernández-Villaverde & Krueger (2007) find similar profiles. However, we focus on consumption expenditure and do not account for the durability of consumption items. Consequently, our results relate purely to expenditure on durable goods instead of the services arising from their consumption. Meanwhile, nondurable consumption follows the common hump-shaped profile as it increases until middle age, then levels, and registers a slight fall around retirement.

Second, we observe significant heterogeneity in consumption profiles among the detailed nondurable consumption classes. Only two classes, transport, and food at home, follow a hump-shaped profile similar to that of total nondurable consumption. We find increasing consumption profiles for the health, housing, and entertainment and recreation classes. In contrast, the clothing and personal care, and alcoholic beverages and tobacco consumption classes have flat profiles until retirement and decrease afterward. Finally, life-cycle profiles of education and children's

clothing consumption are similar and closely connected to children's presence in the household.

Third, inequality in both durable consumption expenditure and nondurable consumption remains generally flat until middle age and rises only thereafter. Once more, the profile for nondurable consumption is a combination of its components' heterogeneous profiles. The rising life-cycle inequality profile happens against stable population-wide inequality levels.

Our results expand the evidence on life-cycle consumption expenditure and inequality profiles. These subjects have received considerable attention since the seminal papers of Deaton & Paxson (1993) and Deaton & Paxson (1994). Though Browning & Crossley (2001) identify the analysis focused on more detailed consumption classes as one of the key directions for future research, most of the evidence is provided for broad classifications. Our life-cycle profile estimates cover significantly more detailed consumption classes than, for example, Alessie & De Ree (2009), Alexandre *et al.* (2020), or Fernández-Villaverde & Krueger (2007). The level of detail is comparable with that of Aguiar & Hurst (2013).

Our results mostly align with the findings of Aguiar & Hurst (2013). Similarly to the authors, we find that only a few nondurable consumption subclasses exhibit hump-shaped life-cycle profiles. These subclasses are primarily work-related and include expenditure on the transport, food away, and clothing and personal care subclasses. Relative to Aguiar & Hurst (2013), we find greater heterogeneity in the life-cycle profiles of the remaining classes. Additionally, we consider a broader specification of nondurable consumption, which also includes expenditure on health and education.

The remainder of the paper is organized as follows. The second section outlines our methodological approach, while the third section describes the HBS data. The fourth section presents our results. The final section concludes.

## 2 Methodology

We rely on repeated cross-sectional data to recover the life-cycle consumption profiles. Concretely, we use the data to follow cohorts defined by the household head's birth year. Given the scarcity of long-run panel data, which would enable following specific households over their entire life-cycles, this became a standard approach in the literature. Deaton & Paxson (1993)

and Deaton & Paxson (1994) pioneered this approach to life-cycle profile measurement. Deaton (1985) develops the econometrics of such data. Deaton (1997) provides an accessible introduction to how, through following specific cohorts over time, repeated cross-sections enable life-cycle profile estimation. Fernández-Villaverde & Krueger (2007), Aguiar & Hurst (2013), and recently Alexandre *et al.* (2020) relied on a similar approach.

The use of repeated cross-sectional data permits the separation of age and cohort effects. It is crucial to separate these two effects when estimating life-cycle consumption profiles. For example, we cannot simply rely on life-cycle profiles obtained as simple averages based on the household head's age. Such profiles can be misleading under variations in cohorts' life-time wealth. It is impossible to separate age and cohort effects in a single cross-section due to the linear connection between them. However, we can control for the two effects using multiple cross-sections as we have independent variation between age and cohort. We include separate sets of dummies for each cohort and age, thus separating the two effects.

We adopt the following specification. Let $c_{it}^k$ denote the log consumption of household $i$ belonging to cohort $k$ in year $t$. *Age* is a matrix of age dummies indicating the household head's age in year $t$. It includes 45 dummies for ages 25 to 69. *Cohort* is a matrix of cohort dummies. We classify households into 5-year cohorts based on the household head's birth year. The choice of 5-year cohort bands is somewhat arbitrary as we could adopt broader or narrower bands. However, with 5-year bands, we obtain a sufficient number of observations for each age-cohort combination. Moreover, Banks *et al.* (2019), Deaton & Paxson (1994) (for the UK and USA), and Fernández-Villaverde & Krueger (2007) also relied on 5-year bands. Similarly to Deaton & Paxson (1994), we calculate age based on the midpoint of the 5-year cohort bands. Equation 1 gives the regression specification.

$$c_{it}^k = \beta_0 + \beta_a Age_{it} + \beta_c Cohort_{it} + \epsilon_{it} \tag{1}$$

We estimate Equation 1 by OLS. The coefficients $\beta_a$ give the life-cycle profiles relative to the omitted category's (25-year-old) consumption expenditure, conditional on cohort. We omit the 1925-1929 cohort, i.e., the oldest cohort.

The specification above does not control for time effects. We cannot directly include a matrix

of time dummies in Equation 1 to control for time effects due to the exact linear relationship between age, year, and cohort effects. This issue is well-documented in the literature estimating life-cycle profiles. Effectively, any time trend can be reinterpreted as a combination of age and cohort effects. Following Deaton & Paxson (1993), steady population-wide growth of log consumption translates into consumption growing with age and declining across cohorts. Deaton & Paxson (1993) argue that these effects should be attributed to age and cohort instead of time. Browning *et al.* (2012) provide an accessible discussion of the age-period-cohort problem and its' possible solutions.

Possible solution to this issue is to impose further restrictions on the time dummies so that these capture business cycle effects. Under these restrictions, the time dummies are constrained to sum to zero and be orthogonal to a time trend. Deaton & Paxson (1993) proposed this solution, which became a popular solution to the age-period-cohort issue and was adopted, among others, by Alessie & De Ree (2009), Alexandre *et al.* (2020), and Fernández-Villaverde & Krueger (2007). However, this specification provides only a partial solution. Jappelli & Pistaferri (2017) note that the method does not account for possible variation of consumption's response to macroeconomic shocks with respect to age.

We consider a model incorporating this restriction on the time dummies. As suggested by Deaton (1997), we obtain transformed time dummies $d_t^*$ from standard time dummies $d_t$ using the transformation $d_t^* = d_t - ((t-1)d_2 - (t-1)d_1)$. We then add a set of transformed time dummies starting from $t = 3$ to Equation 1. Unfortunately, we cannot recover the age, cohort, and year effects even with this restriction due to collinearity. As we are unable to control even for restricted time effects, we are forced to adopt the assumption of zero time effects.

Equation 2 outlines the model we use to study the evolution of consumption inequality over the life-cycle. The dependent variable $(\sigma_{kt}^2)$ is the variance of the error term from a regression of the logarithm of household consumption on the $Age$ and $Cohort$ dummies calculated for cohort $k$ at time $t$.

$$(\sigma_{kt}^2) = \beta_0 + \beta_a Age + \beta_c Cohort + \epsilon_{kt} \tag{2}$$

Similarly to Equation 1, we focus on the coefficients $\beta_a$ to study the evolution of consumption

expenditure inequality over the life-cycle. This specification is similar to those adopted by Deaton & Paxson (1994) and Aguiar & Hurst (2013).

Finally, we have to deal with the variation in household size over its' life-cycle. Using total household consumption unadjusted for household size might thus result in overestimating the hump-shaped profile of life-cycle consumption as the household size tends to follow a hump-shaped profile over the life-cycle as well. We adjust consumption for household size using the square root equivalence scale, which equals the square root of the total number of household members. However, the estimated life-cycle profiles might be sensitive to the chosen equivalence scale, as discussed by Fernández-Villaverde & Krueger (2007). Consequently, as a robustness check, we also present an alternative set of results based on the modified OECD equivalence scales, which gives a weight of 1 to the household head, 0.5 to each additional adult, and 0.3 to each child. We differ from the official OECD modified equivalence scale in defining children as below 15 years of age instead of 14. The structure of the HBS data determines this deviation. We also report results based on total household consumption expenditure.

# 3 Data

We rely on the HBS microdata collected by the Czech Statistical Office (CzSO) during the 1993-2016 period. The main strength of the HBS is that surveyed households recorded their consumption throughout an entire year, thus significantly limiting issues raised by the infrequency of some purchases. Moreover, the HBS provides information about household income and socio-demographic characteristics. We do not extend our analysis beyond 2016, as in 2017, the HBS underwent a major design reform. Changes in the sampling procedure combined with a shift to two two-week expenditure diaries prevent the combination of the pre and post-2017 data.

The HBS is a 4-year rotating panel. Unfortunately, the CzSO did not conserve the panel identifier between waves. Moreover, it is impossible to recover the panel structure from the data alone. Crawford *et al.* (2003) discuss this issue of the HBS. Consequently, we are unable to profit from the panel dimension of the data.

The HBS contains data on the consumption behavior of 73,691 households during the 1993-2016 period. The average annual sample size is thus 3,070 households. To achieve stability

of the sample structure over time, we filter three household types, i.e., households with unemployed heads, pensioner households with economically active members, and households with no economically active members. These household types were not covered by the HBS prior to 2006. Consequently, including them could introduce accidental patterns in the estimated life-cycle profiles. Appendix A contains more information on the HBS sampling procedure and the 2006 changes. This leaves 66,019 households.

We filter the following households to identify the final sample. First, we filter out households that did not remain in the sample for the entire 12 months. Second, we filter out households reporting negative expenditure on some consumption items. Third, we filter out the top and bottom 1% based on household equivalised non-durable expenditure. This leaves 59,096 households in the final sample. Table B.1 presents the number of observations for each cohort-year pair. The average cell size for cohorts with ages in the desired range of 25 to 69 years is 241 observations.

Table 1 presents the descriptive statistics. During the considered time period, the average household size decreased, and household heads became, on average, older. This evolution is consistent with the decrease in the share of nuclear households in the final sample. A rise in the share of single-person households almost offsets this fall. The large share of male household heads stems from the CzSO automatically considering the male as the household head in the case of jointly living partners.

Household size and the number of children in the household display strong life-cycle profiles. Figure 1 displays the cohort paths of mean household size and number of children. Both the size and number of children peak around the age of 40. The figure also indicates the presence of cohort effects among younger cohorts. Mean household size and number of children decrease among younger cohorts. Contrarily, we observe little to no cohort effects among older cohorts as their profiles are almost linked.

Mean equivalised household disposable income and consumption significantly increased during the considered time period, indicating the general rise in living standards. This increase was accompanied by mostly stable inequality levels, as suggested by the variances of logarithms reported in Table 1. However, stable population-wide inequality levels are not inconsistent with rising inequality within cohorts over time and over the life-cycle. A flat population-wide in-

