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Intrahousehold Consumption Inequality over 24 Years: Evidence from Czechia

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Unequal consumption sharing within households is well-documented. However, there is limited evidence on the stability of within-household inequality over time. We combine a collective household model with consumption survey data spanning 24 years to study the evolution of within-household consumption inequality. Our findings reveal substantial and persistent within-household consumption inequality. On average, Czech men consume nearly 60% of total adult household consumption expenditure during the considered time period.

Keywords: collective household model, sharing rule, inequality, within-household inequality

JEL: D13, D16, D39

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1 Introduction

Both economic theory and empirical evidence reject equal consumption sharing within households. However, we know relatively little about how this inequality evolves over time. It is difficult to shed more light on the issue as consumption surveys commonly provide information on the household rather than individual level. Recent advances in the collective household literature have enabled researchers to do away with the assumption of equal consumption sharing, which is still present in most distributional studies. Unfortunately, estimates covering periods of over a decade are seldom available. This significantly limits our insight into the dynamics of within-household inequality.

In this paper, we study the evolution of within-household consumption inequality over a 24-year period in an economy undergoing economic transformation. We combine a collective household model with household-level survey data to recover relative resource shares. Relative resource shares are the proportion of total adult household consumption expenditure accruing to female household members. We deploy a novel approach proposed by Blundell *et al.* (forthcoming), enabling us to estimate the relative resource shares by analyzing household Engel curves. Moreover, we can impose milder restrictions on the Engel curves' shapes relative to the previous studies, such as Bargain & Donni (2012), Browning *et al.* (2013), or Dunbar *et al.* (2013). We combine this approach with the Czech Household Budget Survey data covering the 1993-2016 period. The main strength of the survey is that it followed households throughout an entire year instead of relying on recall questions like other commonly used surveys.

Our findings reveal significant within-household inequality. On average, Czech men consume nearly 60% of total adult household consumption expenditure during the considered time period. Moreover, this inequality persists throughout the 24 years. Within-household inequality thus persists even in an economy undergoing economic transformation and a general rise in living standards. These within-household inequality levels rank Czechia among countries with high within-household inequality. However, any cross-country comparison is inevitably difficult.

We make multiple contributions to the literature. First, we provide novel evidence on within-household inequality in a country located in a previously understudied region. Currently available estimates cover primarily western European and developing countries such as France (Bargain

& Donni (2012)), Netherlands (Cherchye *et al.* (2017)), Spain (Bargain & Martinoty (2019)), UK (Lise & Seitz (2011)), Bangladesh (Brown *et al.* (2021)), India (Calvi & Keskar (2021)), and Malawi (Penglase (2021)). However, Central and Eastern European (CEE) countries differ from these across multiple dimensions that likely affect within-household inequality, including labor market structure and preferences. For example, Fuchs-Schündeln & Schündeln (2020) document a lower support for gender equality in CEE countries. Moreover, Bursztyn *et al.* (2023) find that, in a sample of 60 countries, Czechia records the lowest support for gender-based affirmative action. We find that a CEE country ranks among the most unequal countries in terms of within-household inequality.

We significantly expand the evidence on the long-run evolution of within-household inequality. Only a few studies have covered a period of over two decades. Lise & Seitz (2011), Bargain *et al.* (2022a), and Blundell *et al.* (forthcoming) study the evolution of within-household inequality in the UK, while Lise & Yamada (2019) focus on Japan. The authors conclude that female resource shares increased in the UK. Lise & Yamada (2019) exploit the panel dimension of their data set and find a strong relationship between expected wage profiles at the time of marriage and resource sharing within households. Contrarily to the UK, our findings reveal that within-household inequality can persist over time. This persistence contrasts with the general rise in living standards and the fact that women became relatively more educated than men during the studied period.

Finally, we contribute to the literature studying the welfare implications of the transition from planned to market economies. The transition effects were already assessed among others through the lenses of income distribution (Bukowski & Novokmet (2021), Lisina & Van Kerm (2022)); social mobility (Bukowski *et al.* (2021)), and mortality (Bertoli & Grembi (2021)). Consumption inequality, especially within-household consumption inequality, received surprisingly little attention. Lechene *et al.* (2022) provide the only available estimates of within-household inequality for two post-communist countries, i.e., Albania and Bulgaria. However, our estimates cover the entire transition period, whereas Lechene *et al.* (2022) provide evidence on the distribution in one year for each country.

The remainder of this paper is organized as follows. The second section outlines our estimation strategy, while the third section provides an overview of the Household Budget Survey data.

Section four presents the results and the final section concludes.

2 Estimation Strategy

We rely on the collective household approach to recover the relative resource shares of respective household members. Collective household models rely on the assumption of Pareto efficiency and model households as a collection of household members with individual preferences. Browning *et al.* (2014) and Vermeulen (2002) provide a detailed discussion of the collective household approach and compare it to other methodological approaches to modeling household behavior.

We recover the relative resource shares through the analysis of household consumption behavior. Recent studies relying on a similar approach include, among others, Bargain *et al.* (2022a), Brown *et al.* (2021), Calvi (2020), and Calvi & Keskar (2021). Unlike these, we deploy the methodological approach proposed by Blundell *et al.* (forthcoming) (BKLP) to recover the relative resource shares. An alternative approach would be to rely on household labor supply behavior. Cherchye *et al.* (2015) and Lise & Seitz (2011) follow this identification approach.

2.1 Relative Resource Shares

Relative resource shares are the proportion of total adult household consumption expenditure accruing to female household members. Let y denote total household consumption expenditure and η^t denote the share of y accruing to a type j household member. By definition $\sum_j \eta^j = 1$. We consider two household member types, i.e., adult males (m), and adult females (f). Equation 1 then gives the definition of the relative resource shares.

$$R_h = \frac{\eta^f}{\eta^m + \eta^f} \tag{1}$$

In this setting, we can consider children to be either attributes of the household or household members with own resource shares. In the former case, relative resource shares describe the distribution of total household consumption expenditure. In the latter case, they describe the distribution of adult household consumption expenditure. That is the distribution of the household consumption expenditure left once children receive their share. The children share remains unidentified. Either way, $R_h \neq 0.5$ indicates gender inequality within the household.

2.2 Identification

Households consume a bundle of k goods $z = (z^1, ..., z^k)$ which they purchase at prices $p = (p^1, ..., p^k)$. We denote by y total household consumption expenditure and by $x_j = (x_j^1, ..., x_j^k)$ the consumption bundle of a type t household member. As noted above, we consider two household member types, i.e., m, and f. We distinguish two household types. Nuclear households with children (mfc), and without children (mf). Each household thus includes one member of each type.

The sum of individual consumptions ($\sum_t x^j$) might exceed the observed total household consumption z. This is a consequence of the shareable or public nature of some consumption goods. For example, total individual consumption of gasoline might exceed household consumption if household members at least occasionally ride together as the household has to purchase a lower amount of gasoline to satisfy their consumption. We relate individual and household consumption through a k by k consumption technology matrix A. A converts the purchased quantities into corresponding private good equivalents, i.e., $z = A \sum_j x^j$.

The household maximizes the sum of individual utilities weighted by pareto weights subject to the budget constraint and the constraint imposed by the consumption technology. Under Pareto efficiency, this can be described as a two-stage process commonly considered in the collective household literature. First, the household allocates resources between household members. Second, household members maximize their individual utilities given these shadow budgets ($\eta^j y$) and shadow prices (Ap).

Individual utility functions depend on the utilities achieved by other household member types. Household members thus care about each others' welfare. However, their utility is not affected by the composition of the consumption bundle that yields the given utility level. They are not paternalistic. Moreover, we follow the literature and assume that the utility function is separable from all items not included in the consumption bundle. These also include leisure, and savings.

Solving the household's optimization problem yields a set of household demand functions. While these are in general rather complicated, we rely only on household demand for assignable goods to recover the relative resource shares. Assignable goods are goods which are consumed only by a type t household member and we observe the household expenditure on them. We choose to rely on female, and male clothing as our assignable goods. This is a common choice in the literature and is determined by the structure of the available data. Alternatively, some studies chose to rely on food consumption when it was recorded in sufficient detail.

We recover the relative resource shares through the analysis of assignable goods' Engel curves. W_s^j denotes the proportion of household expenditure spent on type t assignable good in type s household. Moreover, w_s^j denotes the proportion of individual budget spent on the assignable good by the respective type t household member living in a type s household. Following Dunbar *et al.* (2013), the household level Engel curve is then given by the following expression.

$$W_s^j(p,y) = \eta_s^j(p,y) w_s^j(A_s p, \eta_s^j(p,y)y) \tag{2}$$

We impose the following restriction on the household level Engel curves. These follow BKLP and Dunbar *et al.* (2013). First, we assume that the budget shares are independent of y. Second, we assume individual preferences of the PIGLOG functional form. Combined, these yield Engel curves of the following form.

$$W_s^j = \eta_s^j(\alpha_s^j + \beta_s^j(ln(y) + ln(\eta_s^j)) \tag{3}$$

Unfortunately, neither the relative resource shares, nor the resource shares are identified from Equation B.6. We observe W_s^j in the household budget survey data. However, with two household member types (f, m), we have to identify β_s^f, β_s^m and either η_s^f or η_s^m (given $\sum_t \eta_s^t = 1$). Moreover, we cannot use W_s^j as a measure of η_s^j due to possible differences in w_s^j. We impose an additional restriction on the Engel curves' slopes to overcome this issue.

We adopt the Weakened Similarity Across People (WSAP) assumption of BKLP. Under WSAP we assume that $\beta_s^j = \Delta^j \beta_s$. Normalizing $\Delta^f = 1$ leads to $\beta_s^f = \beta_s$ and $\beta_s^m = \Delta^m \beta_s$. In words, WSAP restrict the slopes of assignable goods' Engel curves to be similar but not identical across household member types. They differ by a factor Δ^m. In our setting, this means that clothing is either a necessity or a luxury for both males and females. However, the degree to which they consider it to be a luxury or a necessity can differ.

