Children Costs in a One-Adult Household: Empirical Evidence from the UK.

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Abstract

This paper addresses two critical questions for family and economic policy. Are estimates of the cost of children based on two-parent households generalizable to single-parent families? Does the "two-child limit" policy—restricting family benefits to low-income parents with a maximum of two children—contribute to child poverty? In this paper, I extend the collective consumption model to one-adult households and apply it to data from the Family Expenditure Survey (FES) in the UK and present two key findings. First, child cost estimates derived from two-parent households tend to underestimate by 5.3 percentage points those incurred by single parents due to significant structural differences between these households. Second, in low-income families, household size plays a crucial role in determining the proportion of resources allocated to children, a factor less relevant for higher-income families. This suggest that the "two-child limit" policy would likely exacerbate inequalities within larger families.

JEL Classification: C30, D11, D12, D36, D63, I31, J12, J13

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1 Introduction

The cost of raising children is a significant factor in shaping family transfer policies, particularly in the UK, where child poverty remains a pressing issue. Recent poverty statistics reveal that the number of children living in relative poverty (after housing costs) rose from 3.6 million in 2010 to 4.2 million by 2022.[1] This represents about 29% of all children in the UK, highlighting a concerning upward trend in child poverty over the decade. This alarming trend has sparked considerable attention in the national media and underscores the need for well-designed family transfer systems. Treating single and coupled parents equitably through tax deductions and social policies requires a deep understanding of the financial pressures unique to each family type. In two-parent households, resource pooling and shared decision-making may alleviate some economic pressures (DeLeire et al., 2005; Nieuwenhuis and Maldonado, 2018). By contrast, single parents, whose well-being is more directly tied to that of their children, often bear a greater financial strain. Therefore, cost estimates based on two-parent households overlook these structural differences, potentially underestimating the financial strain on single parents and leading to policies that fail to meet their specific needs. Despite this, much of the existing literature focuses on two-parent households, raising concerns about the applicability of these findings to single-parent families. See, e.g., Bradbury (1994, 2008); Bourguignon (1999); Apps and Rees (2001); Blundell, Chiappori, and Meghir (2005); Bargain, Donni, and Gbakou (2010); Bargain and Donni (2012a); Dunbar, Lewbel, and Pendakur (2013, 2021); Adda, Dustmann, and Stevens (2017); Penglase (2021); Bargain, Donni, and Hentati (2022).

An additional policy concern in the UK revolves around the "two-child limit" in welfare provisions, which restricts benefits to the first two children in a family. This policy can disproportionately affect low-income families, particularly those with more than two children. Moreover, this policy risks deepening inequalities between children from low- and high-income families, if larger families in lower-income brackets face increasing financial disadvantage.

This paper leverages existing methods in the literature to identify and estimate the consumption shares of single parents and their children. Specifically, it investigates

[1] The report is available on the Child Poverty Action Group website.

whether standard resource shares (computed for 2-parent households) accurately measure the indiviual well-being of single parents. More importantly, the paper examines how family size influences the allocation of resources to children across income levels. For this purpose, I extend the collective model of Bargain, Donni, and Hentati (2022, hereafter BDH) to a setting with single adult households and discuss identification in this environment. The approach infers expenditures on children from traditional consumer surveys by examining adult clothing expenditures and socio-demographic variables. This study constructs and estimates a static model of intra-household allocation to explore how changes in parent and child characteristics affect resource distribution. The suggested household consumption framework has three main components: (1) an additive utility function, assuming the parent is altruistic towards their children; (2) a consumption technology describing how households convert purchased goods into individual consumption; and (3) a sharing rule that determines the distribution of individual resource shares, defined as the fraction of household's total resources devoted to each member. The model is estimated on a sample of one-adult households with and without children from the UK Family Expenditure Survey (henceforth FES) from 1978 to 2020.[2] The estimates are not a direct measure of the well-being of children as they may receive transfers from another parent/agent(government) outside the household.[3] The objective is not to quantify what children receive. Instead, it centers on the costs incurred by single parents in raising children.