Table 1: Household Budget Survey: Descriptive Statistics

| | 1993 | 1995 | 1997 | 1999 | 2001 | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Household structure:** | | | | | | | | | | | |
| Size | 2.78 | 2.68 | 2.68 | 2.64 | 2.62 | 2.61 | 2.49 | 2.48 | 2.42 | 2.42 | 2.41 |
| Children (below 15) | 0.71 | 0.62 | 0.6 | 0.58 | 0.55 | 0.55 | 0.48 | 0.44 | 0.43 | 0.45 | 0.45 |
| **Household head:** | | | | | | | | | | | |
| Age | 46.3 | 47.02 | 47.48 | 47.99 | 48.36 | 48.28 | 48.68 | 49.6 | 50.27 | 50.43 | 51.05 |
| Male | 0.79 | 0.79 | 0.79 | 0.78 | 0.77 | 0.76 | 0.75 | 0.75 | 0.72 | 0.7 | 0.7 |
| Education - Primary | 0.08 | 0.07 | 0.06 | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 |
| Education - High school (No final exam) | 0.43 | 0.44 | 0.44 | 0.46 | 0.48 | 0.48 | 0.48 | 0.49 | 0.44 | 0.43 | 0.43 |
| Education - High school (Final exam) | 0.35 | 0.35 | 0.36 | 0.34 | 0.35 | 0.36 | 0.37 | 0.36 | 0.4 | 0.42 | 0.42 |
| Education - University | 0.14 | 0.14 | 0.13 | 0.13 | 0.12 | 0.11 | 0.11 | 0.11 | 0.11 | 0.12 | 0.12 |
| **Spouse:** | | | | | | | | | | | |
| Age | 41.1 | 42.05 | 42.9 | 43.37 | 43.97 | 44.3 | 44.83 | 45.81 | 46.64 | 46.65 | 47.09 |
| Education - Primary | 0.08 | 0.08 | 0.07 | 0.07 | 0.07 | 0.06 | 0.05 | 0.05 | 0.06 | 0.04 | 0.03 |
| Education - High school (No final exam) | 0.24 | 0.26 | 0.27 | 0.32 | 0.3 | 0.3 | 0.32 | 0.29 | 0.24 | 0.24 | 0.24 |
| Education - High school (Final exam) | 0.59 | 0.57 | 0.58 | 0.53 | 0.55 | 0.55 | 0.54 | 0.57 | 0.59 | 0.6 | 0.59 |
| Education - University | 0.09 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 | 0.09 | 0.09 | 0.11 | 0.12 | 0.14 |
| **Sample structure:** | | | | | | | | | | | |
| Nuclear family | 0.69 | 0.69 | 0.69 | 0.67 | 0.67 | 0.66 | 0.64 | 0.64 | 0.62 | 0.6 | 0.59 |
| Multigenerational family | 0.06 | 0.05 | 0.05 | 0.06 | 0.05 | 0.04 | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 |
| Single parent | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 |
| Single parent (multigenerational) | 0.01 | 0.01 | 0.01 | 0 | 0.01 | 0 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 |
| Mixed household | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Single Adult | 0.19 | 0.19 | 0.19 | 0.21 | 0.2 | 0.21 | 0.23 | 0.24 | 0.25 | 0.26 | 0.26 |
| **Consumption:** | | | | | | | | | | | |
| Consumption expenditure (log) | 11.75 | 11.84 | 11.92 | 11.91 | 11.91 | 11.97 | 11.96 | 12.06 | 12.07 | 12.04 | 12.01 |
| Consumption expenditure (var of log) | 0.12 | 0.14 | 0.13 | 0.14 | 0.13 | 0.13 | 0.14 | 0.14 | 0.14 | 0.14 | 0.13 |
| Core durables | 0.07 | 0.08 | 0.09 | 0.08 | 0.07 | 0.08 | 0.08 | 0.09 | 0.08 | 0.07 | 0.06 |
| Expanded durables | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 |
| Nondurables | 0.88 | 0.88 | 0.87 | 0.88 | 0.89 | 0.89 | 0.89 | 0.88 | 0.88 | 0.9 | 0.91 |
| ***From that:*** | | | | | | | | | | | |
| Alcoholic beverages tobacco | 0.06 | 0.05 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Clothing children | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Clothing personal care | 0.13 | 0.13 | 0.12 | 0.11 | 0.1 | 0.1 | 0.1 | 0.1 | 0.09 | 0.09 | 0.09 |
| Education | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Entertainment Recreation | 0.09 | 0.1 | 0.11 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 | 0.15 | 0.15 | 0.14 |
| Food at home | 0.34 | 0.34 | 0.33 | 0.29 | 0.29 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 | 0.25 |
| Food away | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Health | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.06 | 0.06 | 0.07 | 0.07 |
| Housing | 0.18 | 0.17 | 0.18 | 0.22 | 0.23 | 0.24 | 0.23 | 0.23 | 0.24 | 0.24 | 0.24 |
| Transport | 0.1 | 0.09 | 0.09 | 0.1 | 0.09 | 0.09 | 0.1 | 0.1 | 0.09 | 0.1 | 0.1 |
| **Income:** | | | | | | | | | | | |
| Disposable income (log) | 11.9 | 11.99 | 12.07 | 12.08 | 12.11 | 12.18 | 12.2 | 12.32 | 12.37 | 12.34 | 12.33 |
| Disposable income (var of log) | 0.12 | 0.13 | 0.12 | 0.12 | 0.13 | 0.12 | 0.13 | 0.13 | 0.14 | 0.12 | 0.13 |
| Observations | 2843 | 2320 | 2379 | 2384 | 2948 | 2686 | 2804 | 2406 | 2341 | 2347 | 2337 |

Author based on the Household Budget Survey data.

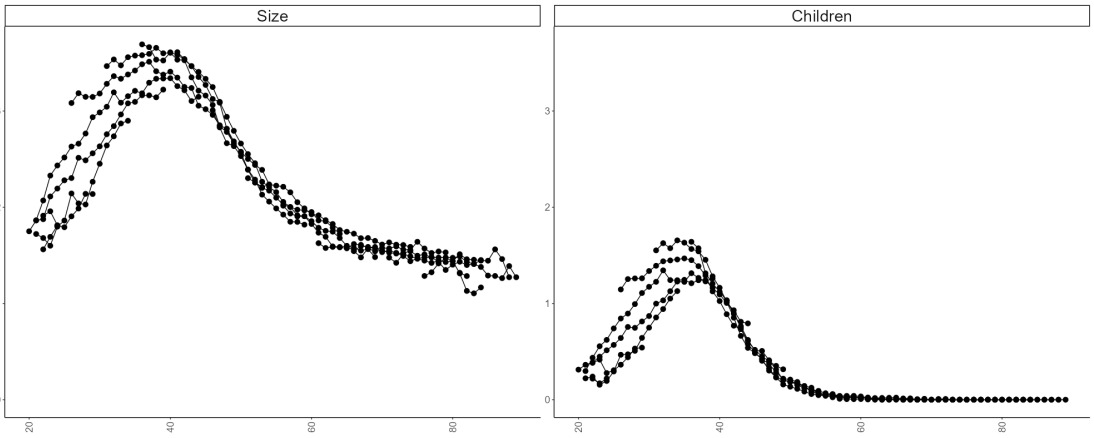
equality profile can arise as younger (lower inequality) cohorts continuously replace older (higher inequality) cohorts.

We deflate expenditure and income with aggregate CPI provided by the CzSO. All values are expressed in 2015 Czech crowns. The HBS uses a different classification of consumption goods from the COICOP classification applied by the CzSO for CPI measurement. A converter between the two classifications does not exist at a sufficiently detailed level for our analysis. This leads us to adopt the imperfect solution of relying on aggregate CPI.

We distinguish thirteen consumption classes. These are alcoholic beverages and tobacco, appliances, children's clothing, clothing and personal care, education, entertainment and recreation, food at home, food away, furniture and large household items, health, housing, housing services and construction, and transport. Table C.2 presents the items included in each consumption class. We ensure that each class is consistently defined over the entire 24-year period, even in the presence of occasional changes in the HBS classification of consumption items.

We proceed in two steps. First, we divide consumption expenditure into three broad classes

Figure 1: Cohorts: Household Size




*Source:* Author's calculation

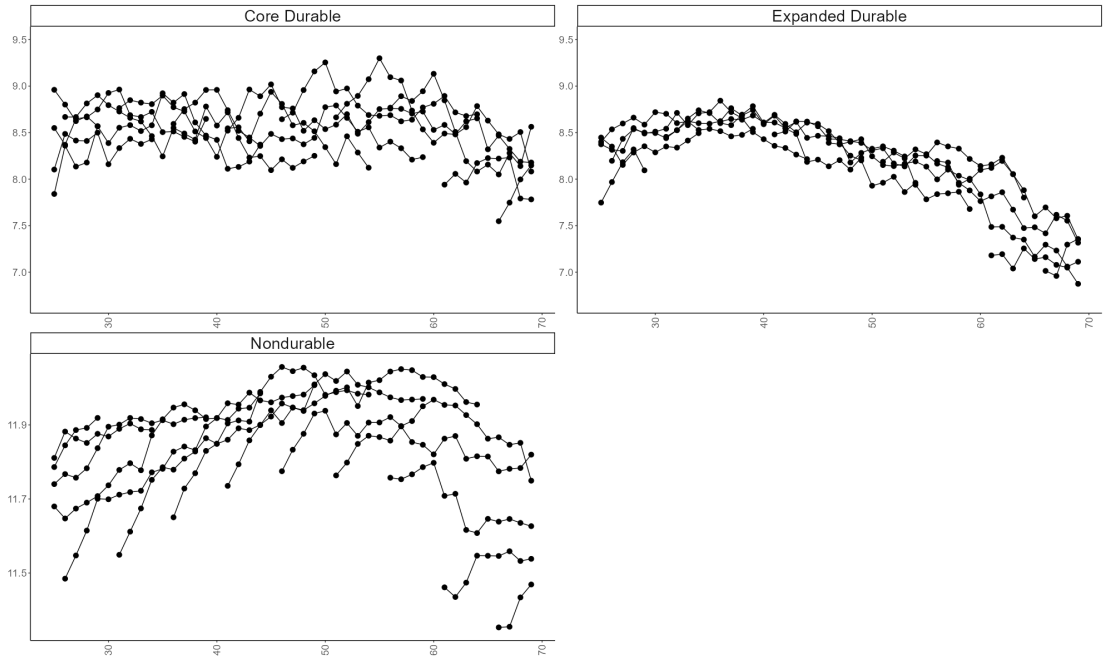
*Note:* The figure displays the mean household size (left panel) and the mean number of children (right panel) at each age for 5-year birth cohorts.

covering all reported items, i.e., core durables, expanded durables, and non-durables. Second, we focus on the evolution of consumption classes classified as non-durables. The content of most classes fits into one of the broad categories, with the exceptions of entertainment and recreation, and transport. We classify durable items from the entertainment and recreation consumption class, e.g., mobile phones, TV sets, and watches, as expanded durables. At the same time, we include the services from this class among non-durables. We split transport among core durables (cars, motorbikes), expanded durables (bicycles), and non-durables (rest of the class). Appliances, furniture and large household items, and housing services and construction belong to core durables. We classify the remaining consumption classes as non-durables.

We want to comment on two consumption classes before proceeding further. The housing class does not contain rent. Though the HBS records rental expenditures and mortgage payments, it does not provide a rental equivalent for homeowners. The treatment of rent and rental equivalence for homeowners varies in the literature as, for example, Alessie & De Ree (2009) and Alexandre *et al.* (2020) include them among consumption expenditure, while Banks *et al.* (2019) exclude them. We provide an additional set of results in which we impute rent for homeowners as a robustness check.

Our measure of nondurable consumption includes health expenditure. This choice might seem controversial as some studies, such as Aguiar & Hurst (2013) or Attanasio & Weber (1995), choose

Figure 2: Cohorts: Consumption




*Source:* Author's calculation

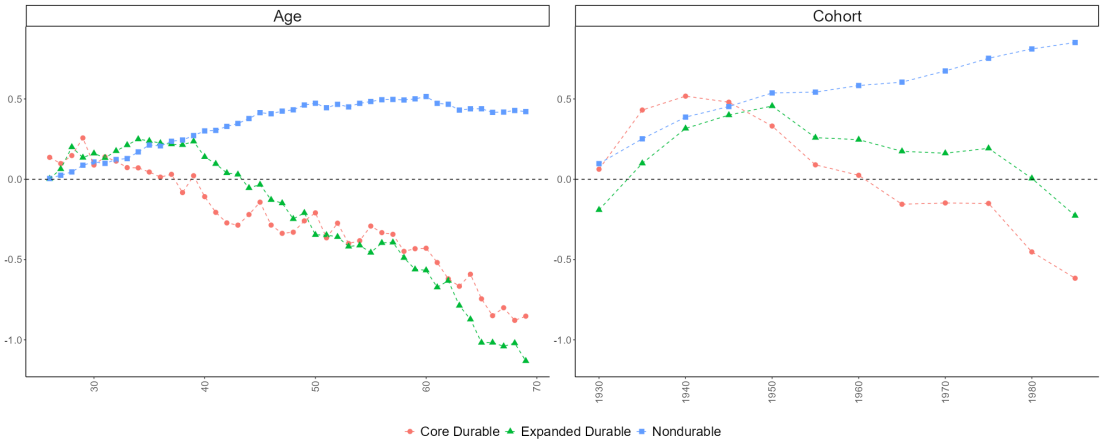
*Note:* The figure displays mean log equivalised consumption expenditure on the core durable (top left), expanded (top right) durable, and nondurable (bottom left) classes at each age for five-year birth cohorts.

not to include health expenditure among nondurable consumption. Our decision to include it is motivated by the role it can play in shaping life-cycle profiles. Banks *et al.* (2019) show it can drive between-country life-cycle profile differences.

The distribution of household consumption across the broad consumption classes is stable over time. Nondurable consumption commands, on average, nearly 90% of total household consumption expenditure. Core durables and expanded durables account, on average, for around 7% and 3% of total household consumption expenditure, respectively. Over 90% of households report nonzero expenditure on core and expanded durables. Figure 3 displays the cohort profiles for each of the broad consumption classes. Nondurable consumption seems to follow a life-cycle profile peaking around the age of 50. Moreover, it exhibits strong cohort effects. Consumption of expanded durables also displays a life-cycle profile. However, it peaks earlier, around the age of 40. It is difficult to identify any life-cycle profile for core durables based on Figure 3.

We can identify several patterns in the evolution of the structure of nondurable consumption.

Figure 3: Broad Classification: Life Cycle Profiles




*Source:* Author's calculation

*Note:* The figure displays the estimated life-cycle consumption profiles (left panel) and cohort effects (right panel) for the core durable, expanded durable, and nondurable classes.

Food at home commands, on average, the biggest share of household nondurable consumption. However, this share decreased significantly during the considered time period. This development aligns with income and consumption growth if we consider food at home to be a necessity. Contrarily, the shares commanded by entertainment and recreation, health, and housing increased.

# 4 Results

We present the life-cycle profiles obtained by combining the HBS with the methodology outlined in section 2. We first discuss the dynamics of the broad consumption classes and then analyze the evolution of the components of nondurable consumption. Finally, we discuss how alternative modeling choices affect our results.

## 4.1 Broad Classification

Figure 3 presents the estimated effects from Equation 1 for the three broad consumption classes, i.e., core durables, expanded durables, and nondurables. The omitted categories are age 25 and the 1925-1929 cohort. The left panel presents the age effects, while the right panel presents the cohort effects.

The consumption expenditure on core and expanded durables follow similar life-cycle profiles.

The expenditure on both classes peaks before the age of 40, after which it decreases until the end of the life-cycle. This suggests that most of the expenditure on durable goods occurs in the first phase of the life-cycle. Alessie & De Ree (2009) and Fernández-Villaverde & Krueger (2007) identify similar life-cycle profiles for durable consumption expenditure. However, our profiles start to decrease earlier in the life-cycle. Similarly to Alessie & De Ree (2009) and Fernández-Villaverde & Krueger (2007), we focus on consumption expenditure. Recently, Browning *et al.* (2016) modeled the demand for services from specific durable goods instead of consumption expenditure and found that, for example, demand for electronics increases with age.