2.3 Estimation

BKLP propose a two step procedure to recover the relative resource shares. First, they mobilise information on Engel curves of singles' assignable goods to estimate the difference in their slopes Δ^m. Second, they combine this information with household assignable goods' Engel curves to estimate the relative resource shares. Consequently, they require information on Engel curves of single-person households unlike Dunbar *et al.* (2013). They impose a restriction that the ratio of assignable goods' budget semi-elasticities is identical between single-person and multi-person households.

First, we recover Δ^m from the assignable goods' Engel curves of single-person households. These take the following form.

$$w_{tj}^j = a_{tj}^j + b_{tj}^j ln(y_{tj}) + \epsilon_{tj}^j \tag{4}$$

Where subscript j denotes either a single male or single female. For each time period t, we have $a_j^j = \alpha_j^j$ and $b_j^j = \Delta^j \beta_{single}$. We can then recover Δ^m as $\Delta^m = \frac{b_m^m}{b_f^f}$.

Second, we estimate the assignable goods' Engel curves for the collective households. These take the following form.

$$W_{th}^j = a_{th}^j + b_{th}^j ln(y_{th}) + \epsilon_{th}^j \tag{5}$$

Where for each time period t, we have $a_h^j = \eta_h^j \alpha_h^j + \eta_h^j \Delta^j \beta_h ln(\eta_h^j)$ and $b_h^j = \eta_h^j \Delta^j \beta_h$. We approximate the nonlinear functional forms above with a linear index of control variables z. Concretely, for singles we choose $a_{tj}^j = a_j^j(t) + a_j^{zj}(t)' z_j$ and $b_{tj}^j = b_j^j(t) + b_j^{zj}(t)' z_j$, while for collective households we choose $a_{th}^j = a_h^j(t) + a_h^{zj}(t)' z_h$ and $b_{th}^j = b_h^j(t) + b_h^{zj}(t)' z_h$. The estimates vary both over demographic characteristics and time. We are thus able to recover the coefficients by linear estimation techniques like OLS, and SURE, which enables us to avoid reliance on potentially troublesome non-linear estimation methods.

An alternative approach would be to rely on the Similar Across People (SAP) assumption proposed by Dunbar *et al.* (2013). Under SAP the Engel curves' slopes are assumed to be identical across household types. That is $\beta_s^f = \beta_s^m$. In words, clothing is assumed to be exactly the same level of luxury or necessity for both males and females. While this assumption was broadly adopted in the literature it seems too strong in our setting. We find evidence for differences in slopes of male and female clothing. Consequently, we choose to follow the BKLP approach instead of the Dunbar *et al.* (2013) approach or its' linear reframing by Lechene *et al.* (2022).

We impose additional two restrictions on the Engel curves to avoid weak identification of the relative resource shares. Weakly identified relative resources are unreliable as they might attain illogical values or exhibit wild behavior. First, we assume that the slope of singles' Engel curves are independent of personal characteristics. Technically this amounts to setting $b^j_{tj} = b^j_j(t) + b^{zj}_j(t)'z_j = b^j_j(t)$. Second, we assume that Δ^m is constant over time and denote this value δ. Technically this means that $\Delta^m = \frac{b^m_m(t)}{b^f_f(t)} = \delta$. Unlike BKLP, we do not assume that $\beta^{zm}_h(t) + \delta\beta^{zf}_h(t) = 0$. Consequently, our assumptions are slightly more lenient.

We estimate singles' Engel curves by OLS. We include a linear trend in time t for $a^j_h(t)$, $a^{zj}_h(t)$, $b^j_h(t)$, and $b^{zj}_h(t)$ to account for possible time effects. We control for females' and males' ages, education, and regional dummies. We estimate the Engel curves by regressing the assignable goods' budget share on a $constant$, t, z, zt, $ln(x)$, and $tln(x)$.

We estimate collective households' Engel curves by SURE. We include a linear trend in time, similar to singles' Engel curves. We also include an additional control for the number of children in households with children. We first consider a restricted specification under which the households' Engel curve slopes are independent of household characteristics z. The restricted specification yields relative resource shares that vary over time but are identical for all households in a given year. Finally, we consider the full specification under which households' Engel curve slopes vary with household characteristics. We regress the assignable goods' budget shares on a $constant$, t, z, zt, $ln(x)$, $tln(x)$, $zln(x)$, and $tzln(x)$. Equation 6 gives the formula for the relative resource share. We obtain standard errors through the delta method.

$$\hat{R}_h = \frac{(b^f_h(t) + b^{zf}_h(t)'z_h)\delta}{(b^m_h(t) + b^{zm}_h(t)'z_h) + (b^f_h(t) + b^{zf}_h(t)'z_h)\delta} \tag{6}$$

Weak identification may occur when the denominator in Equation 1 is too close to zero. Under the restricted specification, the denominator is identical across all households in a given year. We can thus directly test its value in each year. Failing to reject the null hypothesis of the denominator being equal to zero would suggest possible presence of weak identification.

Under the full specification, the denominator varies across households in a given year. We thus consider the following two indicators of the possible presence of weak identification. First, we consider the proportion of households for which we reject the null hypothesis that the denominator equals zero. Second, we consider the proportion of households for which the predicted relative resource shares attain illogical values, i.e., lie outside the (0,1) range. Such cases might occur due to the linear nature of the model.

We set the following thresholds for the weak identification indicators under the full specification. We adopt a threshold of 75% for the former indicator. This choice is inspired by Lechene *et al.* (2022), who adopt the same threshold in a similar context. We adopt a threshold of 5% for the later indicator. However, we acknowledge that both of these thresholds are, to some extent, arbitrary. Consequently, we also assess the sensitivity of our results to more stringent values.

Before proceeding, we would like to clear several issues regarding our methodological approach. First, relative resource shares are identified through restrictions on the shapes of the assignable goods Engel curves. They are not identified solely from the recorded budget shares. It is possible, that relative resource shares are equal among household members, but the budget shares spent on their assignable goods differ. It is also possible, that the household spends a lower budget share on the assignable good of the household member who commands a higher relative resource share. Second, we do not assume that singles' and collective households' demands are identical. We assume that only the ratio of the slopes of assignable goods' Engel curves is the same for collective households and singles. This is thus a significantly weaker assumption than adopted for example by Browning *et al.* (2013).

3 Czech Household Budget Survey

We rely on the Household Budget Survey (HBS) data collected by the Czech Statistical Office (CzSO) during the 1993-2016 period. The HBS is a 4-year rotating panel. Surveyed households were selected through quota sampling. Unfortunately, we are unable to connect households between years, which leads us to treat the HBS as a cross-sectional survey. During the considered time period, the HBS contains data on the consumption behavior of 73,691 households. Unlike other commonly used surveys, the HBS did not rely on recall questions to collect this data. Instead, surveyed households recorded their consumption throughout the whole year through diaries, which they returned to the CzSO on a monthly basis. We first identify the final sample and then proceed to the descriptive analysis of the dataset.

We study the evolution of relative resource shares in households with economically active household heads and pensioner households without economically active members. We choose not to include households with economically inactive heads and pensioner households with economically active members as these were not covered by the HBS until 2006. This leads us to remove 7,672 households from the final sample to ensure the stability of its structure over time. Moreover, we remove households that dropped out of the sample before the end of the year (5,317 households) and households that reported negative consumption expenditure on any of the surveyed items (394 households).

The remaining households have one the following structures: (in)complete nuclear households, i.e., households composed of parents living with dependent children; (in)complete mixed households, i.e., nuclear families with additional household members; non-family households; singles. These account on average for 69.8%, 5.93%, 1.02%, and 23.2% of the total sample respectively and are subject to further cleaning.

We begin by filtering out single-person households. We use these to recover the δ following the approach outlined in the previous section. We rely only on households of individuals below 65 years of age, a condition we also apply to nuclear households. Our estimate of δ is thus based on 9,271 households, of which 7,106 are single female households and the remaining 2,165 households are single male.

We estimate relative resource shares for complete nuclear households with children below 15 years of age. First, we filter out incomplete nuclear households as in these $R = 1$ by definition. Second, we filter out mixed and non-family households as the HBS provides information only on the age, education, and sex of the household head and his spouse. Consequently, we are able to properly control for the household structure only in the case of nuclear households.

Finally, we filter out nuclear households with children above 15 years of age. We remove them as their expenditure on adult clothing might also contain expenditure on clothing consumed by children. This would mean that clothing would no longer be an assignable good. An alternative

Table 1: Household Budget Survey: Descriptive Statistics

	Women			Men			Men/Women			Men/Women/Children		
	1993	2004	2015	1993	2004	2015	1993	2004	2015	1993	2004	2015
Assignable Goods:												
Male Clothing				0.06	0.04	0.04	0.04	0.02	0.02	0.03	0.02	0.01
Female Clothing	0.07	0.06	0.05				0.05	0.03	0.03	0.04	0.03	0.03
Controls:												
Age Men				45.85	42.26	42.64	50.84	53.24	52.62	34.25	35.18	38.00
Age Women	51.34	49.52	50.76				48.54	51.17	50.41	31.55	32.32	35.51
Age Children										6.61	6.62	6.06
Children Count										1.63	1.56	1.59
Own House	0.45	0.63	0.75	0.49	0.56	0.61	0.66	0.79	0.86	0.64	0.65	0.82
Own Car	0.12	0.28	0.40	0.49	0.53	0.61	0.78	0.82	0.90	0.72	0.89	0.95
Large City	0.46	0.50	0.39	0.49	0.38	0.40	0.32	0.34	0.28	0.33	0.32	0.27
Education - Men:												
Elementary				0.11	0.04	0.02	0.07	0.05	0.03	0.02	0.01	0.01
High School				0.30	0.44	0.44	0.50	0.58	0.53	0.47	0.46	0.42
High School, A-levels				0.40	0.42	0.35	0.32	0.28	0.33	0.31	0.41	0.40
University				0.19	0.10	0.20	0.11	0.09	0.11	0.19	0.12	0.16
Education - Women:												
Elementary	0.19	0.06	0.05				0.13	0.06	0.07	0.02	0.02	0.01
High School	0.28	0.23	0.32				0.31	0.26	0.24	0.18	0.23	0.14
High School, A-levels	0.45	0.63	0.49				0.50	0.61	0.57	0.65	0.60	0.55
University	0.08	0.07	0.14				0.06	0.07	0.12	0.16	0.15	0.30
Observations	279	315	330	80	91	101	531	527	374	798	647	409

Author's calculation.

solution would be to reclassify children above 15 as adults. However, this is impossible as the HBS contains only the total count of dependent children living in the household. It does not contain information about their sex. Dependent children are children below 26 years of age that are economically inactive.