The primary contribution of this paper is the initial estimation of the cost of children in single-parent households. It reveals a potential underestimation of this cost when these families are assessed using estimates derived from couples BDH. Furthermore, this paper contributes to the literature on the UK's two-child welfare program by questioning its effectiveness for larger, low-income families, while broadening the discussion on fertility and welfare programs (Kearney, 2004; Milligan, 2005;

[2]Family Expenditure Survey (FES) has been replaced by Expenditure and Food Survey (EFS) in 2001, then Living Costs and Food Survey from 2008 onwards. For the sake of convenience, I use FES to qualify all three.

[3]See Folbre (2008) for an in-depth analysis of how conceptualizing the cost of children. Research on child development includes numerous articles addressing external investment in children. Those interested in delving deeper into this issue should refer to the works of Costas Meghir on Early Childhood Interventions. Also, the consideration of cognitive skills investment and its lasting effects on children is explored by Cunha et al. (2010), Del Boca et al. (2014, 2016), and Agostinelli and Wiswall (2016), among others.

Brewer, Ratcliffe, and Dsmith, 2012; Cohen, Dehejia, and Romanov, 2013; Laroque and Salanié, 2014; González and Trommlerová, 2023). Finally, by including single fathers in the analysis, this study also lays a basis for comparing the child-related costs between single mothers and single fathers.[4]

This research is made possible by the availability of relatively large sample data on single-household expenditures. However, as expenditure surveys typically provide consumption data at the household level, addressing the issue of equivalence scales presents significant challenges. Our empirical findings can be summarized as follows. First, estimates of child-related costs derived from couple households appear to underestimate these costs for single-parent households by 5.3 percentage points, likely due to the structural differences inherent in these two types of households. Second, family size emerges as a critical determinant of child-related economic burden in low-income families, whereas it plays a negligible role in high-income families. Specifically, a larger number of siblings significantly disadvantages children in low-income households. This suggests that the "two-child limit" policy would likely worsen disparities in larger families. Finally, our results reveal notable differences in resource allocation between single mothers and single fathers, as well as differences due to the size and gender composition of siblings, which overall provide strong support in favor of economies of scale in childcare. On average, the cost of a child represents 33% of total expenditures for single fathers and 22% for single mothers.

The remainder of this paper is organized into five parts. The first presents the theoretical model. The second outlines the empirical framework. The third describes the data. The fourth reports and discusses the empirical results, and the last section concludes.

2 Theoretical Framework

This section presents a static household consumption model following BDH, starting with single individuals as a foundation for analyzing unpartnered adults with children.

[4] Prior studies on single parents have predominantly centered on mothers. See, e.g., Edin and Lein (1997), Meyer and Rosenbaum (2000, 2001), Schoeni and Blank (2000), Grogger (2001), Blank and Schoeni (2003), Blundell and Hoynes (2004), Meyer and Sullivan (2004, 2008), Winship and Jencks (2004), and DeLeire et al. (2005).

2.1 The Consumption Behavior of a Single-Adult without Children

In this section, I model the consumption behavior of a single-adult household without children. Each household is assumed to have a well-behaved utility function, $U(x^a, x^c)$, which is twice continuously differentiable, strictly increasing, and strictly concave over two goods: an exclusive good x^a and a composite good x^c.[5] Individual utility is further influenced by preference-driven factors, which are incorporated into the budget share function in the empirical section. Preferences are assumed to be stable, enabling predictions about household behavior.

Each individual purchases x^a quantities of private assignable goods and x^c quantities of composite goods.[6] Thus, each individual faces the budget constraint as follows:

$$x^a p + x^c = y \tag{1}$$

where y denotes the total household expenditure and p the price of the exclusive good. The market price of the composite good is normalized to one.

At this stage, the optimization program of the household member is as follows:

$$\max_{x^a, x^c} \quad u(x^a, x^c) \text{ subject to (1)} \tag{2}$$

The solution of this program allows expressing the demand functions for the exclusive good as:

$$\omega = g(p, y) \tag{3}$$

where $\omega = px^a/y$. It is worth noting that $U(.)$ is strictly increasing, then ω must exhaust the consumer's income.