Nondurable consumption follows a slightly hump shaped life-cycle profile, similar to those found in previous studies. It rises until the age of 50, after which it levels for nearly ten years. We observe a slight drop in nondurable consumption in the years surrounding retirement, i.e., around the age of 60. Aguiar & Hurst (2013), Alexandre *et al.* (2020), and Fernández-Villaverde & Krueger (2007) find some version of hump shaped life-cycle nondurable consumption profiles. Banks *et al.* (1998) study the drop in consumption around retirement.

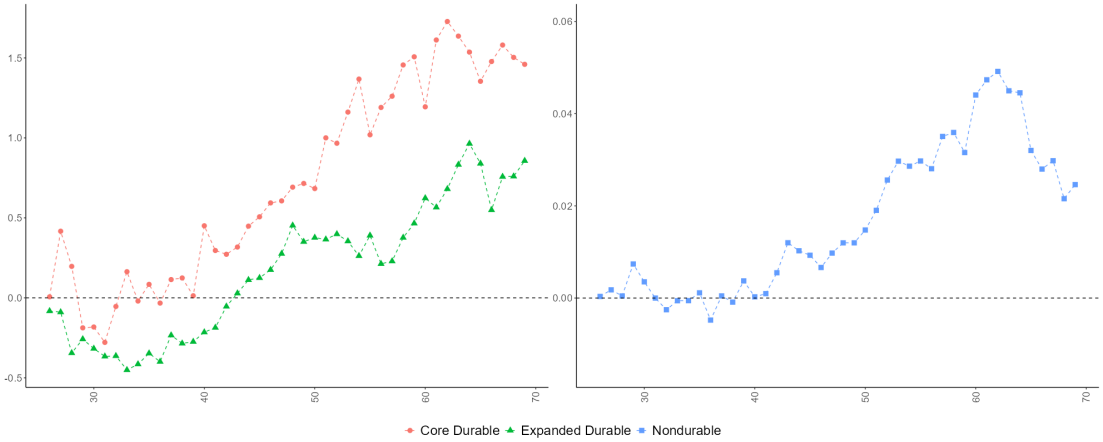
Cohort effects vary between the broad classes. Nondurable goods' cohort effects increase steadily from older to younger cohorts. This profile is expected given the general economic growth associated with higher lifetime resources of younger cohorts compared to older cohorts. Both core durables' and expanded durables' cohort effects exhibit different behavior, reaching a peak for older cohorts and then declining.

Figure 4 displays the estimated life-cycle inequality profiles. The difference in the scale of the estimated effects leads us to plot nondurable consumption separately from core durables and expanded durables. All broad classes follow a similar pattern of rising inequality starting at the age of 40. This is preceded by mostly flat profiles for core durables and nondurables. In the case of expanded durables, the flat profile before age 40 is combined with a drop at the beginning of the life-cycle. Figure D.1 presents the estimated cohort effects.

## 4.2 Nondurable Consumption

Figure 5 presents the estimated life-cycle profiles of nondurable consumption disaggregated into the ten previously described classes. We observe significant heterogeneity in the estimated life-

Figure 4: Broad Classification: Inequality




*Source:* Author's calculation

*Note:* The figure displays the estimated life-cycle inequality profiles for the core durable, expanded durable, and nodurable consumption classes.

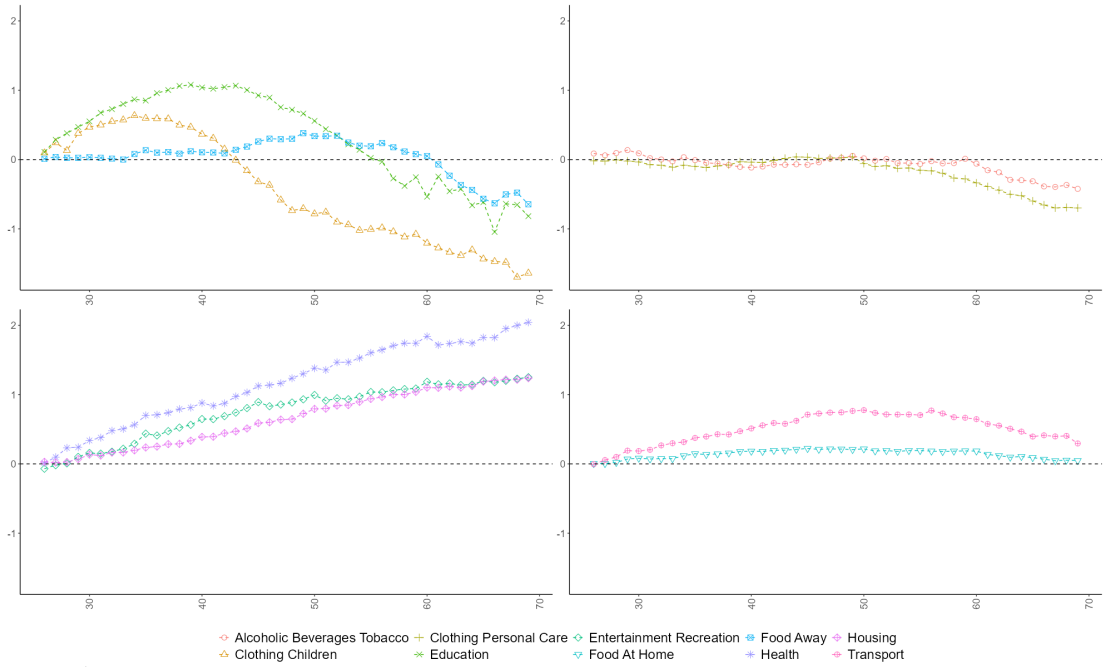
cycle profiles. Consequently, to avoid clutter, we plot jointly classes with similar profiles. Figure D.2 displays the estimated cohort effects.

Only a few consumption classes follow a life-cycle profile similar to aggregate nondurable expenditure. Looking at the bottom-right panel, only transport (nondurable) and food at home display some version of the "hump" shaped life-cycle profile. The profile is considerably more pronounced for transport, which peaks around the mid-40s, then levels until the late 50s, and steadily declines thereafter. Food at home follows a flatter profile as it slightly increases until the age of 40 and registers a minor drop around retirement.

Several classes manifest purely growing life-cycle profiles. These are health, entertainment and recreation, and housing. Health consumption registers the most significant growth. The latter two classes achieve similar growth over the life-cycle, with entertainment and recreation growing faster towards the beginning of life-cycle. The consumption of clothing and personal care, and alcoholic beverages and tobacco follows a sharply different profile, remaining flat throughout most of the life-cycle and steadily declining after retirement.

Children clothing and education display similar profiles registering a growth at the beginning of the life-cycle, peaking around the middle age, and then steadily declining. The peak in education consumption happens later in life and is more pronounced. The similarity in life-cycle profiles stems from education consisting mostly of expenditure on children's schooling. Finally,

Figure 5: Nondurable Consumption: Life Cycle Profiles




*Source:* Author's calculation

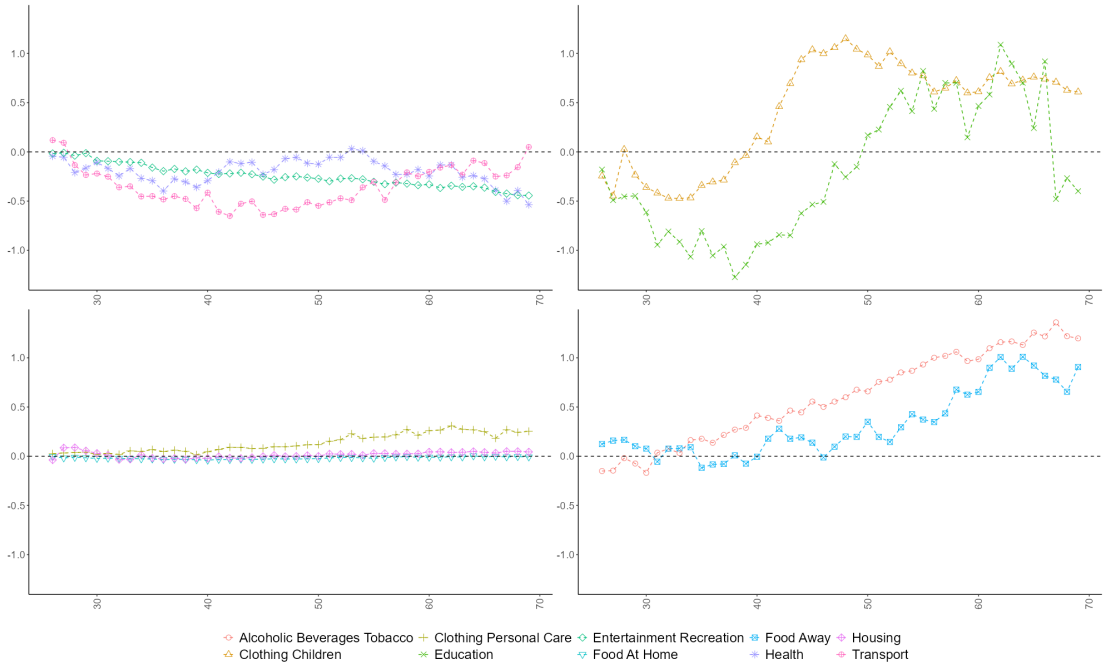
*Note:* The figure displays the estimated life-cycle consumption profiles for each of the nondurable consumption subclasses.

the profile of food away is mostly flat registering a slight increase in the mid-40s followed by a fall starting around retirement.

Our analysis of detailed nondurable consumption classes bears the closest connection to Aguiar & Hurst (2013). Similarly to Aguiar & Hurst (2013), we find that primarily work-related classes, i.e., transport, food away, and clothing and personal care, exhibit hump-shaped life-cycle profiles. However, unlike the authors, we also find considerable heterogeneity in other classes' profiles. Aguiar & Hurst (2013) do not study education expenditure, which, together with children's clothing, displays a hump-shaped profile likely connected to the presence of children in the household. Additionally, we find a strong decrease in alcoholic beverages and tobacco consumption towards the end of the life-cycle.

Figure 5 reports the estimated life-cycle inequality profiles. Similarly to the consumption profiles, we see that children clothing and education exhibit similar profiles. Inequality in food away and alcoholic beverages and tobacco increase throughout the life-cycle, whereas inequality in entertainment and recreation decreases. We observe a u-shaped evolution for transport, and

Figure 6: Nondurable Consumption: Inequality




*Source:* Author's calculation

*Note:* The figure displays the estimated life-cycle inequality profiles for each of the nondurable consumption subclasses.

flat profiles for housing and food at home. Inequality in clothing and personal care slightly rises, while inequality in health fluctuates with two decreases, one between 30 and 40 and the second starting before retirement.

## 4.3 Robustness Checks and Supplementary Results

The appendices contain the results from all robustness checks and selected supplementary results. Figure E.1 and Figure E.2 display the previously reported life-cycle consumption profiles with their respective 95% confidence intervals. Overall, the consumption profiles are precisely estimated, and the life-cycle dynamics are visible, even taking into account the confidence intervals. The only exception is the core durables class.

Figure F.1 and Figure F.2 present the estimated life-cycle consumption and inequality profiles for durable consumption subclasses. Consumption expenditure on the appliances, and furniture and large household items classes follow decreasing life-cycle profiles, while the entertainment

and recreation class follows a hump-shaped profile. Consumption expenditure on the housing services and construction, and transport classes follows growing life-cycle profiles. Life-cycle inequality profiles are purely rising for the housing services and construction, and transport classes, purely decreasing for appliances, and decreasing until middle age and growing afterwards for the entertainment and recreation, and furniture and large household items classes.

Figure G.1 and Figure G.2 present the life-cycle consumption profiles and cohort effects stemming from consumption adjusted by the modified OECD equivalence scale instead of the square root scale. Changing the equivalence scale has a limited effect on the estimated consumption profiles and does not affect our findings. Figure G.3 and Figure G.4 display the life-cycle profiles based on total unequivalised household consumption expenditure. Not equivalising consumption expenditure primarily affects nondurable profiles, which exhibit significantly more hump-shaped profiles.

Figure H.1 displays the life-cycle profiles of nondurable consumption, rent and imputed rent, and nondurable consumption including rent and imputed rent. We observe that nondurable consumption with and without rent and imputed rent follow similar life-cycle profiles. Figure H.2 suggests that adding rent and imputed rent to nondurable consumption leads to a lower rise in inequality over the life-cycle. Appendix H describes our imputed rent calculation.

We additionally report the profiles for total income, disposable income, and earnings. Figure I.1 and Figure I.2 present the estimated profiles for total income, disposable income, and earnings. Finally, Figure J.1, and Figure J.2 display the life-cycle profiles disaggregated by household head's education.

# 5 Conclusion

We study the consumption and inequality life-cycle profiles. We rely on Czech Household Budget Survey data covering the 1993-2016 period and the standard approach of Deaton & Paxson (1993) to separate age and cohort effects. We distinguish thirteen consumption classes. We first separate classes based on their durability. We then focus in detail on the evolution of consumption classes that make up household nondurable consumption.