Table 1 reports descriptive statistics for all considered household types and all variables of interest. These include single-person households, which we use to estimate δ, as well as nuclear households with and without children, which constitute our final sample. We present the values in 11-year intervals. Appendix A presents the evolution of all variables over the entire 24-year period.

Female and male clothing constitute our assignable goods. These include household expenditure on ready-to-wear clothes, knitted clothes, shoes, socks, and stockings. Clothing expenditure accounts for less than 10% in both single-person and nuclear households. Moreover, its budget share is decreasing over time. Though the budget share devoted to expenditure might seem low, it is comparable to the budget shares reported in other studies using clothing expenditure as the assignable good. Appendix A contains a detailed list of all consumption items included in our measure of total household consumption. Similarly to previous research, we focus solely on nondurable consumption items.

Adults living in nuclear households with children are, on average, younger than adults living in childless households. We observe an increase in the average adult age in our sample, which is consistent with population aging. In addition, women become more educated and achieve, on average, higher education than men. We also observe high levels of home-ownership, and car-ownership. The share of households owning a car or a house increases substantially over the considered time period.

The HBS also contains information on both capital and labor income received by the household. Nevertheless, this data was reported only in broad categories, unlike the data on household expenditure. We thus choose to rely on household consumption expenditure in our baseline specification. However, we also provide an additional set of results in which we instrument for household expenditure with disposable income as a robustness check. Appendix A contains a list of all income sources covered by the HBS.

4 Within-Household Inequality

We combine the collective household approach with the HBS data to recover the relative resource shares. First, we test whether the WSAP assumption is appropriate in our setting. Second, we test whether the relative resource shares are identified or if we are at risk of weak identification. It is crucial to avoid weak identification as weakly identified relative resource shares can exhibit wild behavior or attain illogical values. Finally, we discuss the evolution of the estimated relative resource shares.

We find that the WSAP assumption is appropriate in our setting. We consider the SAP assumption as an alternative. SAP is the most frequently applied identifying assumption in the literature, thus constituting a natural alternative. Moreover, it generally performs well in identifying assumption tests, as documented by Bargain *et al.* (2022b) and Brown *et al.* (2021). However, Sokullu & Valente (2022) reject SAP, which makes us careful in identifying assumption selection.

Choosing between WSAP an SAP requires testing the equality of clothing budget semi-elasticities of females and males living in households. Unfortunately, it is impossible to conduct a direct test in the absence of more detailed data. We thus rely on singles' clothing Engel curves to conduct an indirect test. We test whether the estimated clothing budget semi-elasticities differ for single males and females. Failing to reject this hypothesis would suggest that SAP might be a feasible approach. Contrarily, rejecting it would lead us to adopt the WSAP assumption.

We reject the null hypothesis of equal Engel curve slopes at the 1% significance level. We also find no overlap in the estimated singles' budget semi-elasticities' 95% confidence intervals during the considered time period. Moreover, we obtain similar results under an alternative specification in which we instrument for expenditure with household income. Appendix C presents the evolution of estimated budget semi-elasticities.

We thus deploy the WSAP assumption and recover δ through a minimum distance estimator finding $\delta = 0.3618$. Instrumenting for consumption with income leads to $\delta = 0.3545$. We rely only on the former estimate given the minor difference in the estimated values of δ.

We evaluate the indicators outlined in the methodological section to assess the possible risk of weak identification. We present the results separately for households with and without children. The first two panels of Figure 1 present the denominator values estimated under the restricted specification. They also include the respective 95% confidence intervals. The bottom two panels of Figure 1 present the two indicators used for the full specification. These are the proportion of households for which we reject the null hypothesis of the denominator being equal to zero and the proportion of households whose predicted relative resource shares lie outside of the (0,1) range.

Relative resource shares are identified for the entire 1993-2016 period for households with children. Both the restricted and full specification clear the weak identification indicators. Under the restricted specification, we reject the null hypothesis of the denominator being equal to zero for the entire 24-year period. Under the full specification, both the proportion of households with predicted relative resource shares outside (0,1) range and households for which we reject the null hypothesis of the denominator being equal to zero are well within the set thresholds. Concretely, below 5% for the former and above 75% for the latter. Moreover, with the exception of the first and final year, these would comfortably satisfy more stringent thresholds.

Relative resource shares are less precisely identified in childless households. Similarly to households with children, we reject the null hypothesis of the denominator being equal to zero for the entire 24-year period. However, the full model fails to clear some of the weak identification thresholds. The proportion of households for which we reject the null hypothesis of the denominator being equal to zero is near or above the critical value of 75% only during the 1998-2013 period. Moreover, the proportion of households with predicted relative resource shares

Figure 1: Model Identification

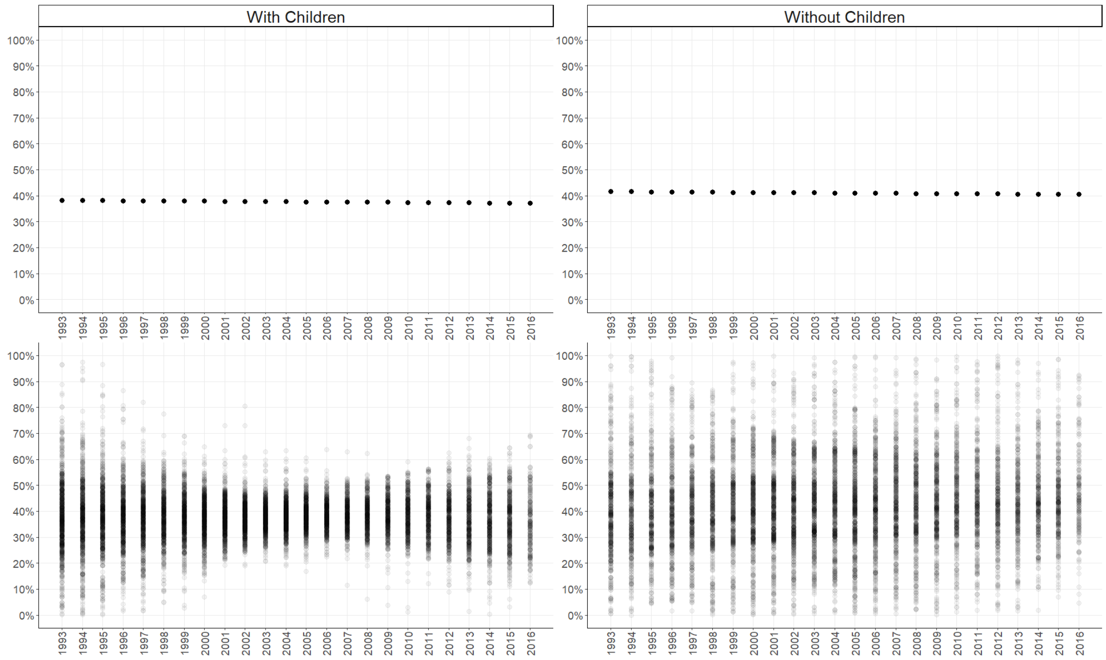
Source: Author's calculation

Note: The top two panels display the estimated denominator values obtained under the restricted specification and their respective 95% confidence intervals. The bottom two panels display the proportion of predicted relative resource shares that fall outside of the (0,1) range, and the proportion of households for which we reject the null hypothesis of the denominator being equal to zero under the full specification.

outside (0,1) range is above 5% during the entire 24-year period. Though it would clear a less stringent threshold of 10% during the 1996-2001, 2003-2006 periods and in 2008. This leads us to interpret the relative resource shares in childless households with caution. Especially outside of the 1998-2008 period. In the remainder of the paper, we focus on the relative resource shares that fall inside the (0,1) range.

We find pronounced levels of within-household inequality during the 1993-2016 period. The mean relative resource shares over the entire time period were 37.6% in households with children (1993-2016) and 42.1% in childless households (1998-2008). Bargain & Martinoty (2019) find similar inequality levels in Spanish childless households in 2006/2007. Almås *et al.* (2021) provide an overview which suggests that these relative resource shares rank Czechia among countries with elevated within-household inequality levels. Nevertheless, the available studies differ in their identification approaches. This significantly complicates any cross-country comparison as

Figure 2: Relative Resource Shares



Source: Author's calculation

Note: The figure displays the evolution of the predicted relative resource shares over the 1993-2016 period. The top two panels display the relative resource shares unconditional on household and individual characteristics. The bottom two panels display the evolution of the distribution of relative resource shares that vary with household and individual characteristics.

they differ, for example, in their treatment of children.

The pronounced inequality levels persist over time. Figure 2 presents the estimated relative resource shares for both household types. The first two panels present relative resource shares which are unconditional on individual and household characteristics (z). Consequently, they vary over time but not over households. The bottom two panels present the distribution of the relative resource shares obtained from the full specification of our model. These vary both over households and time.

We find a rise in within-household consumption inequality in households with children. First, the mean relative resource share increased from 37.8% at the beginning of the studied period (1993) to reach a maximum of 38.4% in the 2005-2009 period. However, this rise was followed by a fall to 36% at the end of the considered period (2016). Overall, within-household inequality thus registered only a limited change during the entire 24-year period.