[5] An exclusive good refers to a good that is consumed by a specific individual and cannot be shared or jointly consumed with others (e.g., clothing). The composite good represents any good other than the exclusive one. Thus, the distinction between private and exclusive goods could be omitted in the case of an unpartnered adult without children, as all goods are consumed privately, eliminating any potential confusion regarding individual consumption. However, I retain this distinction to maintain clarity and consistency, particularly because the demand function under consideration is specifically related to exclusive goods.

[6] Non-durable goods are excluded from the analysis, as is standard in the literature. Therefore, if the fraction of purchased goods that remain unconsumed is small, the quantities purchased can be considered equivalent to the quantities consumed.

2.2 The Consumption Behavior of a Single-Adult with Children

In this section, I consider a household consisting of an adult and their children.[7] The parent is assumed to be altruistic in the Beckerian sense, meaning they derive utility not only from their own consumption but also from their child's well-being. In this case, each single parent has a well-behaved utility function $W[u(x^a, x^c), u_k(x^c)]$ that contains two components - the first sub-utility derived from their own consumption u and the other one from their representative child's consumption u_k.

I consider an additive utility function that takes the following form:

$$W = u(x^a, x^c) + \delta(n)u_k(x_k^c) \tag{4}$$

where x^a represents goods consumed exclusively by the parent, while x^c and x_k^c represent composite goods for the parent and for the children, respectively.[8] The parameter $\delta(n)$ reflects how resources allocated to the child change as the number of children increases and can be interpreted as the weight the parent places on the child's consumption (Bargain and Donni, 2012b).[9] Alternatively, it can be viewed as a measure of parental altruism.

For simplicity, household income is given with no time-allocation decisions or household production considerations[10]. Household income is entirely allocated to purchasing q^a quantities of assignable goods and Q quantities of composite goods. Thus, y represents total expenditures rather than total income. The household budget constraint is expressed as follows:

$$q^a p + Q = y \tag{5}$$

[7] In contrast to Penglase (2021), the model treats foster and non-foster children indiscriminately. Penglase (2021) explicitly separates the two groups of children, focusing on whether there is differential treatment in the allocation of resources for the consumption of foster and non-foster children. At this point, no distinction is made regarding the characteristics of the children. My assumption is limited to the child residing with either the father or the mother and younger than 16 years old.

[8] Assignable good and exclusive good are used interchangeably as well as single parent and lone parent. See Browning, Chiappori, and Lewbel (2013) for more details about exclusive and assignable goods.

[9] When there are no children ($n = 0$), then $\delta = 0$, and the model reduces to a standard single-adult consumption model. Thus, children influence household decisions through the utility their parents derive from their well-being.

[10] A broader perspective on this topic is addressed by Apps and Rees (2001) and Cherchye et al. (2012).

Here, q^a and Q denote, respectively, the purchased quantities of the household's exclusive goods and household composite goods.

Several remarks can be made. First, children's consumption is included in Q. Second, there are two types of goods: an adult exclusive good x^a, such as adult clothing, and other goods that are non-assignable to adults, x^c and x_k^c. Third, household composite goods consist of both private non-assignable goods and public goods. Finally, household survey data typically do not track individual consumption within a household. Therefore, information on composite goods provides limited insights into the share of resources allocated to children. However, observing adult-exclusive goods can reveal relevant aspects of household behavior.

An assignable good or exclusive good is purely private. That is, for any household's demographic structure, the consumption of an exclusive good reflects precisely the household's expenditure. Thus:

$$q^a = x^a \tag{6}$$

However, in a household with at least two members—an adult and a child—some goods have public properties, meaning their consumption cannot be accurately captured by their purchased quantities alone. Two main approaches address economies of scale. The Independence of Base (IB) assumes that the cost savings from shared consumption are independent of both prices and the household's total expenditure. This approach suits studies based on cross-sectional data from a single or two years (Lewbel and Pendakur, 2008; Bargain and Donni, 2012a; Dunbar et al., 2013). Conversely, the Barten scales introduce a transformation in the price vector, allowing the cost savings from shared consumption to vary with the household's composition and the type of good. Given the multi-year dataset with varying prices, I favor the latter approach. In this framework, purchased quantities are transformed into higher consumption levels with a transformation rate dependent on three exogenous variables. This assumption follows the work of (Browning, Chiappori, and Lewbel, 2013, hereafter BCL).