We reach several conclusions. First, our findings reveal substantial differences in the con-

sumption profiles of durable and nondurable consumption items. Second, we find substantial heterogeneity among the classes that make up total nondurable consumption. Third, our findings suggest that inequality profiles remain mostly flat throughout the life-cycle and begin to rise only after middle age.

Our findings also suggest possible directions for future research. The estimated life-cycle profiles vary with the choice of the equivalence scale. This issue is well-documented and was studied in detail by Fernández-Villaverde & Krueger (2007). However, consensus about the appropriate solution is lacking. Fernández-Villaverde & Krueger (2007) solve the issue by creating an equivalence scale through averaging the alternative commonly-applied equivalence scales. Contrarily, Aguiar & Hurst (2013) control for family structure directly in their version of Equation 1, which they estimate on the household level. Both these approaches represent only a partial solution.

Indifference scales might be a possible solution to this problem. The indifference scale, proposed by Browning *et al.* (2013), is the scale to income or expenditure, which gets an individual living in two different household types to the same indifference curve. Consequently, it avoids the issues raised by interpersonal utility comparison. Chiappori (2016) claims that indifference scales should replace equivalence scales, whereas Pendakur (2018) argues for their joint use. In the context of life-cycle profile measurement, indifference scales would enable researchers to move from the household to the individual level. To the best of our knowledge, only Deaton & Paxson (2000) took a step in this direction.

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# Appendices

## A Household Budget Survey: Sampling Desing

Households with economically active household head were sampled based on three criteria. Before 2006 the first criterion was the social group of the household head, i.e., workman, employee, farmer, and self-employed. Households with unemployed household head were not included in the sample. Since 2006 the first criterion was adjusted, and households with economically active household members were sampled based on their membership of the following groups: employees with lower education, employees with higher education, self-employed, and unemployed. The additional two criteria were the number of dependent children and net monthly income.

Households with economically inactive household head were also sampled based on three criteria. Before 2006 this group included only pensioner households with inactive household members. The sampling criteria were the amount of pension received, number of household members, and sex in the case of single-person households. Since 2006 this group also included households headed by non-pensioners as well as households with inactive household head with economically active household members. The sampling criteria were the household head type (pensioners/others), household size, and monthly income.

Households were recruited into the sample in the year prior to the survey year. Before 2006 the sampling criteria were evaluated according to the prevalent state in June of the selection year for households with economically active heads, e.g., based on the prevalent state in June 1998 for the survey year 1999. Since 2006 the sampling criteria were evaluated according to the prevalent state in the year prior to the enrolment year, e.g., the prevalent state in 2004 for survey year 2006. For households with economically inactive household heads, the sampling criteria were evaluated according to the prevalent state in November of the enrolment year during the entire 1993-2015 period, e.g., November 1998 for survey year 1999.

# B Household Budget Survey: Cohorts

Table B.1: Household Budget Survey: Cohorts

| cohort | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1910-1914 | 69 | 57 | | | | | 7 | 7 | 7 | 4 | 2 | 2 | | | | | | | | | | | | |
| 1915-1919 | 50 | 37 | 75 | 58 | 37 | 31 | 22 | 19 | 11 | 10 | 4 | 3 | 3 | 1 | 2 | 2 | 4 | | | | | | | |
| 1920-1924 | 132 | 124 | 103 | 100 | 100 | 92 | 84 | 83 | 80 | 65 | 42 | 35 | 33 | 25 | 16 | 16 | 11 | 10 | 8 | 6 | 6 | 5 | | |
| 1925-1929 | 134 | 120 | 131 | 130 | 144 | 135 | 130 | 149 | 146 | 143 | 102 | 95 | 86 | 67 | 61 | 47 | 42 | 37 | 30 | 28 | 22 | 19 | 18 | 12 |
| 1930-1934 | 167 | 136 | 148 | 152 | 156 | 159 | 151 | 178 | 181 | 177 | 126 | 124 | 118 | 103 | 93 | 91 | 87 | 72 | 67 | 62 | 54 | 46 | 40 | 30 |
| 1935-1939 | 236 | 186 | 169 | 171 | 150 | 139 | 133 | 149 | 167 | 165 | 135 | 129 | 132 | 120 | 114 | 110 | 105 | 100 | 96 | 92 | 84 | 79 | 73 | 47 |
| 1940-1944 | 317 | 235 | 245 | 250 | 237 | 230 | 230 | 268 | 251 | 238 | 218 | 198 | 189 | 161 | 158 | 152 | 143 | 147 | 158 | 142 | 156 | 162 | 151 | 101 |
| 1945-1949 | 380 | 293 | 285 | 286 | 289 | 292 | 297 | 359 | 362 | 374 | 355 | 357 | 373 | 283 | 275 | 245 | 227 | 213 | 202 | 187 | 182 | 169 | 175 | 109 |
| 1950-1954 | 417 | 323 | 293 | 302 | 300 | 295 | 288 | 340 | 349 | 320 | 325 | 338 | 364 | 309 | 314 | 303 | 317 | 305 | 276 | 263 | 239 | 233 | 197 | 119 |
| 1955-1959 | 392 | 315 | 304 | 292 | 276 | 273 | 269 | 330 | 314 | 308 | 290 | 298 | 278 | 243 | 248 | 262 | 248 | 246 | 251 | 246 | 246 | 251 | 247 | 127 |
| 1960-1964 | 328 | 286 | 271 | 291 | 289 | 267 | 291 | 344 | 354 | 346 | 300 | 346 | 282 | 277 | 276 | 256 | 261 | 261 | 251 | 246 | 249 | 247 | 253 | 142 |
| 1965-1969 | 184 | 177 | 203 | 219 | 238 | 211 | 252 | 316 | 338 | 345 | 336 | 350 | 312 | 254 | 259 | 237 | 239 | 246 | 245 | 250 | 260 | 267 | 252 | 136 |
| 1970-1974 | 37 | 52 | 93 | 126 | 147 | 163 | 192 | 270 | 281 | 309 | 294 | 321 | 354 | 307 | 289 | 300 | 301 | 315 | 313 | 311 | 329 | 330 | 319 | 189 |
| 1975-1979 | | 2 | 2 | 9 | 16 | 28 | 45 | 92 | 115 | 147 | 145 | 189 | 238 | 235 | 243 | 263 | 270 | 280 | 298 | 310 | 293 | 298 | 293 | 181 |
| 1980-1984 | | | | | | | | 4 | 3 | 10 | 18 | 26 | 45 | 48 | 60 | 67 | 73 | 98 | 120 | 133 | 158 | 165 | 165 | 99 |
| 1985-1989 | | | | | | | | | | | | | | 3 | 8 | 8 | 17 | 24 | 40 | 47 | 66 | 82 | 95 | 57 |
| 1990-1994 | | | | | | | | | | | | | | | | | | | | 2 | 6 | 16 | 24 | 17 |
| 1995-1999 | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | |

Author based on the Household Budget Survey data.

# C Consumption classes: Specification

Table C.2: Specification of Consumption Classes

| Broad Class | Class | Items |
|---|---|---|
| Core Durables | Appliances | regrigerators; washing machines, dryers, and dishwashers; cooking devices; heating and ventilations; cleaning devices; sewing machines; other housing devices; durable housing and gardening tools including repairs; small domecstic appliances |
| | Furniture, Large HH Items | furniture; housing equipment and accessories; carpets and other floor coverings; other housing equipment; items for construction or reconstruction of household |
| | Housing Services Construction | furniture, and flooring material reparations; repairs of domestic appliances; household maintenance and repair services; household services; domestic works conducted by staff |
| | Transport | new cars; second-hand cars; motorbikes |
| Expanded Durables | Entertainment Recreation | mobile phones; TV sets, VHS and DVD players; radios, audio equipment; photographic and cinematic equipment; optical devices; data processing machines; jewels, and watches; phones, and fax machines; toys; durable products for recreation in the nature; camping equipment; musical instruments; durable products for indoor recreation; books; maintenance and reparations of durable recreation and cultural items |
| | Transport | bicycles |
| Nondurables | Alcoholic Beverages Tobacco | beer; wine from grapes or other fruits; other wine; spirits; beer consumed in restaurants; beer consumed in cafes, bars, and similar businesses; wine consumed in restaurants; wine consumed in cafes, bars, and similar businesses; other alcoholic beverages consumed in restaurants; other alcoholic beverages consumed in cafes, bars, and similar businesses; cigarettes; cigars; other tobacco |
| | Clothing Children | underwear and knitted wear - children; ready-to-wear clothes - children; stockings and socks - children; shoes - children |
| | Clothing Personal Care | clothing materials; underwear and knitted wear - male; underwear and knitted wear - female; ready-to-wear clothes - male; ready-to-wear clothes - female; clothing accessories; haberdashery; stockings and socks - male; stockings and socks - female; shoes - male; shoes - female; travel equipment, bags, wallets; other personal accessories; cosmetics; personal hygiene products; electronic self-care products; cleaning, reparation, and renting of clothes; repairs and renting of shoes; hairdressing, and personal care services |
| | Education | food consumed in school canteens; food consumed in nurseries; textbooks; other services related to transportation tools; primary school, 1.-5. grade; primary school, higher grades; secondary and high schools; follow-up study below university level; university education; other education; kindergarten |

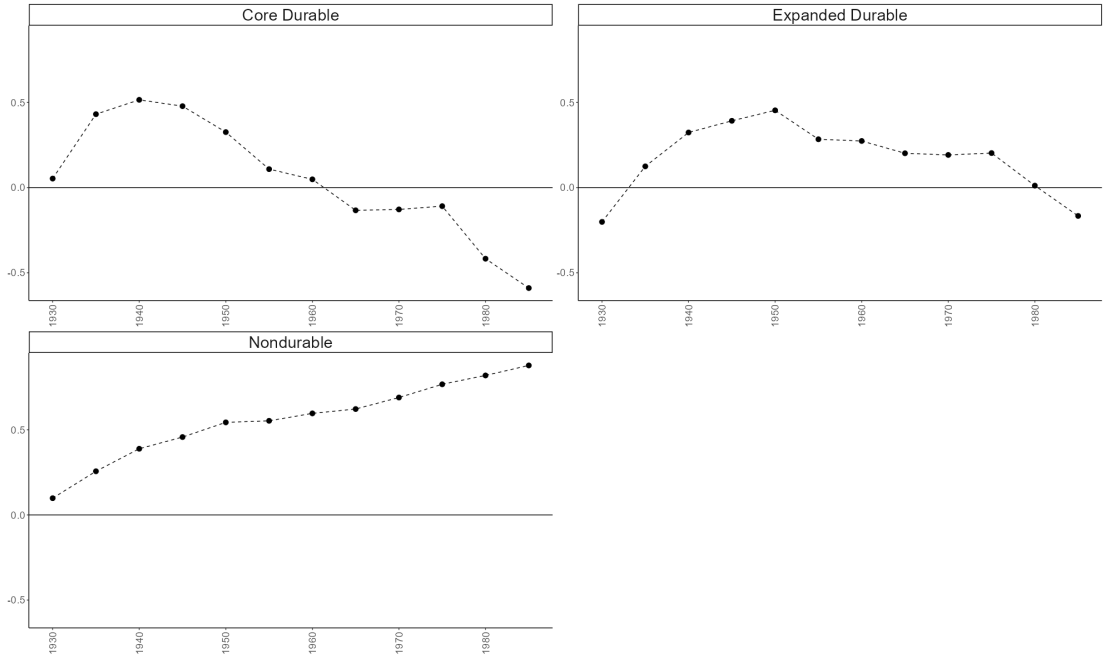
| | |
|---|---|
| Food At Home | meat - pork; meat - beef; meat - lamb, and mutton; other meats and entrails; smoked products, sausages and smoked meats; meat cans, other meat products; poultry; fish - fresh, refrigerated, and frozen; sea products - fresh, refrigerated, and frozen; fish and sea products - dried, solted, smoked; other fish and meat products; butter; pork fat and bacon; olive oil; other edible oils; plant-based and other fats; eggs; egg-based products; milk - full-fat; milk - low-fat; milk - dried, canned; cheese; yogurts; curd cheese; other milk products; bread; ordinary baked goods; sandwich; other fine baked goods; durable bread, wafers, and gingerbread; other durable baked goods; wheat flour; pasta; other cereal products; rice; legume; potatoes; potato-based products; tomatoes, peppers, cucumbers, and other fruit vegetables; leaf and tops legumes; brassicaceous legumes; mushrooms, root and other vegetables; dried vegetables; other vegetable products elsewhere not mentioned; citrus fruits; bananas; apples; pears; other fruits with core elsewhere not mentioned; peaches, cherries, and other fruits with pit; grapes, and other berry plants; exotic berry plants; other fruit elsewhere not mentioned; jams; fruit products; dried fruit; sugar; chocolate and chocolate-based products; non-chocolate sweets; ice-cream; other candy elsewhere not mentioned; cocoa; honey; fuit sugars, artifical sweeteners; coffee replacements and mixtures; coffee; tea; soups, and sauces; salt, and spices; flavours and seasonings; baking goods and other food; fuit syrups, and concentrates; vegetable syrups, and concentrates; fruit juices; vegetable juices; other non-alcoholic beverages; mineral, and table water |
| Food Away | food consumed in factory canteens; food consumed in restaurants; food consumed in cafes, bars, and similar businesses; fruit and vegetable juices consumed in restaurants; fruit and vegetable juices consumed in cafes, bars, and similar businesses; other non-alcoholic beverages consumed in restaurants; other non-alcoholic beverages consumed in cafes, bars, and similar businesses; mineral, and table water consumed in restaurants; mineral, and table water consumed in cafes, bars, and similar businesses |
| Health | co-payed medicine; other medical products; fully payed medicine; non-prescription and other medicine; orthopaedic and other therapeutic equipment; medical care; dental care; laboratory and x-ray services; therapeutical services; outpatient care; institutional medical care; nursery, and other children facilities; other social care services; regulatory payments for medicine; regulatory payments for doctors; regulatory payments for dentists; regulatory payments in spa, and other curative institutions; life insurance; health insurance |

| | |
|---|---|
| Housing | ben linen and tablecloths, including fabrication and repairs; washing powder; cleaning products; other drugstore products; products for common maintenance and repairs of flat/house; housing textile including fabrication and repairs; glass, porcelain, and ceramic tableware; cutlery; metal and other tableware; other kitchen equipment elsewhere not mentioned; housing equipment repairs; tools; liquid fuels; solid fuels; gas in canisters; rent for main residence; electricity; gas; hot and cold water; water rate, and sewer rate; other services connected to housing; garbage collection; other rent; flowers; housing insurance |
| Entertainment Recreation | prams; portable devices for storing image and sound; other industrial products; small cultural products; writing, and drawing equipment; newspapers, and journals; other printed materials; postal services; phone services; radio, and television; mobile phone operating costs; data and internet; repairs of audiovisual, photographic, and data processing tools; financial services; consulting, and administrative services; recreation - domestic; recreation - foreign; accommodation services; recreational and sporting services; cinema, theatres, concerts, and similar performances; museums, ZOOs, and similar institutions; CD, DVD, and VHS renting services; cultural and entartainment services elsewhere not mentioned |
| Transport | fuels, oils, and other agents for personal transportation; spares and accessories for personal transportation; combined personal transport; within-city personal transport; inter-city personal transport; taxi; train travels; airplane travels; nautical, and river transport; other payed transportation services; maintenance and services of personal transportation tools; travel insurance |