Table 2: Marginal Effects

	Without Children (m/w)	With Children (m/w/c)
Age Men	-0.003	-0.0011
	(0.0109)	(0.0085)
Age Women	0.0075	0.0073
	(0.015)	(0.0056)
Education Men	-0.1636	0.002
	(0.2937)	(0.0587)
Education Women	0.1402	0.012
	(0.2454)	(0.0664)
Men Active	-0.1618	-0.297
	(0.4971)	(1.0774)
Women Active	0.0329	0.008
	(0.3042)	(0.0993)
Region Stredocesky	0.0947	0.0771
	(0.2631)	(0.071)
Region Jihocesky	0.169	0.15
	(0.4073)	(0.1005)
Region Zapadocesky	0.0865	0.0855
	(0.3922)	(0.0788)
Region Severocesky	0.0925	0.1405
	(0.3356)	(0.1403)
Region Vychodocesky	0.1863	0.0578
	(0.4281)	(0.1365)
Region Jihomoravsky	0.1707	0.1103
	(0.4451)	(0.093)
Region Severomoravsky	0.1854	0.0795
	(0.4271)	(0.2184)
Children		-0.0699
		(0.0977)

Author's calculation.

Our findings suggest that relative resource shares in childless households followed a similar path. We focus on the 1998-2008 period as discussed above. The mean relative resource share increased from 41% (1998) to 43.2% (2007, 2008). It thus recorded a rise in the same period as in households with children. However, this rise was more pronounced and started from a higher level.

The finding of elevated and persistent within-household consumption inequality is interesting in light of the currently available evidence. As we have already noted, long-run within-household consumption inequality estimates are seldom available. We focus on the comparison with the UK, for which multiple studies are available. Bargain *et al.* (2022a) and Lise & Seitz (2011) find a decrease in within-household inequality. Contrarily, our findings suggest that within-household inequality can persist at elevated levels even despite a general rise in living standards.

We assess how control variables influence the relative resource shares. The marginal effects vary across households as the numerator and denominator of Equation 6 vary with household characteristics. Consequently, we calculate the marginal effects for all households. Table 2 presents mean marginal effects and their standard deviation for all control variables. Appendix D presents the evolution of mean marginal effects and their standard deviations over time.

The estimated marginal effects have the expected signs. Our results suggest that relative resource shares rise with women's age, education, and economic activity. Contrarily, except for men's education in households with children, men's characteristics have a negative effect on relative resource shares. Moreover, each additional child in the household negatively affects the relative resource share.

We consider two alternative specifications of the restricted and full model as a robustness check. The first specification adds a quadratic time trend to the linear trend included in the baseline specification. In the second specification, we instrument for household consumption by household disposable income. Appendix E reports complete results from both robustness checks.

Both robustness checks support our findings for households with children. The average relative resource shares are below 40% under both specifications. We also observe a decrease in mean relative resource shares during the considered period. This decrease is less pronounced when including a quadratic time trend and more pronounced when instrumenting for consumption. Both results support our finding of significant and persistent within-household inequality.

Similarly to our baseline results, relative resource shares in childless households suffer from the possible presence of weak identification. The average relative resource shares are similar to those obtained under the baseline specification. This similarity supports our finding of lower within-household inequality in childless households. However, their evolution differs depending on the chosen specification. Including a quadratic time trend yields relative resource shares that are increasing on average over time. Contrarily, instrumenting for household consumption leads to relative resource shares that decreased during the studied period. Overall, we are inclined to conclude that the relative resource shares slightly increased in childless households. We reach this conclusion based on the alignment between the baseline and quadratic specifications, and the high quality of consumption relative to income data. Nevertheless, the possible presence of weak identification, joined with the different dynamics obtained from one of the robustness checks, intensifies the need to interpret these relative resource shares cautiously.

5 Conclusion

We study the evolution of within-household consumption inequality over a 24-year period. We focus on the case of Czechia during the 1993-2016 period, which includes economic transformation and a significant rise in living standards. We combine a collective household model with household-level survey data to recover the relative resource shares, i.e., the proportion of total adult household consumption accruing to female household members. Moreover, we rely on a novel methodological approach proposed by Blundell *et al.* (forthcoming), which, compared with previous research, enables us to impose milder identification assumptions.

Our findings reveal substantial and persistent within-household inequality. On average, men control over 60% of adult household consumption expenditure in nuclear households with children and slightly below 60% in childless households. These inequality levels persist over time. In addition, we observe a minor rise in within-household inequality in households with children.

Our findings suggest that Czechia ranks among countries with pronounced within-household consumption inequality levels. However, any cross-country comparison is inherently complicated. Additionally, we find that pronounced within-household consumption inequality levels can persist even despite a general rise in living standards. This finding contrasts with the evidence on the evolution of within-household inequality in the UK.

We identify multiple issues to be tackled by future research. First, future research should focus on increasing the availability of long-run within-household inequality estimates. The difference in inequality evolution in Czechia and the UK shows the need for estimates covering a broad range of economies. Moreover, the lack of such estimates limits our ability to study the forces shaping within-household inequality. While, for example, Manzur & Pendakur (2023) and Bargain & Martinoty (2019) make a step in this direction, the evidence remains constrained. In Appendix F, we illustrate how our estimates can be used to study child penalty in resource sharing within households. We combine the estimates obtained in the body of the paper with a pseudo-event study approach proposed by Kleven (2023) and Kleven *et al.* (2024).

Second, future research should provide more evidence on the distribution of leisure. Inequality in leisure may worsen or temper the pronounced and persistent within-household inequality levels identified by our research. Unfortunately, datasets containing information on both consumption expenditure and time use are scarce. Browning *et al.* (2021) and Cosaert *et al.* (2023) provide interesting insights into time allocations within households.

Third, our results identify only the relative resource shares but remain silent on the household consumption technology. Unlike resource share identification, little evidence is available on household consumption technology. Calvi *et al.* (2023) provide an approach to identify household consumption technology. Recently, Hsieh *et al.* (2024) proposed an approach to estimate the economies of scale in consumption within the collective household framework.

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Appendices

A Czech Household Budget Survey, 1993-2016

This appendix provides more information about the structure of the Czech Household Budget Survey.

A.1 Descriptive Statistics: 1993-2016

Figure A.1 presents the evolution of dependent and control variables for single-person households. Figure A.2 presents their evolution for households with and without children.