Assumption 1 *(Barten prices). For each adult living in a household with $n > 0$, there exists a scalar-valued, differentiable function $\pi(y, p, n)$ such that household pur-*

chases of composite goods satisfy:

$$Q = \pi(y, p, n)x^c + x_k^c \tag{7}$$

The function $\pi(y, p, n)$ represents shadow prices for the parent. To ensure identification, I normalize the shadow price for children to one. The shadow price serves as a deflator that measures the cost savings experienced by adult due to household economies of scale (Bargain and Donni, 2012a). Instead of using the market purchases Q to produce composite goods that contribute to utility, the household effectively achieves an increased quantity of market goods x^c through sharing. A classic example of such a good is heating. The interpretation of $\pi(y, p, n)$ leads to three distinct scenarios. If $\pi(y, p, n) = 1$ for $n > 0$, goods are purely private[11]. The parent's shadow price depends on the presence of children. If the parent prefers public goods because of the children, π will be greater than one; otherwise, it will be less than one.

Substituting Equations (6) and (7) into the household budget constraint (5), we get:

$$x^a p + \pi(y, p, n)x^c + x_k^c = y \tag{8}$$

Parents maximize their utility subject to the new budget constraint (8). In a household consisting of one adult and children, the parent's decisions are automatically Pareto efficient. This outcome is derived from the assumption that the adult acts as a dictator within the household, making all consumption decisions on behalf of the children.[12]

The trade-off that needs to be done will happen in allocating resources for the parent and child consumption. Given budget and technology constraints, parents cannot improve the child's well-being without diminishing their own. The household allocation can be derived from the following optimization program:

[11]This explains why it is unnecessary to explicitly introduce the function π in Equation 1.

[12]Dauphin, El Lahga, Fortin, and Lacroix (2011) found that children, particularly those aged 16 and older, may have some degree of decision-making power within households. However, the present study focuses on children aged 15 or younger. At this age, children are neither expected to contribute to household income nor to play a significant role in household decision-making. Consequently, it is reasonable to assume that children in this age group hold no bargaining power within the household.

$$
\begin{aligned}
&\max_{x^a, x^c, x_k^c} u(x^a, x^c) + \delta(n) u_k(x_k^c) \\
&\text{s.t.} \quad x^a p + \pi(y,p,n) x^c + x_k^c = y
\end{aligned} \tag{9}
$$

where $\delta(n)$ represents the weight the parent assigns to the child, depending on the number of children. The budget constraint shows total expenditures on both adult and child consumption.

Adopting an additive utility function simplifies the transition to a decentralized approach. In the first stage, the resource distribution between the parent and the child is determined by solving:

$$
\max_{\phi, \phi_k} \quad \nu\left(\frac{p}{\pi}, y\frac{\phi}{\pi}\right) + \nu_k(y\phi_k) \quad \text{s.t.} \quad \phi + \phi_k = 1 \tag{10}
$$

where ν and ν_k are the indirect sub-utility functions of the parent and child, respectively, and ϕ and ϕ_k represent the share of total expenditures allocated to the parent and child.
The second stage solves the parent's decision problem:

$$
\max_{x^a, x^c} \quad u(x^a, x^c) \quad \text{s.t.} \quad x^a p + \pi(y,p,n) x^c = y \cdot \phi(y,p,n) \tag{11}
$$

where $\phi(y,p,n) \leq 1$ and $n > 0$. The term $\phi_i(y,p,n_i)$ represents the fraction of resources the parent retains for their consumption, with $1 - \phi$ allocated to the child. If no children are present, $\phi = 1$, meaning the parent keeps the entire budget, as in a single-adult household.

Finally, the budget share equation is given by:

$$
\frac{\omega}{\phi(y,p,n)} = g\left(\frac{p}{\pi(y,p,n)}, y\frac{\phi(y,p,n)}{\pi(y,p,n)}\right) \tag{12}
$$

where $\omega = px^a/y$. The demand function highlights why detailing the child's utility function is unnecessary, as it does not dictate the model's outcome.