# D Cohort Effects

Figure D.1, Figure D.2, and Figure D.3 display the estimated cohort effects for the broad classification life-cycle inequality profiles, and nondurable consumption life-cycle and life-cycle inequality profiles, respectively.

Figure D.1: Broad Classification: Inequality (Cohort Effects)




*Source:* Author's calculation

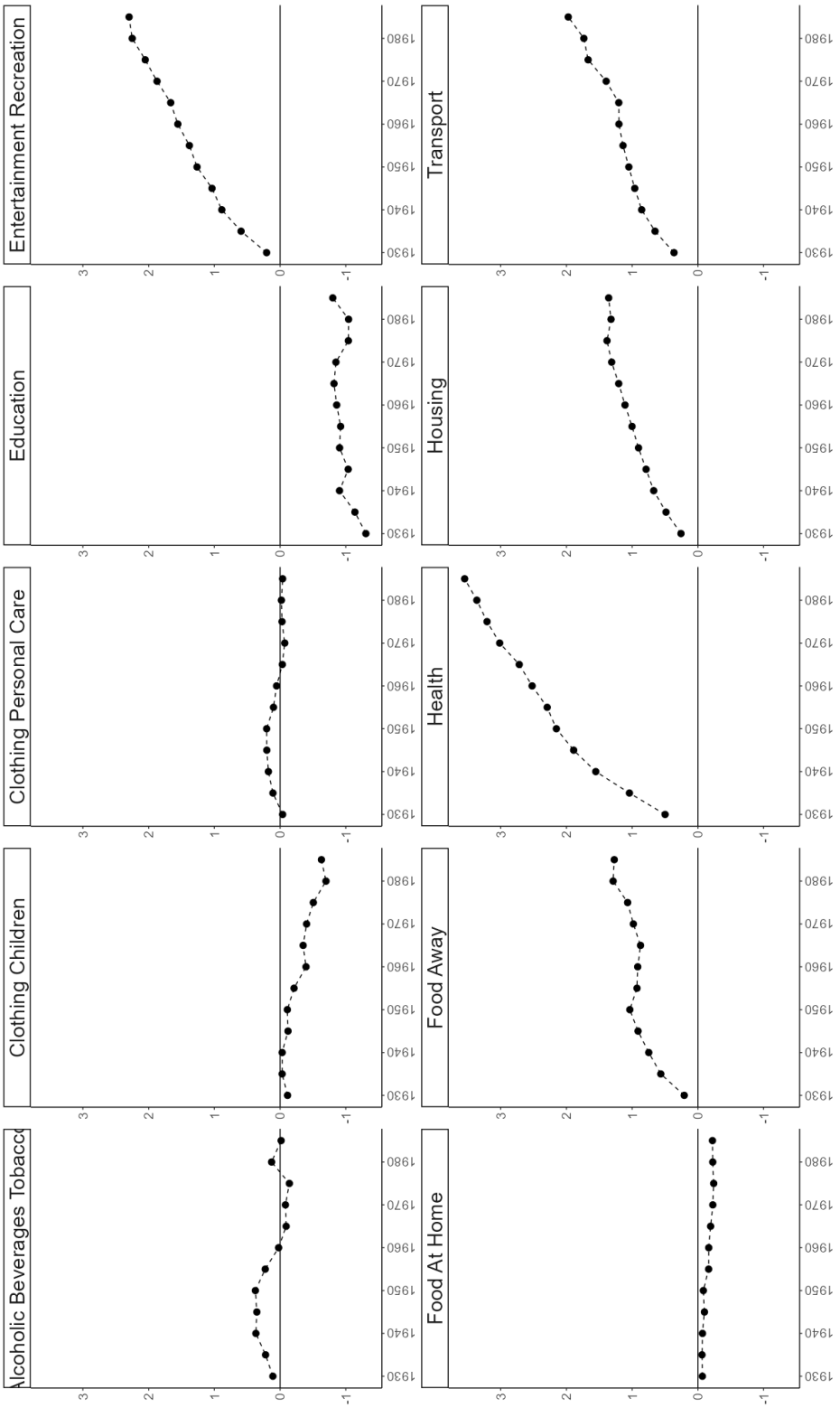
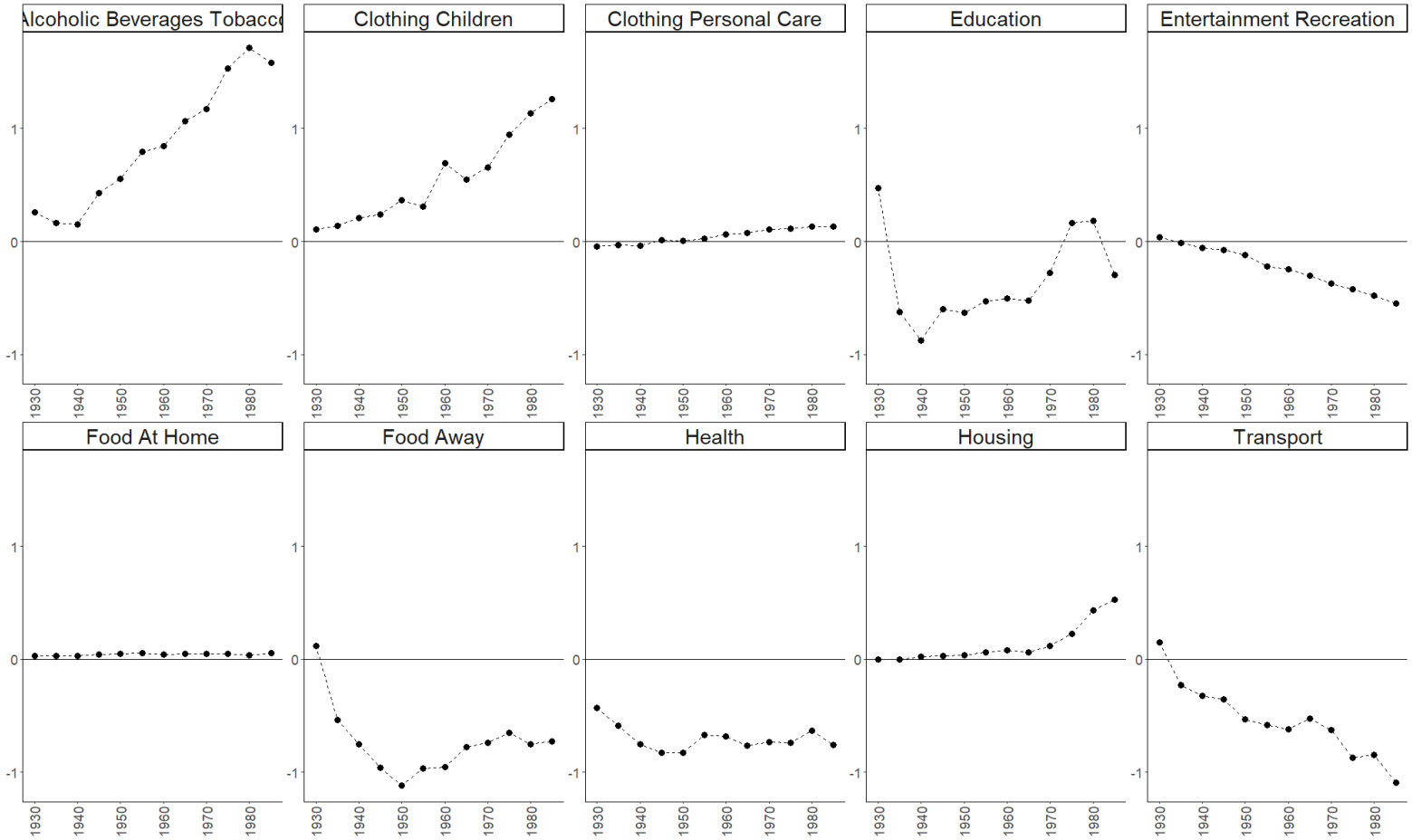



Figure D.2: Nondurable Consumption: Life-cycle (Cohort Effects)

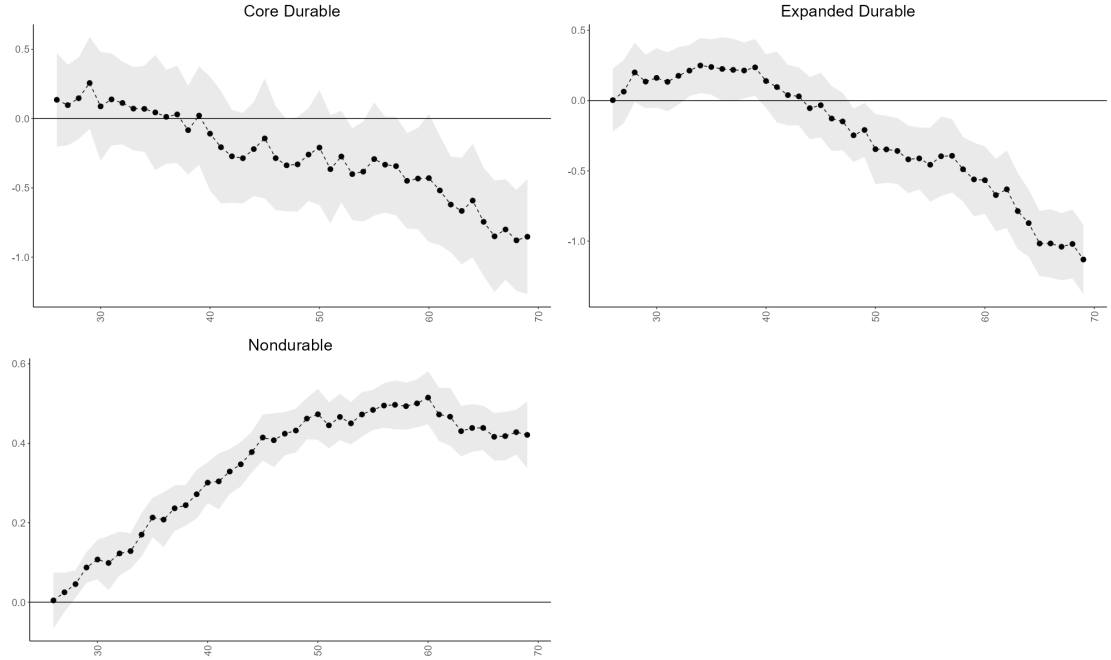
Figure D.3: Nondurable Consumption: Inequality (Cohort Effects)