Figure A.1: Single Person Households

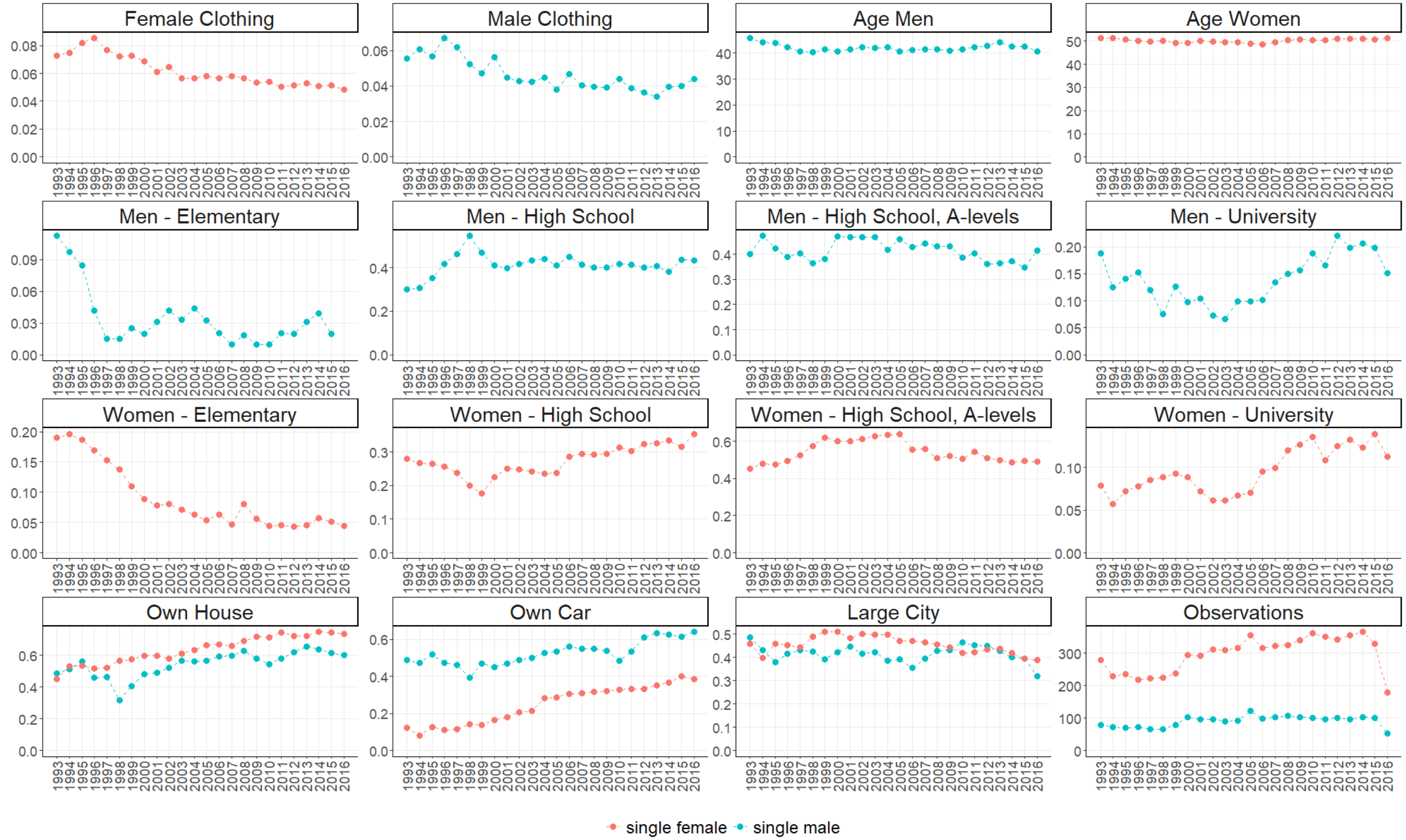

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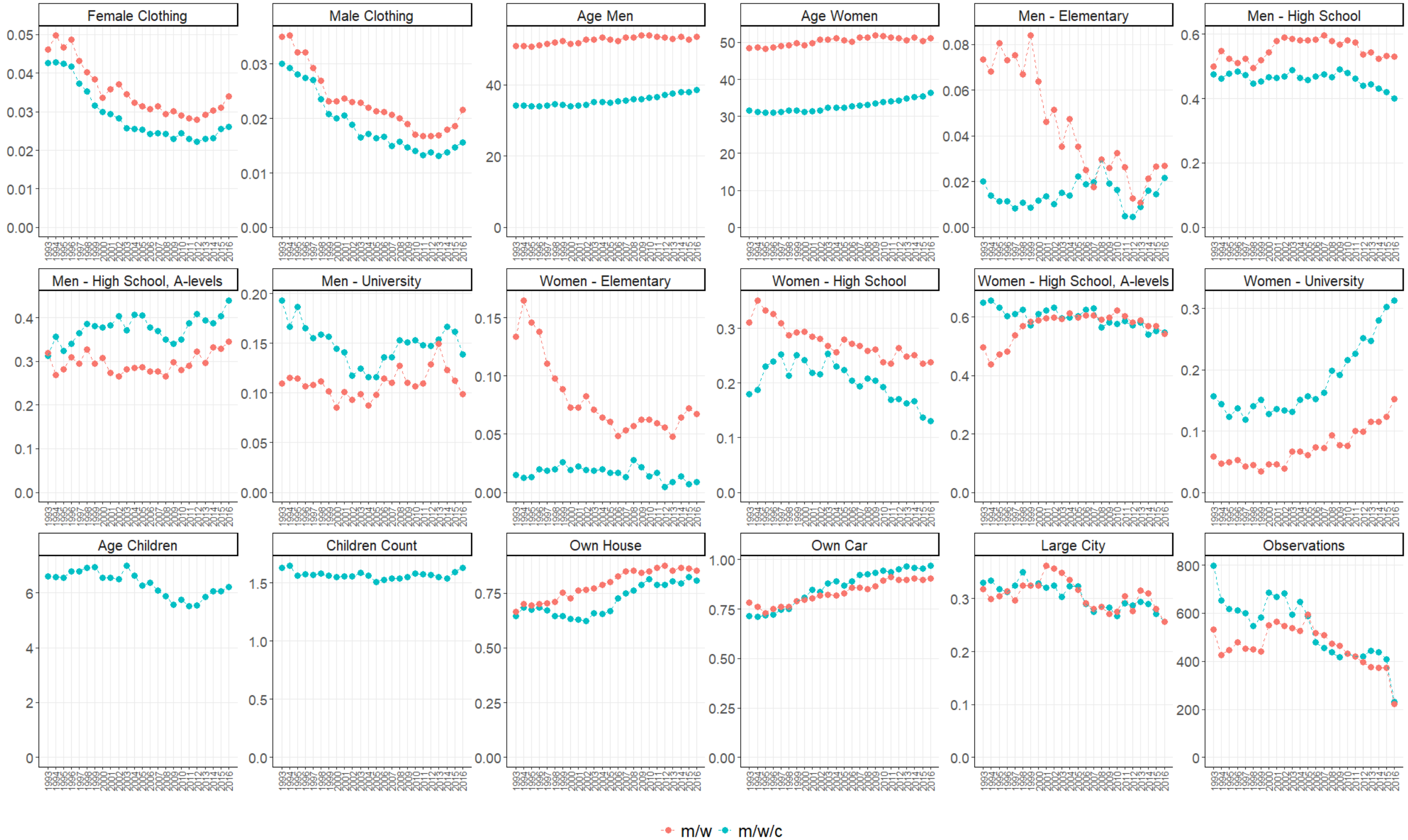
Figure A.2: Households



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A.2 Covered Consumption Items

Food at home, and food away: 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 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

Alcoholic beverages and 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

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

Clothing: 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; cleaning, reparation, and renting of clothes; repairs and renting of shoes; underwear and knitted wear - children; ready-to-wear clothes - children; stockings and socks - children; shoes - children

Housing: bed 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

Health and Personal Care: 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

Transport: fuels, oils, and other agents for personal transportation; spares and accessories for personal transportation; maintenance and services of personal transportation tools; travel insurance; bicycles; combined personal transport; within-city personal transport; inter-city personal transport; taxi; train travels; airplane travels; nautical, and river transport; other payed transportation services

Recreation and other services: financial services; consulting, and administrative services;

recreation - domestic; recreation - foreign; accommodation services

A.3 Covered Income Items

Income from main occupation: household head, spouse, other members; **Other earnings from employment**; **Income from the main activity in the business:** household head, spouse, other members; **Other business income**; **Pensions:** household head, spouse, other members; **Sickness benefits**; **Unemployment benefits**; **Other social benefits**; **Compensation for sick leave**; **Child benefits**; **Social supplement**; **Parental allowance**; **Other state social support benefits**; **Income from the sale of securities**; **Income from ownership**; **Income from the sale of agricultural products**; **Insurance refunds from insurers**; **Aid and other income of a social character**; **Gifts from relatives**; **Sale of real estate and movable property**; **Refunded regulatory fees**; **Other income**

B Collective household model

We outline the collective household model and derive the equations used for relative resource share identification. We include this section for completeness and would like to refer the interested readers to Browning *et al.* (2013), Dunbar *et al.* (2013), and Blundell *et al.* (forthcoming). These provide complete proofs.

Households consume a bundle of k goods $z = (z^1, ..., z^k)$ which they purchase at prices $p = (p^1, ..., p^k)$; y denotes total household consumption expenditure; $x_t = (x_t^1, ..., x_t^k)$ is the consumption bundle of a type t household member. There are two household member types t, i.e., m, and f; and two household types s, i.e., (mfc), (mf).

Households solve the following optimization problem.

$$\underset{x_f,\, x_m,\, z}{max}\ \tilde{U}_s[U_f(x_f), U_m(x_m), p, y]$$
$$subject\ to\ z = A_s(x_f + x_m)\ and\ x = z * p$$

Solving the household optimization problem above yields household demand functions. We study nuclear households. Consequently, each household is composed of one household member of each type. Following Dunbar *et al.* (2013), the household demand function is given by the equation below.

$$z_s^k = H_s^k(p, y) = A_s^k(h_f(A_s^{'}p, \eta_f y) + h_m(A_s^{'}p, \eta_m y)) \tag{B.1}$$

We rely on assignable goods to identify the relative resource shares. These are consumed solely by one household member type. The household demand function for these goods is then given by the following equation.

$$z_s^k = H_s^k(p, y) = h_k(A_s^{'}p, \eta_k y), where\ k \in (f, m) \tag{B.2}$$

We can multiply both left and right hand sides of the equation by $\frac{p^k}{y}$ to obtain the respective Engel curves as shown below.

$$LHS\text{:}\ \frac{p^k * z_s^k}{y} = \frac{p^k * H_s^k(p, y)}{y} = W_s^k(p, y) \tag{B.3}$$

$$RHS\text{: } \frac{p^k * h^k(A_s^{'}p, \eta_k y)}{y} = \frac{p^k * h^k(A_s^{'}p, \eta_k y)}{\eta_f y} \frac{\eta_f y}{y} = \eta_f * w_s^k(p, y) \tag{B.4}$$

Combined, these yield the following expression used in the body of the paper.

$$W_s^t(p, y) = \eta_s^t(p, y) w_s^t(A_s p, \eta_s^t(p, y) y) \tag{B.5}$$

Imposing PIGLOG preferences.

$$W_s^t = \eta_s^t(\alpha_s^t + \beta_s^t(ln(y) + ln(\eta_s^t)) \tag{B.6}$$

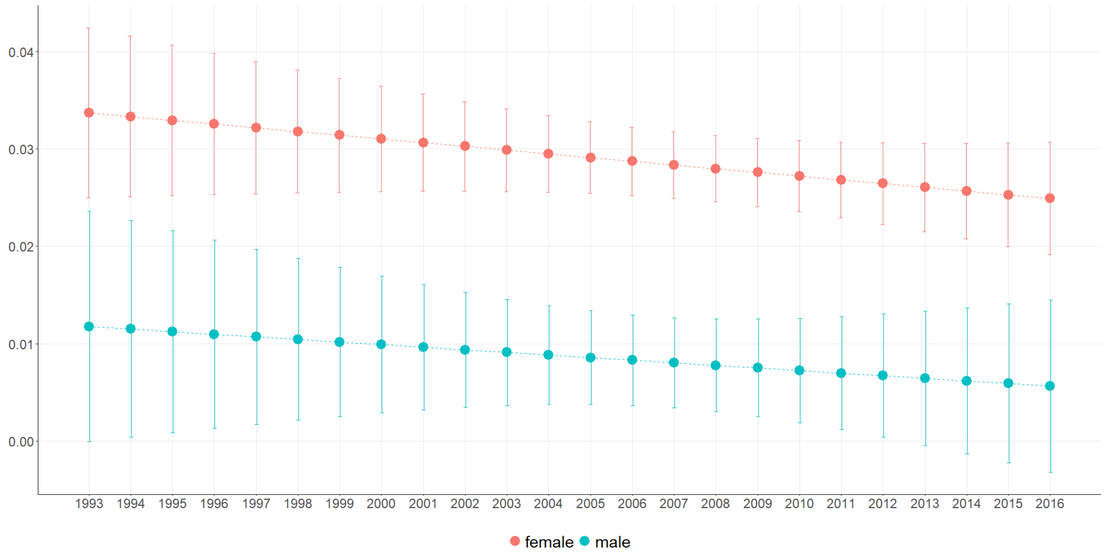
C Estimating δ

C.1 Testing the WSAP assumption

We rely on singles' clothing Engel curves to test the WSAP assumption. We estimate the Engel curves by regressing the clothing budget share on a $constant$, t, z, tz, $ln(x)$, $tln(x)$. We thus follow the assumption that the slopes of singles' Engel curves are independent of personal characteristics. Both intercept and slope can vary between single males and females. We rely on an F-test to test for the difference in slopes. We obtain a test statistic of 23.9, which leads us to reject the null hypothesis of equal slopes at the 1% significance level.