2.3 Identification

An important question in the model of consumer behaviour under study is regarding the sharing function and economies of scale and how to recover them. Overall, the answer to this question lies in the preference stability assumption (typically the state of individual preferences from childless individuals to single parents), the observation of exclusive goods, and the non-linearity of the Engel curve.

As is standard in the literature, I assume that the preferences of individuals with identical characteristics over exclusive goods remain unchanged regardless of family status. See, e.g., BCL; BDH. In this context, the preferences of single individuals and single parents for exclusive goods are considered similar. This assumption allows for the estimation of sharing parameters between single parents and children using the demand functions of single individuals, as their indifference curves remain unaffected by the presence of children. Therefore, any shifts in consumption patterns among single parents are attributed to changes in household composition rather than to alterations in individual preferences when moving from childless individuals to parents.

Chiappori and Ekeland (2009) mentioned that identification requires estimating at least three goods. However, Bourguignon (1999) and Bourguignon et al. (2009) demonstrated that having an assignable good suffices to recover the sharing rule and reach identification. Assignable goods such as clothing are central in several studies. See, e.g., BCL, Bargain and Donni (2012a), and BDH, among others. I exploit the existence of observable assignable goods (clothing in that case) to identify the model's structural elements.

Prais and Houthakker (1971) provided evidence supporting the use of nonlinear Engel curves and the inclusion of socio-demographic characteristics as control variables. Identification in this context requires that the demand equations exhibit non-linearities in log total expenditures. However, this is not a major concern, as budget share equations are typically non-linear, as demonstrated by Banks, Blundell, and Lewbel (1997).

Finally, identification relies on two normalization conditions, which are summarized in the following assumption.

Assumption 2 *For childless single adults, we have:* $\pi(y, p, 0) = 1$ *and* $\phi(y, p, 0) = 1$.

As previously mentioned, this assumption demonstrates that the childless household model is a special case of the household model with children. In the absence of children, the market price for the composite good is normalized to one for a single-adult household, as $\pi(y, p, 0)$ equals one. Furthermore, $\phi(y, p, 0)$ being equal to one implies that the adult retains the entire budget, as illustrated in the single-adult model without children.

The following proposition summarizes the main result of identification.

Proposition 1 *Let the demand functions for an exclusive good, respectively, for single individuals and single parents be defined as:*

$$\omega = g(z_\omega, p, y),$$
$$\omega = g(z_\omega, \pi(p, z_\pi, y, n) \cdot p, \phi(p, z_\phi, y, n) \cdot y),$$

where $\pi(p, z_\pi, y, n)$ *represents the price transformation à la Barten, and* $\phi(p, z_\phi, y, n)$ *denotes the sharing rule. Here,* p *is the price of the exclusive good,* y *represents total expenditures,* n *is the number of children, and* z_ω, z_π, z_ϕ *are sociodemographic variables associated with* ω, π, *and* ϕ, *respectively.*

The functions $\pi(p, z_\pi, y, n)$ *and* $\phi(p, z_\phi, y, n)$ *can be generically identified if any of the following conditions hold:*

1. *At least one variable in* z_ω *is excluded from both* z_π *and* z_ϕ.
2. π *and* ϕ *are independent of* y *(total expenditures).*
3. π *and* ϕ *are independent of* p *(prices).*
4. $\pi(p, z_\pi, y, n)$ *and* $\phi(p, z_\phi, y, n)$ *are known up to some parameters (semi-parametric identification).*
5. $\pi(p, z_\pi, y, n) = \pi_1(p, z_\pi, y) \cdot \pi_2(n)$, *with* $\pi_2(1) = 1$, *and* $\phi(p, z_\phi, y, n) = \phi_1(p, z_\phi, y) \cdot \phi_2(n)$, *with* $\phi_2(1) = 1$.

The proof is given in the Appendix A. Here, we give the intuition for each of the points.

1. z_ω refers to a set of variables that impact the demand for the exclusive good ω, but not necessarily the shadow price π or sharing rule ϕ. These variables may include socio-demographic factors such as age, education, or personal preferences. If there is a variable in z_ω (say, education) that only affects the demand for the exclusive good but not the shadow price or sharing rule, this creates an exclusion restriction. By observing how demand responds to changes in this variable, one can isolate its effect on demand while keeping π and ϕ fixed. For instance, if one observes that a parent's level of education influences their demand for clothing (the exclusive good) without affecting the allocation of their budget between themselves and their children (ϕ) or the adjusted price due to the presence of children (π), this allows for control over education's impact on ω and facilitates the estimation of π and ϕ.