# E Confidence Intervals

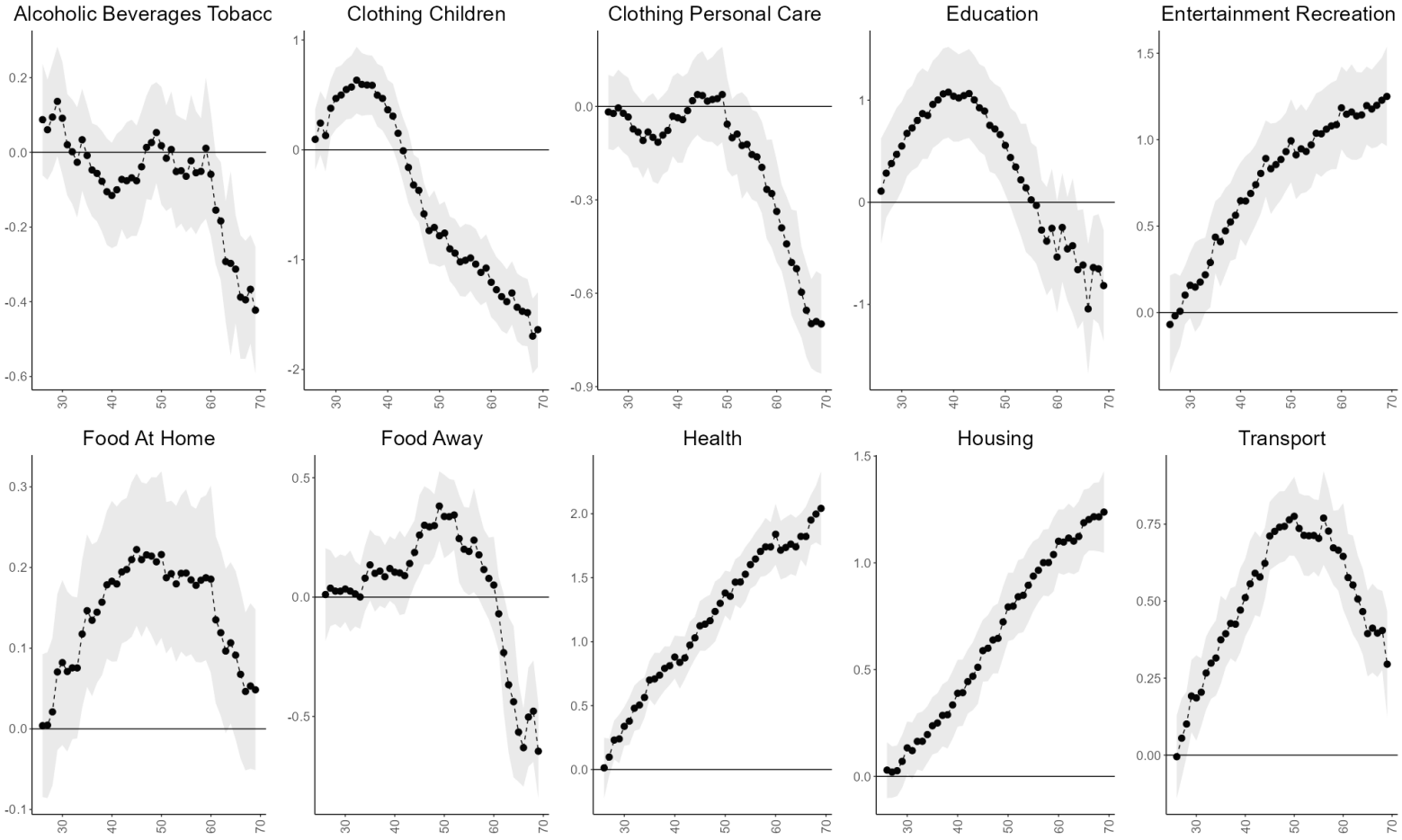
Figure E.1 and Figure E.2 display the estimated life-cycle profiles with their respective 95% confidence intervals.

Figure E.1: Broad Classification: Confidence Intervals




*Source:* Author's calculation

Figure E.2: Nondurable Consumption: Confidence Intervals



# F Durable Consumption: Detailed

Figure F.1, and Figure F.2 present the life-cycle and life-cycle inequality profiles for components of household durable consumption.

Figure F.1: Durable Consumption: Life-cycle Profiles

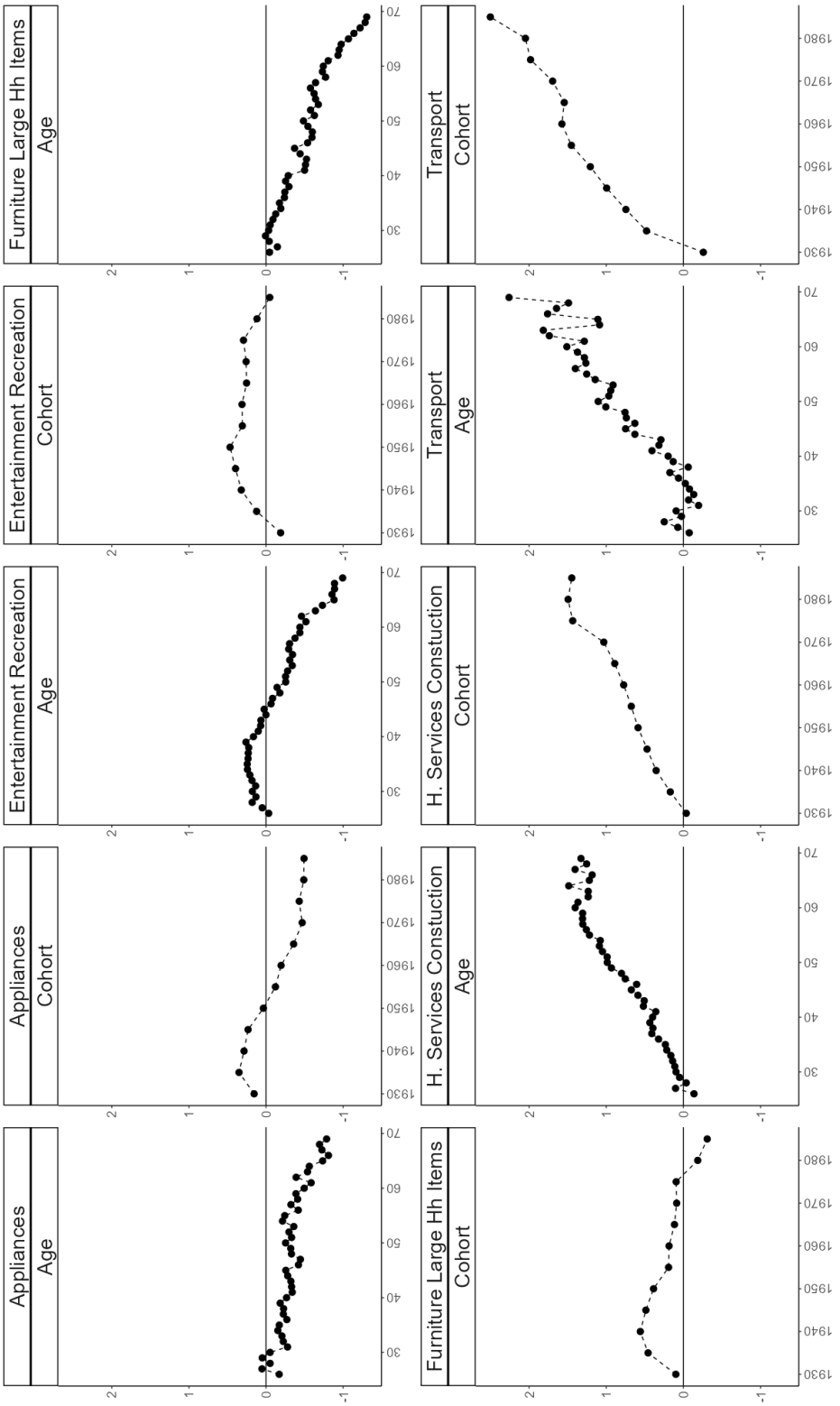
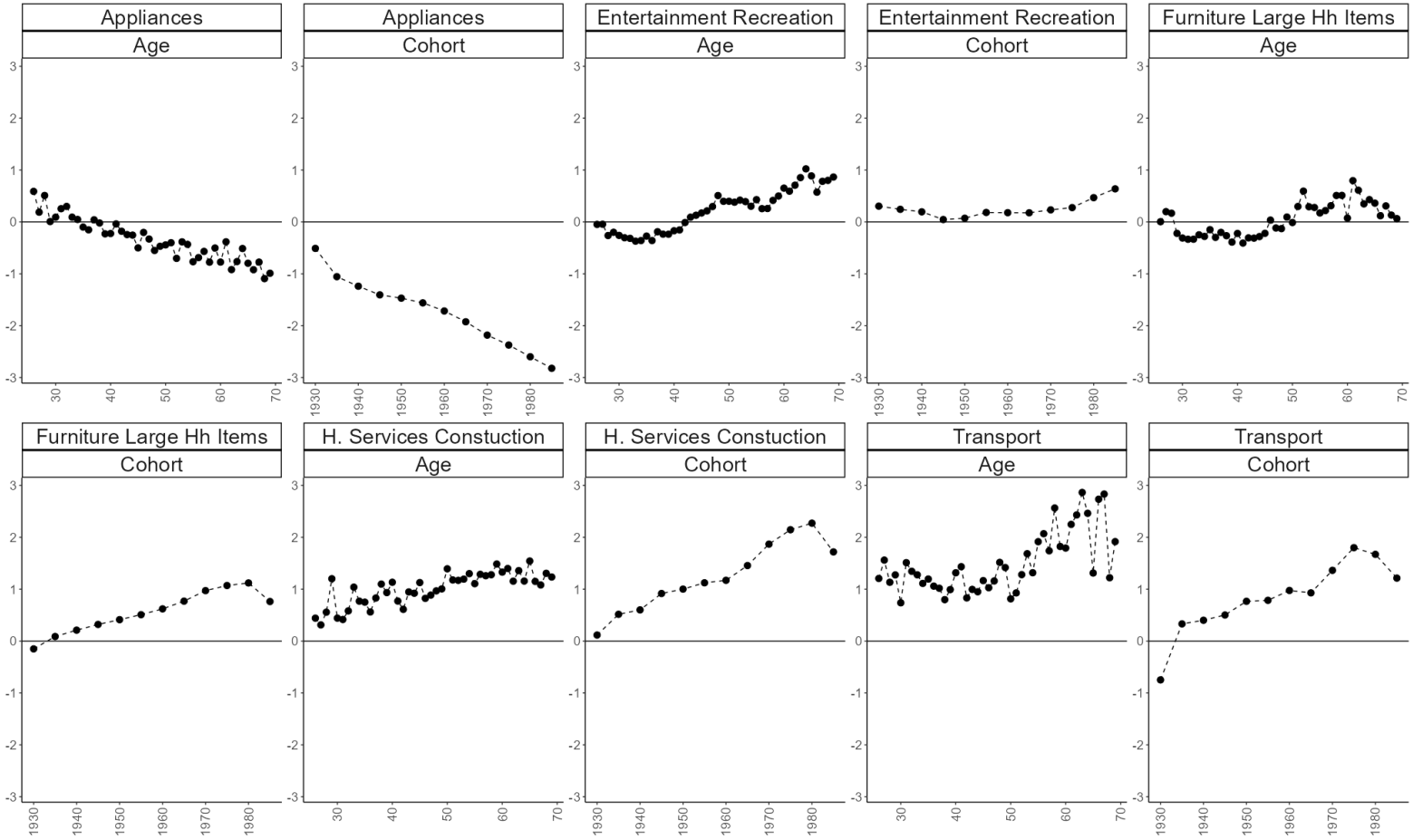