Figure C.1 presents the evolution of the estimated clothing budget semi-elasticities for single-person households and their 95% confidence intervals. We can see no overlap in the confidence intervals during the considered time period.

Figure C.1: Single person households: Clothing budget semi-elasticities



Source: Author's calculation

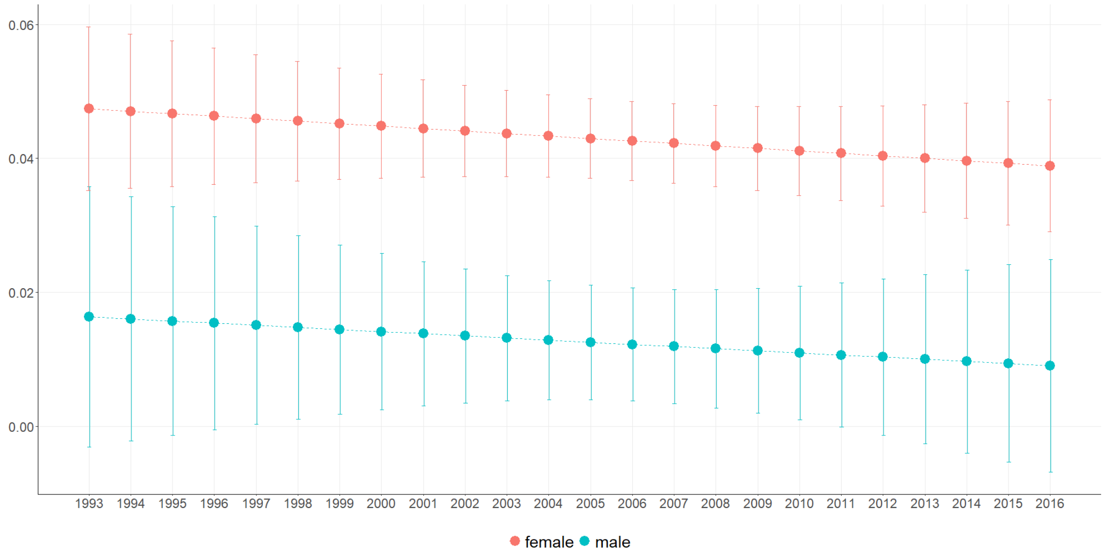
Note: The figure presents the estimated clothing budget semi-elasticities for single person households.

C.2 Estimating δ: IV regression

We also consider an alternative specification in which we instrument for expenditure with disposable income. The test for the difference in slopes yields a test statistic of 16.7, which again leads us to reject the null hypothesis of slope equality at the 1% significance level.

Figure C.2 represents the estimated budget semi-elasticities and their 95% confidence interval. We observe no overlap in the estimated confidence intervals with the exception of 1993.

Figure C.2: Single person households: Clothing budget semi-elasticities

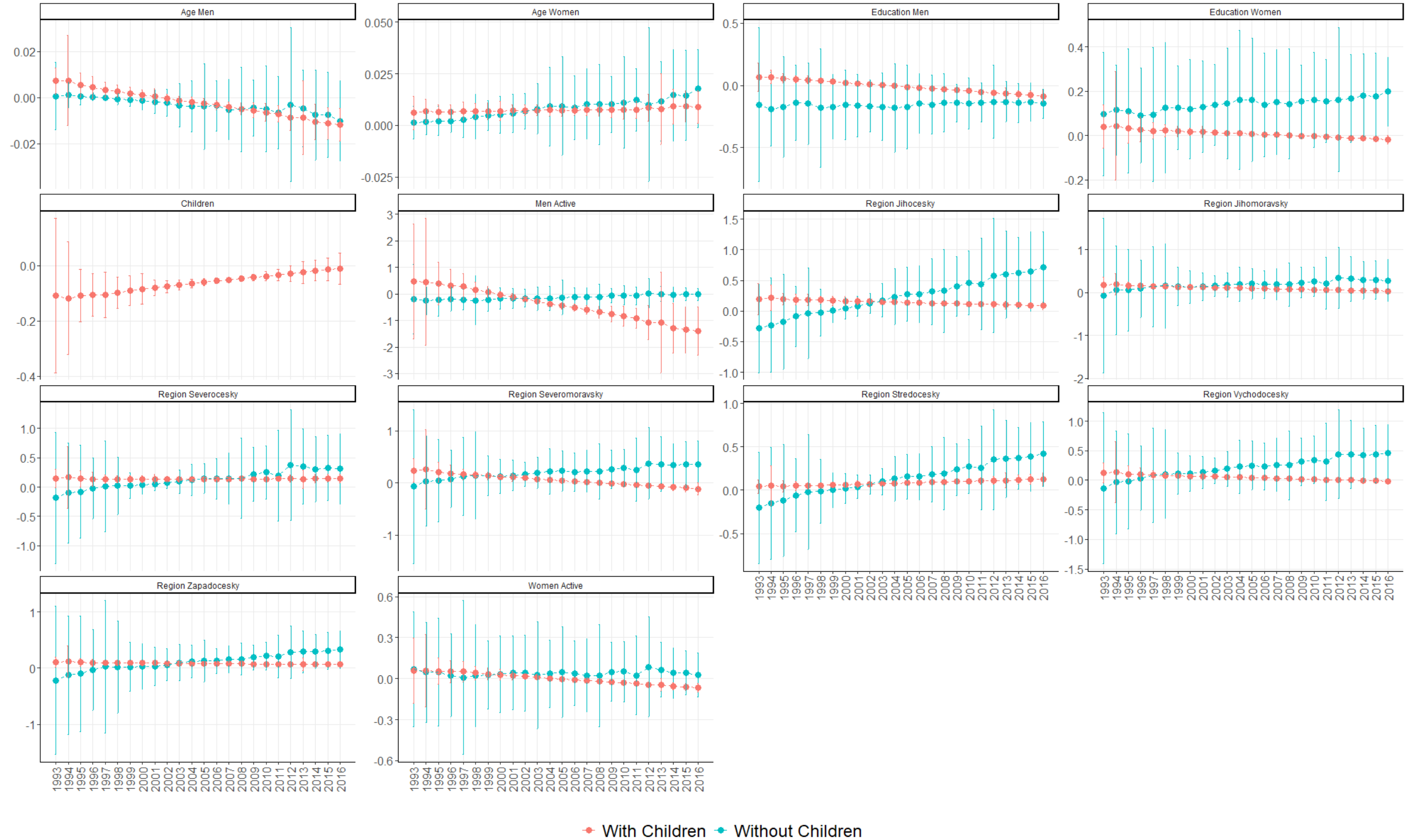


Source: Author's calculation

Note: The figure presents the estimated clothing budget semi-elasticities for single person households.

D Marginal Effects

Figure D.1: Marginal Effects

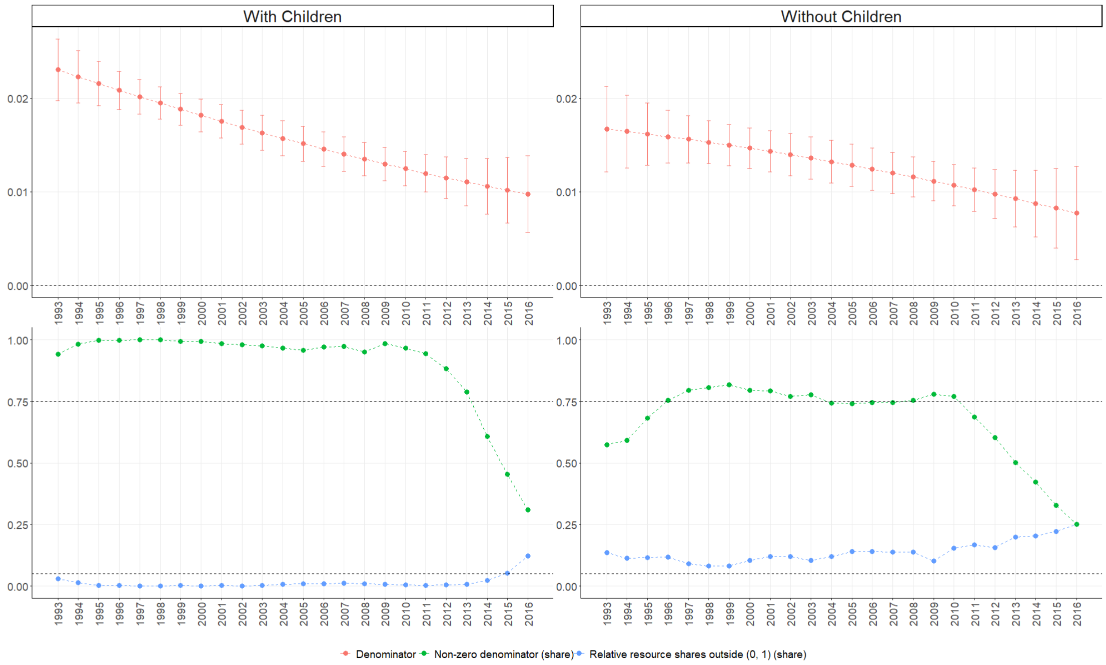


E Relative resource shares: Robustness checks

E.1 Quadratic time trend

First, we consider the specification in which we allow for a quadratic time trend in addition to the linear trend in our baseline specification.

Figure E.1: Model Identification: Quadratic



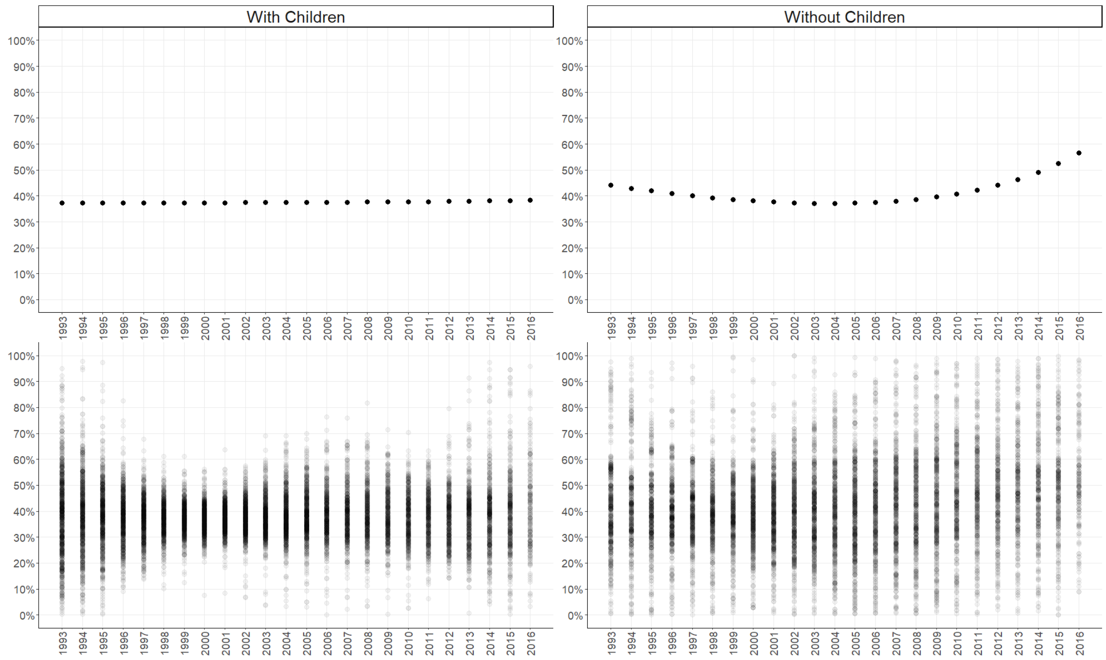
Source: Author's calculation

Note: The top two panels display the estimated denominator values obtained under the restricted specification and their respective 95% confidence intervals. The bottom two panels display the proportion of predicted relative resource shares that fall outside of the (0,1) range, and the proportion of households for which we reject the null hypothesis of the denominator being equal to zero under the full specification.

We estimate singles' Engel curves by regressing the assignable goods' budget share a $constant$, t, t^2, z, zt, zt^2, $ln(x)$, $tln(x)$, and , $t^2ln(x)$. We estimate collective households' Engel curves by regressing the assignable goods' budget shares on a $constant$, t, t^2, z, zt, zt^2, $ln(x)$, $tln(x)$, $t^2ln(x)$, $zln(x)$, $tzln(x)$, and $t^2zln(x)$. We also consider the restricted specification under which the Engel curve slopes vary only over time.

Similarly to the body of the paper, Figure E.1 reports the indicators of possible weak identification. Relative resource shares are better identified in nuclear households with children as in the baseline specification. These clear the thresholds until 2013. Relative resource shares are less well-identified in childless households. Similarly to the baseline specification, these do not clear the threshold for the proportion of households with predicted relative resource shares outside the (0,1) range. They satisfy the second indicator for the 1996-2010 period. Below, we focus on the results from this period, though these should be interpreted with caution.

Figure E.2: Relative Resource Shares: Quadratic



Source: Author's calculation

Note: The figure displays the evolution of the predicted relative resource shares over the 1993-2016 period. The top two panels display the relative resource shares unconditional on household and individual characteristics. The bottom two panels display the evolution of the distribution of relative resource shares that vary with household and individual characteristics

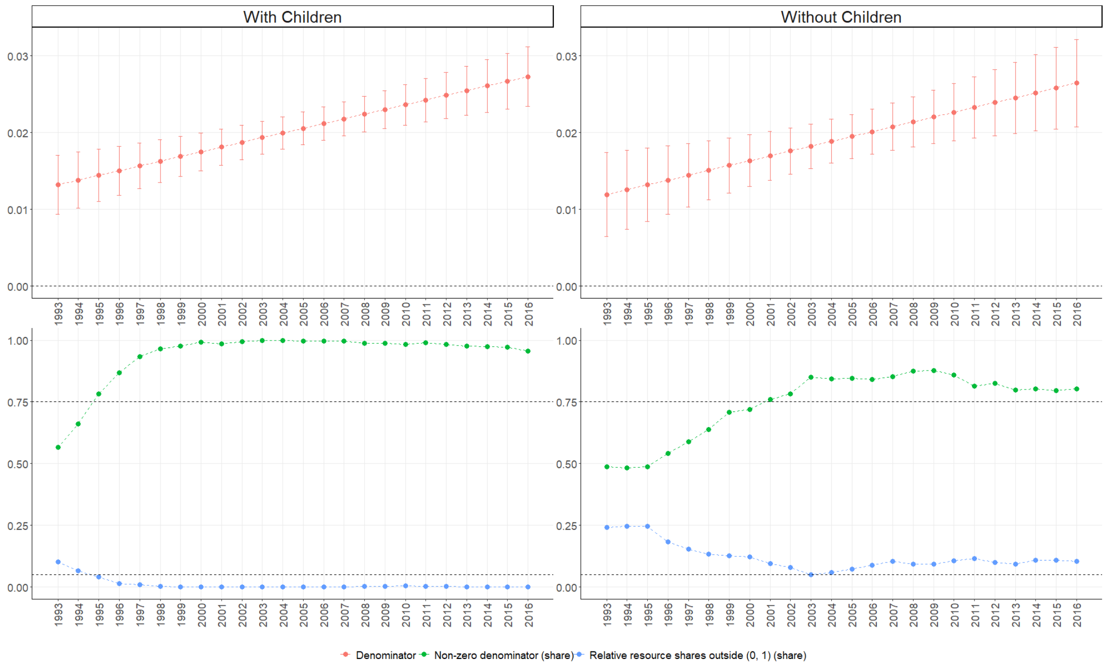
The mean relative resource shares are 37.7% (1993-2013) in households with children and 40.4% (1996-2010) in childless households. We observe a decrease in the mean relative resource share in households with children from 38.5% (1993) to 37.8% (2013), whereas we observe a rise in the mean relative resource share in childless households from 39.4% (1996) to 42.1% (2008), 43.7% (2009), and 45.8% (2010). However, the rapid rise in the final years might stem from weak identification. Figure E.2 presents the estimated relative resource shares.

These findings are mostly in line with the baseline specification. The magnitude and evolution of the estimated relative resource shares are similar to those obtained under the baseline specification. In households with children, we also observe a decrease in the relative resource shares. However, the decrease is slightly less pronounced. We also observe a rise in the relative resource shares in childless households.

E.2 Relative resource shares: IV regression

Second, we consider the specification in which we instrument for household consumption by household disposable income.

Figure E.3: Model Identification: IV

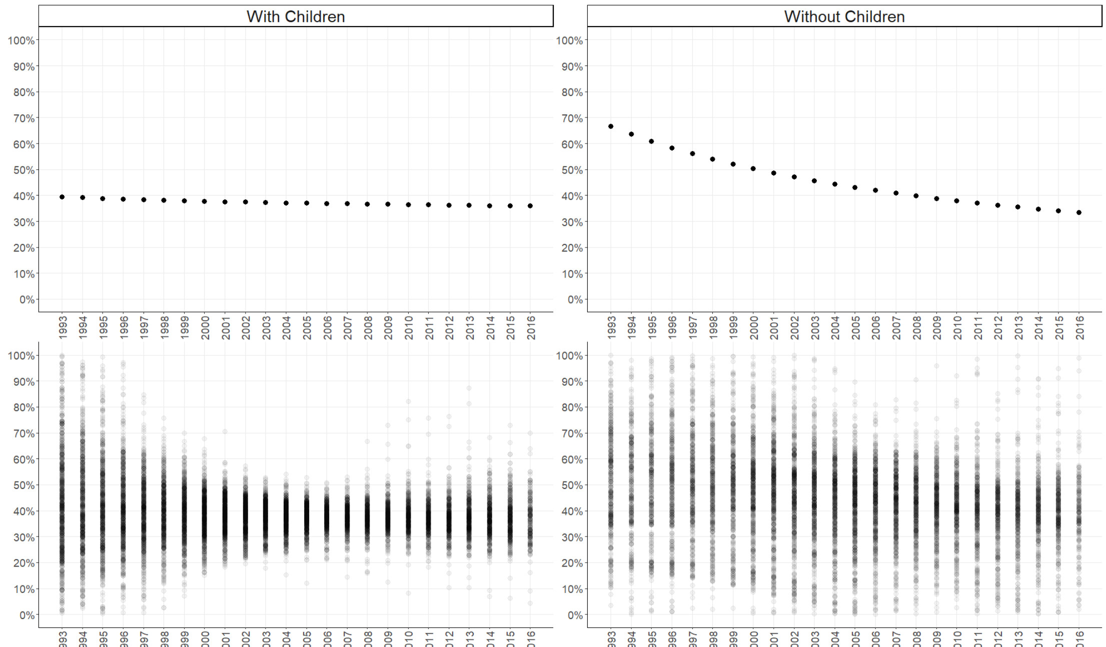


Source: Author's calculation

Note: The top two panels display the estimated denominator values obtained under the restricted specification and their respective 95% confidence intervals. The bottom two panels display the proportion of predicted relative resource shares that fall outside of the (0,1) range, and the proportion of households for which we reject the null hypothesis of the denominator being equal to zero under the full specification.