Figure F.2: Durable Consumption: Inequality

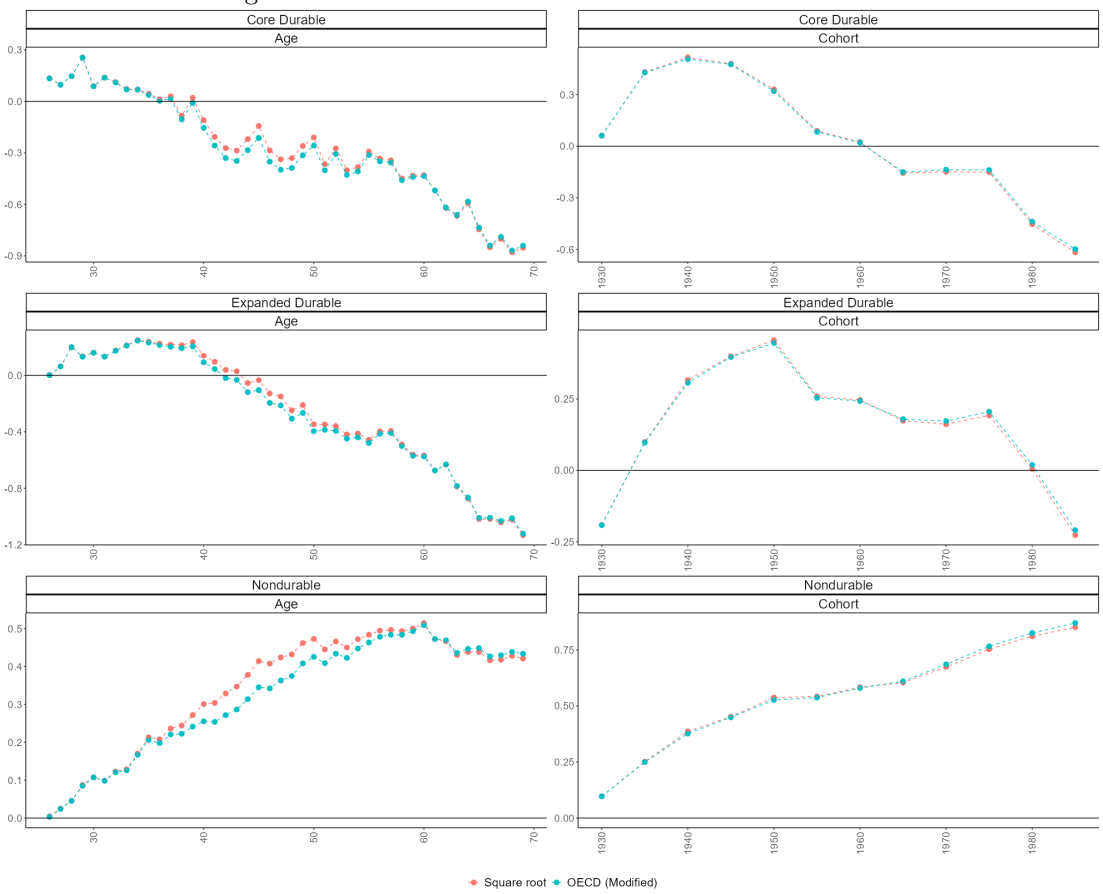


# G Alternative equivalence scales

## G.1 OECD Modified

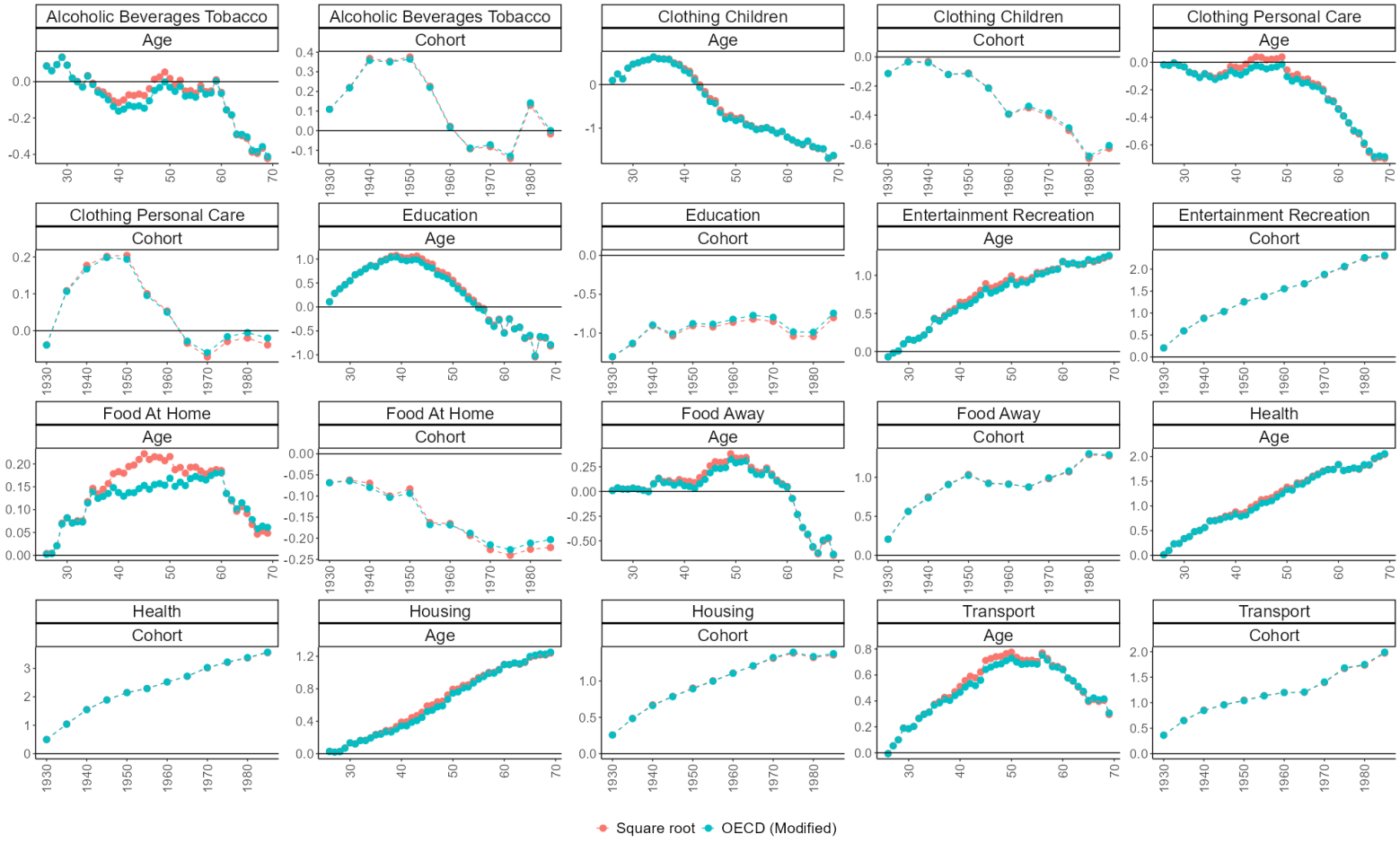
Figure G.1 and Figure G.2 display the estimated life-cycle consumption expenditure profiles based on consumption equivalised by the modified OECD equivalence scale.

Figure G.1: OECD Modified Scale: Broad Classification




*Source:* Author's calculation

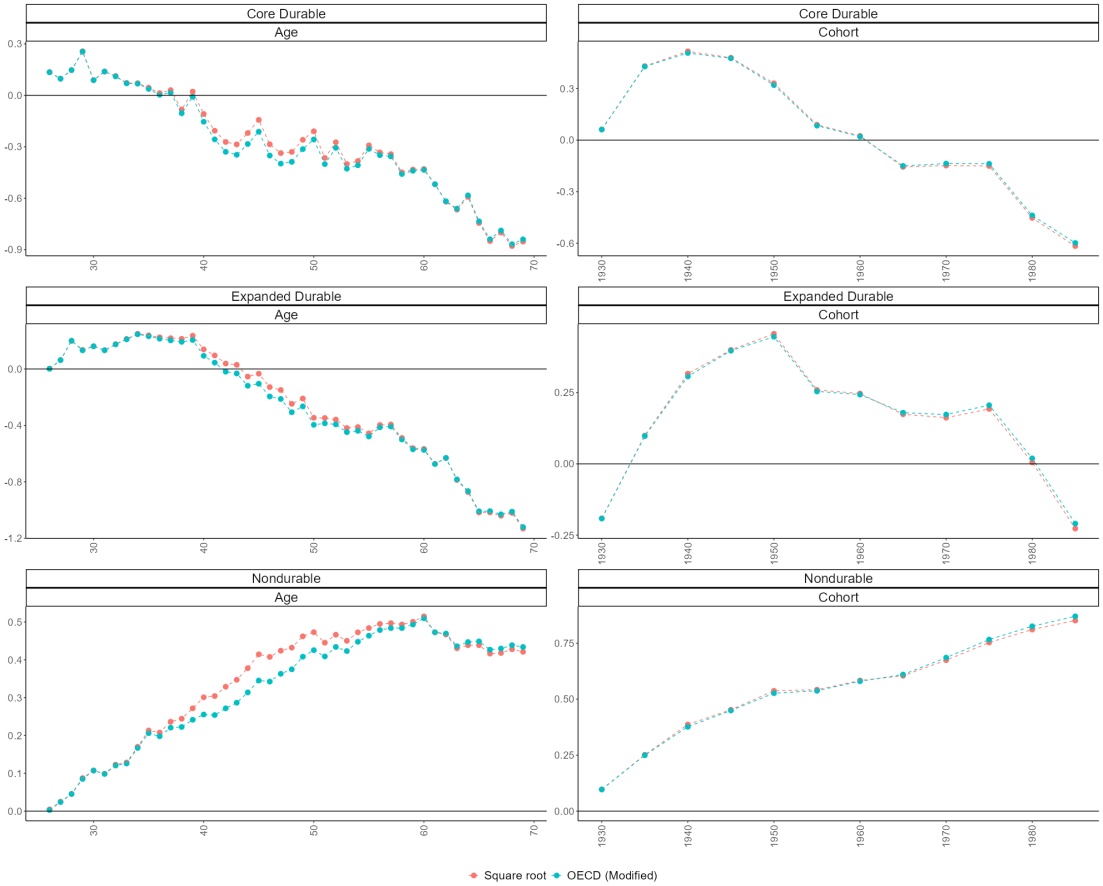
Figure G.2: OECD Modified Scale: Nondurable Consumption



## G.2 Total Consumption

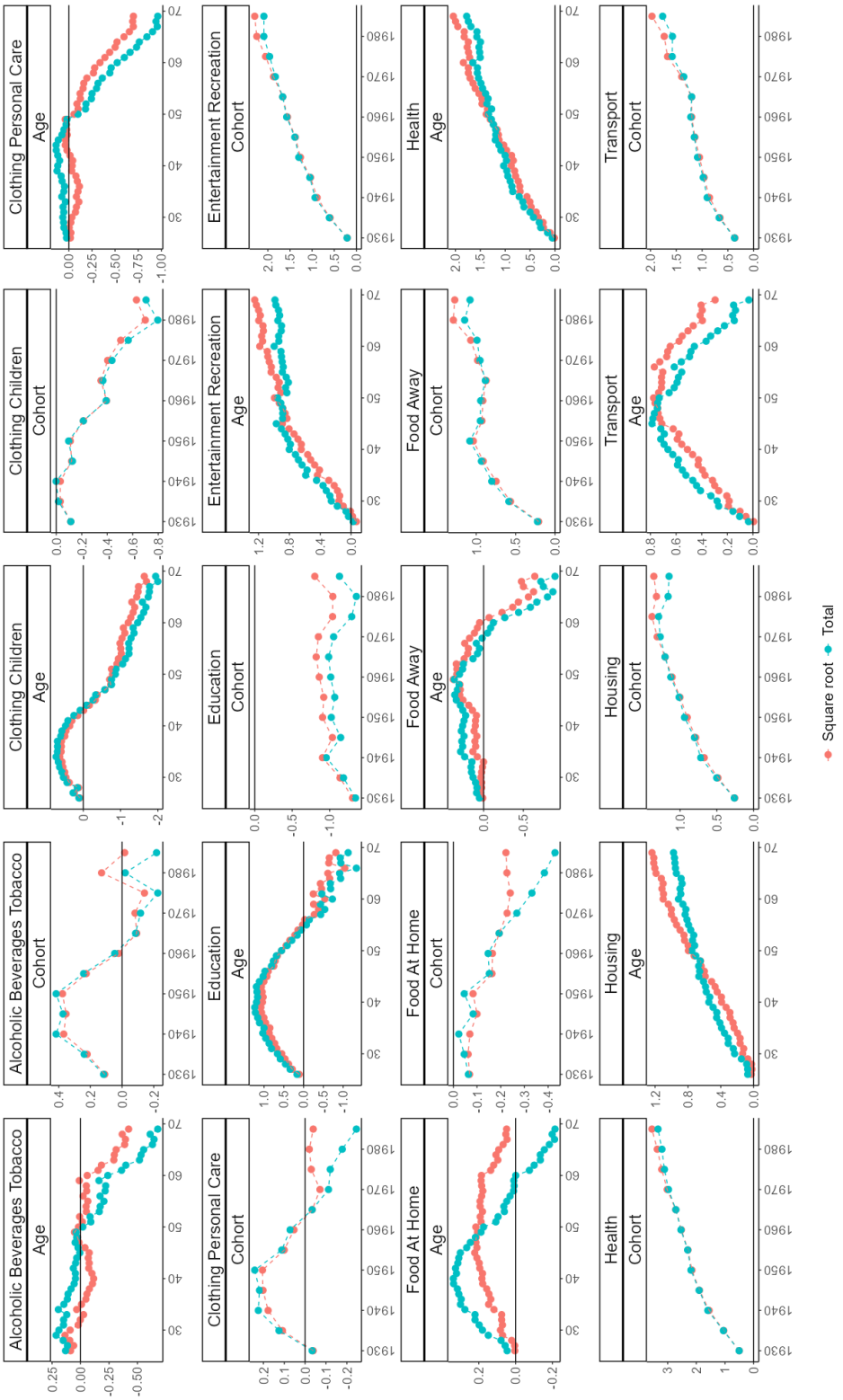
Figure G.3 and Figure G.4 display the estimated life-cycle consumption expenditure profiles based on total household consumption expenditure.

Figure G.3: Total Consumption: Broad Classification




*Source:* Author's calculation

Figure G.4: Total Consumption: Nondurable Consumption

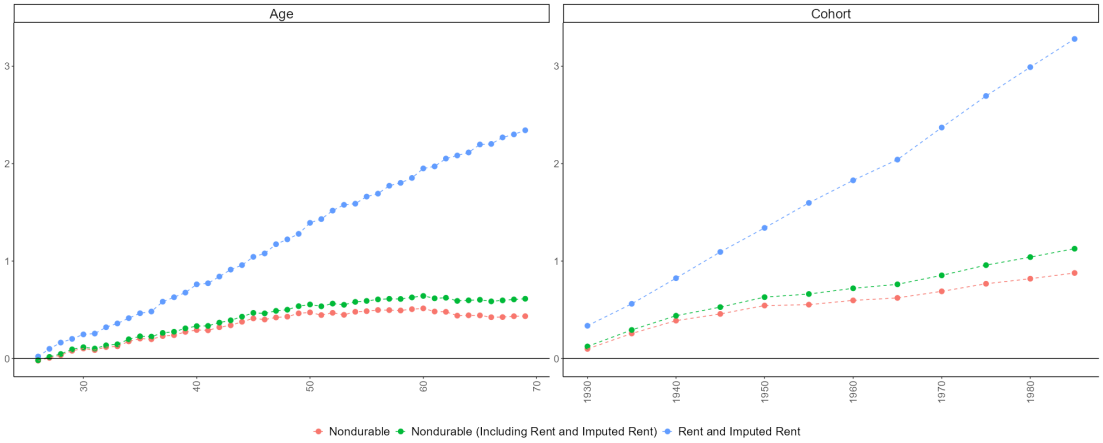


# H Imputed Rent

Figure H.1 and Figure H.2 display the estimated life-cycle and life-cycle inequality profiles for rent and imputed rent, nondurables without rent and imputed rent, and nondurables including rent and imputed rent.