Figure E.3 reports the indicators of possible weak identification. Households with children clear the identification thresholds in the 1995-2016 period. We are thus at risk of weak identification in the first two years of the considered period, unlike in the baseline specification. Similarly to the baseline specification, relative resource shares are less strongly identified in childless households. The proportion of households with predicted relative resource shares outside the (0,1) range is always above the 5% threshold. The second indicator is satisfied in the 2001-2016 period.

Figure E.4: Relative Resource Shares: IV



Source: Author's calculation

Note: The figure displays the evolution of the predicted relative resource shares over the 1993-2016 period. The top two panels display the relative resource shares unconditional on household and individual characteristics. The bottom two panels display the evolution of the distribution of relative resource shares that vary with household and individual characteristics

The mean relative resource shares are 38.1% (1995-2016) in households with children and 41.8% (2001-2016) in childless households. The mean relative resource share decreases substantially in childless households from 41.6% (1995) to 36.6% (2016). We also observe a fall in the relative resource share in childless households from 47.2% (2001) to 39.3% (2016). Figure E.4 presents the estimated relative resource shares.

The decrease in relative resource shares in households with children is in line with our baseline specification. However, it is considerably more pronounced when we instrument for household consumption with household disposable income. Estimated relative resource shares in childless households differ more significantly. We observe a considerable decrease when instrumenting, whereas the baseline specification suggested a slight increase of the relative resource shares. Though the mean relative resource share is similar, its' dynamics are different.

F Application: Child penalty

We present a possible application of long-run within-household consumption inequality estimates for child penalty measurement. Child penalty in within-household consumption distribution can arise for a variety of reasons. For example, the child's presence affects labor force participation and income ratios within the household through parents' maternity and paternity leaves. Moreover, it can affect the parents' lifetime earnings potential, thus worsening their outside option. Bargain & Donni (2012) and Bargain *et al.* (2022a) find that women contribute more to children's resource shares than men. However, there are no estimates of how childbirth affects within-household consumption inequality over time.

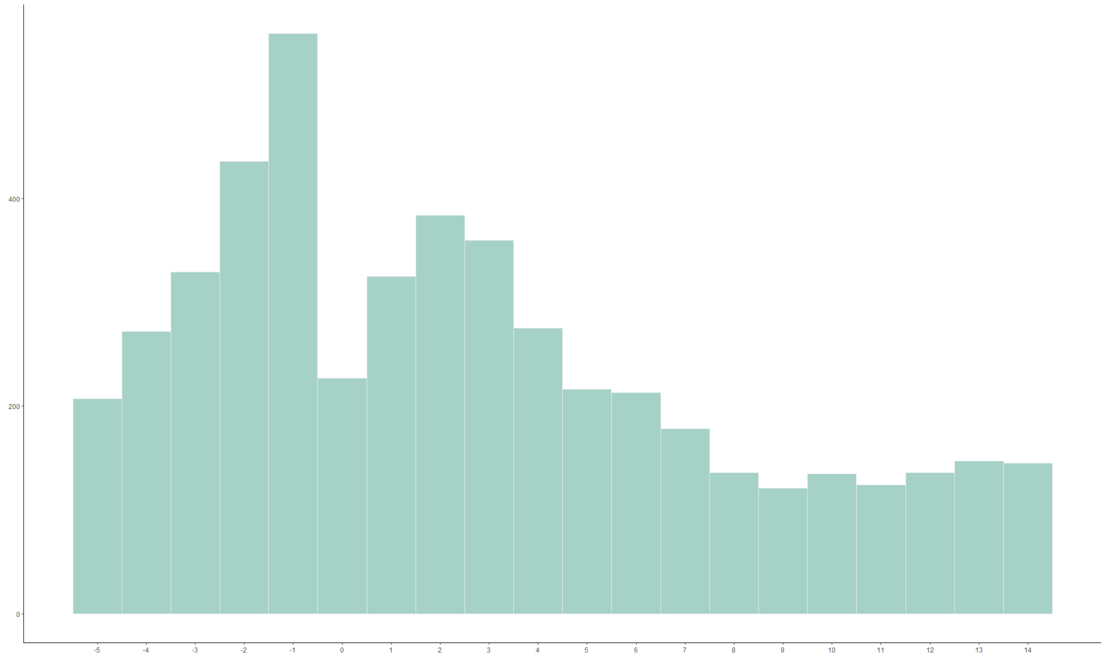
We deploy a pseudo-event study approach in the spirit of Kleven (2023) and Kleven *et al.* (2024). The authors propose an approach to recover child penalties in the absence of longitudinal data. They conduct a pseudo-event study around the first child's birth by relying on cross-sectional data. While we observe positive event times in cross-sectional data, i.e., households with children, outcomes in negative event times are unknown. We do not observe the same households before the first child's arrival. We are also unaware whether and when childless households will have their first child. The key innovation of Kleven (2023) and Kleven *et al.* (2024) is to impute negative event times based on observable characteristics.

Let τ denote the event time, t time, and a the mother's age. The event is the first child's birth. We observe the relative resource shares R_h for $\tau \geq 0$. However, given the nature of cross-sectional data, relative resource shares are unknown for $\tau < 0$. We match to each parent i observed at time t, $\tau = 0$, and age a a childless counterpart j observed at $t - n$, $a - n$ with identical characteristics (education, and region). Following this approach for $n = 1, ..., 5$, we obtain a pseudo-panel with 5 years of pre-child data. In the case of multiple matches, we consider the mean of R_h across the matches. We recover the child penalty using the equation below.

$$(R_h)_{it} = \alpha D_{i\tau}^{event} + \beta D_{it}^{age} + \gamma D_{it}^{time} + \epsilon_{it} \tag{F.1}$$

We are unable to profit from all observations due to the structure of the HBS data. The HBS provides only the mean age of all children in the household and the count of children by the following age brackets: (0,5), (6,9), and (10,14) years of age. Consequently, we are able

Figure F.1: Child Penalty: Observations



Source: Author's calculation

Note: The figure displays the number of observations by event time.

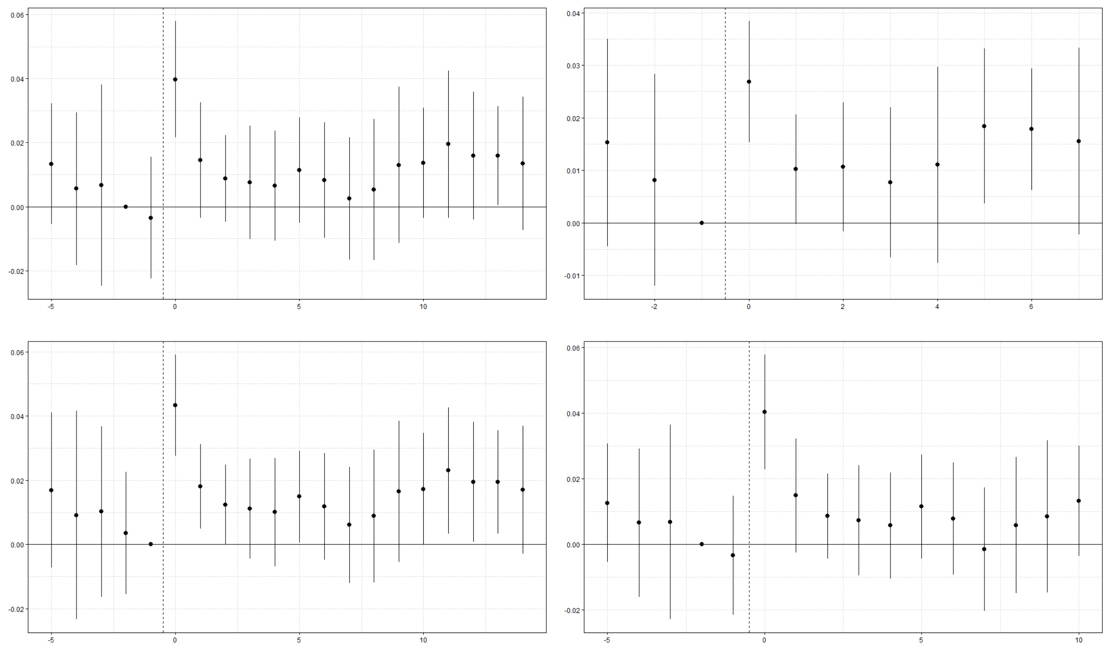
to identify the age of the oldest child in the household only for households with less than two children, where the second child is a newborn. This constraint limits the size of the dataset we can rely on to estimate the possible child penalty.

We use the relative resource shares R_h estimated through the baseline model. We rely only on relative resource shares from the 1998-2009 period due to the possible risk of weak identification in the remaining years for m/w households. Finally, we filter out observations with $a > 40$. However, this choice has little effect on our results.

Figure F.1 presents the number of observations by event time τ. We have, on average, 208 observations for each positive event time. The number of observations for negative event times is the highest for $\tau = -1$ and decreases markedly for earlier event times. This relatively low number of observations translates into event time-age-time cells with either no or only units of observations. For this reason, we have relegated this exercise as an illustration to the appendix instead of including it in the body of the paper.

The top-left panel of Figure F.2 presents the results. We omit $\tau = -2$ as the base year. Our

Figure F.2: Child Penalty



Source: Author's calculation

Note: The figure displays the event study of first child birth and the robustness checks.

results suggest absence of a negative child penalty. Contrarily, we find a positive effect in the first year after birth. However, we fail to reject the null hypothesis of no effect in the subsequent years. We consider the following specifications as robustness checks. First, we omit $\tau = -1$ as the base year. Second, we group event time dummies by two years instead of one. Third, we narrow the event window to $\tau \in (-5, 10)$ and include an end-cap dummy at $\tau = 10$. We obtain similar results under these specifications. The remaining panels of Figure F.2 present the results.

While our results might seem surprising, we want to stress that they should be considered only as an illustrative exercise. This caution stems from the relatively low number of observations caused by our limited ability to recover the oldest child's age. Moreover, the estimated effects are not precisely estimated with broad confidence intervals.