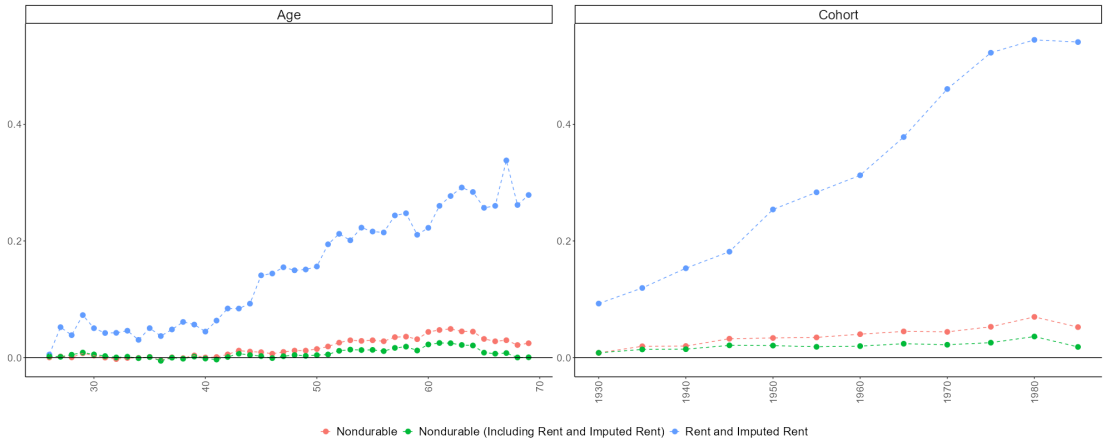
HBS recorded household rental expenditure. For households reporting zero rental expenditure, we construct an imputed rent measure in the following manner. For each survey year, we construct a model predicting household rental expenditure based on households reporting non-zero rental expenditure. We control for the region of residence, household area in square meters, household structure, household head's age, and nondurable consumption structure. We then use this model to perform out-of-sample prediction, thus obtaining imputed rent for non-renting households.

Figure H.1: Imputed Rent: Life-cycle profiles




*Source:* Author's calculation

Figure H.2: Imputed Rent: Inequality

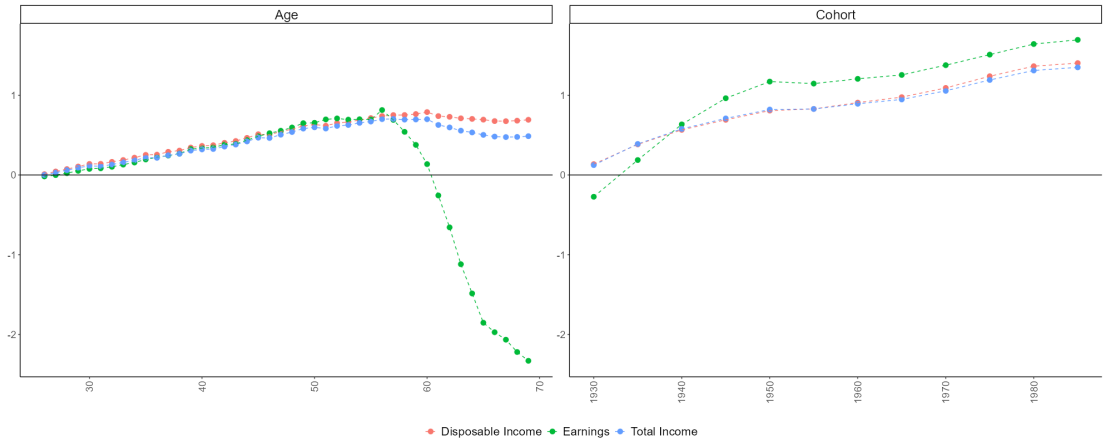



*Source:* Author's calculation

# I Income

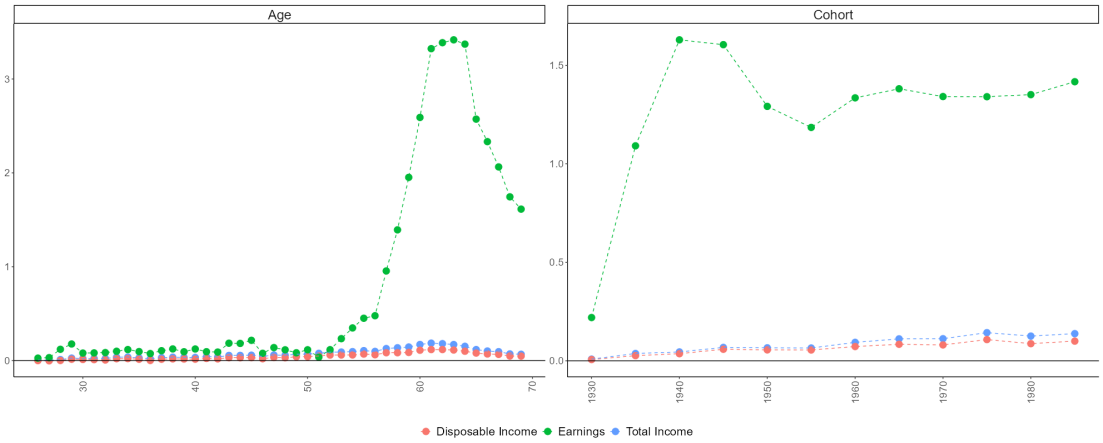
Figure I.1 displays the estimated life-cycle profiles of total income, disposable income, and earnings, while Figure I.2 displays their estimated life-cycle inequality profiles.

Figure I.1: Income and Earnings: Life-cycle profiles




*Source:* Author's calculation

Figure I.2: Income and Earnings: Inequality

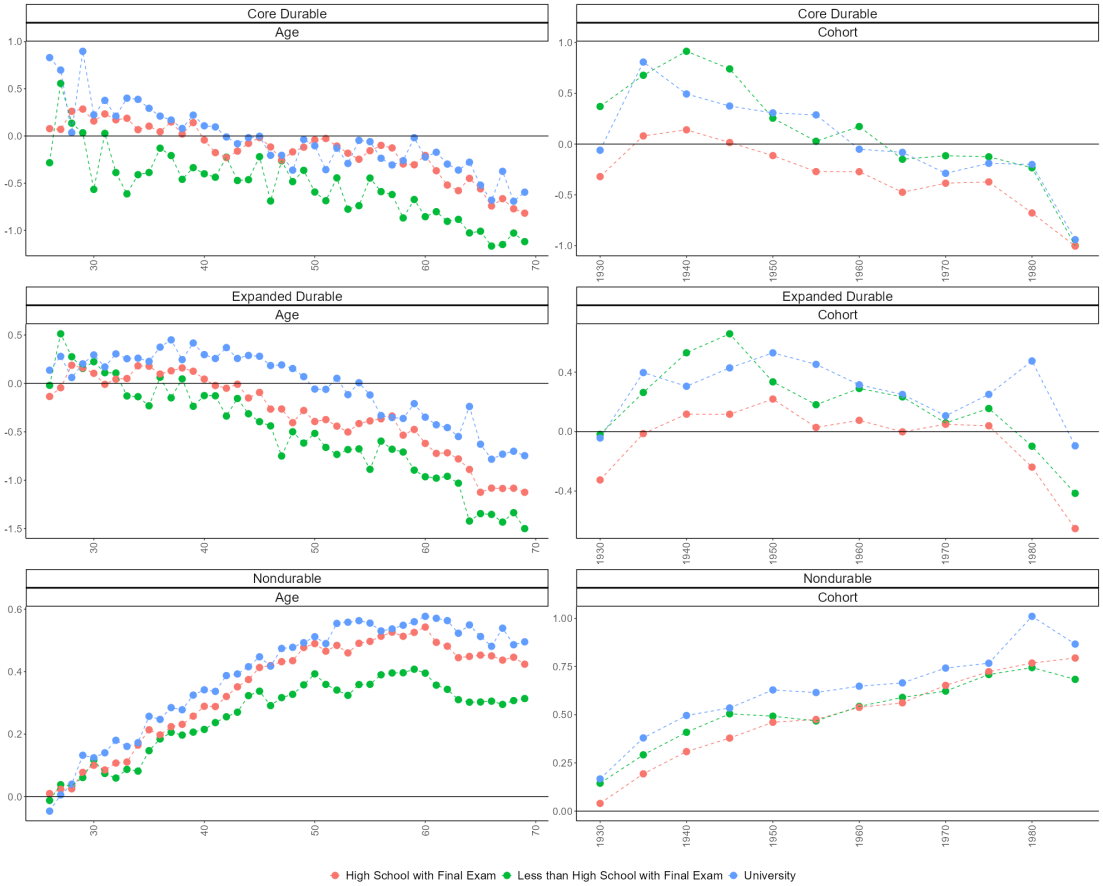



*Source:* Author's calculation

# J Education

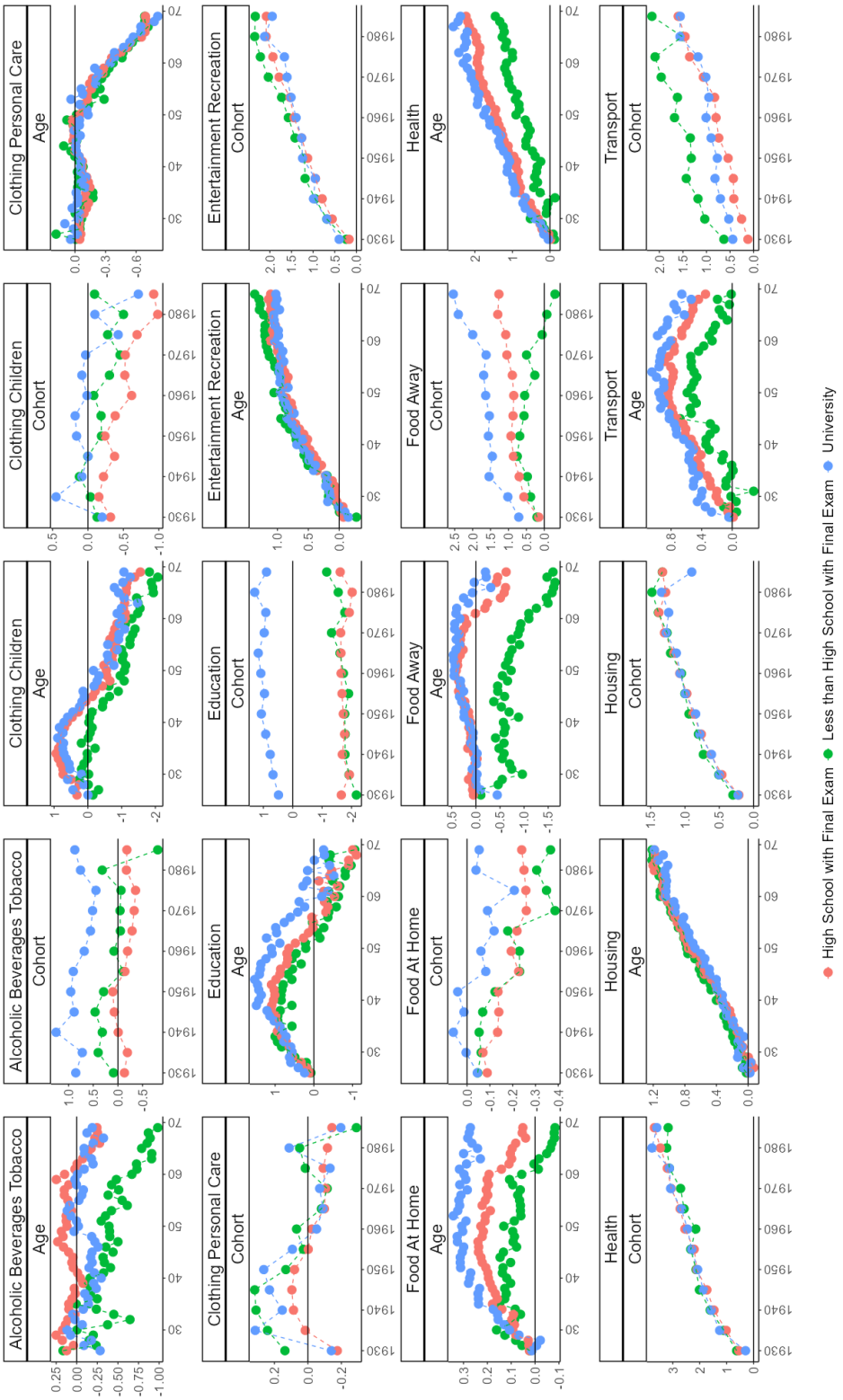
Figure J.1 and Figure J.2 display the estimated life-cycle consumption expenditure profiles for the durable and nondurable classes as well as nondurable consumption subclasses estimated separately for groups based on household head's education.

Figure J.1: Broad Classification: Life-cycle Profiles by Education




*Source:* Author's calculation

Figure J.2: Nondurable Consumption: Life-cycle Profiles by Education



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