2. In this case, the shadow price π and sharing rule ϕ do not change with total expenditures y. Therefore, whether the household's total expenditure is £1000 or £2000, π and ϕ remain unchanged. If one finds that the parent's allocation of resources between themselves and their child remains constant regardless of changes in the household's overall budget, it is not necessary to account for variations in y when estimating π and ϕ, thereby simplifying their identification.

3. Suppose the price of the exclusive good (such as clothing) increases, but this does not affect how the parent allocates their budget between themselves and their child (ϕ). In this case, π and ϕ remain unchanged, allowing for their separate estimation, independent of the effect of price changes on demand.

4. If the functional forms of π and ϕ are known up to some parameters, one can focus on estimating those unknown parameters rather than trying to figure out the entire functional forms of π and ϕ. For example, if it is known that ϕ depends on the number of children, but the exact magnitude of this dependence is unknown, one might assume a specific functional form for $\phi = \Phi(n)$, where Φ

could be a simple linear or logistic function. The task would then be to estimate the parameter that determines how much ϕ decreases as additional children are introduced.

5. By assuming that π and ϕ can be separated into two components, one simplifies their structure. This factorization allows us to estimate the impact of having children (n) separately from the impact of prices and sociodemographics. For example, π might be written as $\pi_1(p, z, y) \cdot \pi_2(n)$, where π_1 reflects the effects of prices and demographics, and $\pi_2(n)$ captures the effect of the number of children. This approach simplifies the estimation of π, as the problem is broken down into two smaller parts: one that depends on p, z and y, and another that depends only on n. The condition $\pi_2(1) = 1$ ensures that, in the absence of children, the shadow price π does not alter the market price p.

3 Empirical Implementation

This section outlines the empirical methodology in two steps: first, specifying the model, followed by addressing the endogeneity issue.

3.1 Econometric Specification

The empirical specification examines a demand system which is quadratic in logarithmic expenditure, as used in studies such as Browning et al. (1994) and BDH. This quadratic parameterization addresses the limitation posed by the linearity hypothesis, wherein marginal budget shares are independent of the expenditure level. To capture the unobserved heterogeneity, I introduce an error term, ϵ_i, which accounts for optimization errors and other unobserved factors that influence budget allocation, but remain unaddressed by the model.

$$\omega_i = \alpha_i z_i + \beta_i \ln p_i + \gamma_i \ln y_i + \eta_i (\ln y_i)^2 + \epsilon_i \tag{13}$$

for $i = f, m$, where α_i, β_i, γ_i and η_i are the parameters to be estimated. The vector z_i is a linear function of a set of covariates, including education level, adult age and its square, year and its square, a set of dummies for labor force participation, home ownership and region of residence.[13] Notably the equations are gender-specific, with separate estimations for men and women.

When the individual has no children, the equation simplifies from (12) to (3). To distinguish between single parents and childless adults, I introduce a dummy variable, $\mathcal{I}_i$, which equals 1 if the adult is a parent and 0 otherwise. The stochastic structure of the budget share equations for single adults and single parents is then expressed as follows:

$$\text{If} \quad \mathcal{I}_i = 0, \quad \text{then} \quad \epsilon_i = \omega_i - \alpha_i z_i - \beta_i \ln p_i - \gamma_i \ln y_i - \eta_i (\ln y_i)^2 \tag{14}$$

$$\text{If} \quad \mathcal{I}_i = 1, \quad \text{then} \quad \epsilon_i = \frac{\omega_i}{\phi_i} - \alpha_i z_i - \beta_i \ln\left(\frac{p_i}{\pi_i}\right) - \gamma_i \ln\left(\frac{\phi_i y_i}{\pi_i}\right) - \eta_i \left[\ln\left(\frac{\phi_i y_i}{\pi_i}\right)\right]^2 \tag{15}$$

To model how parental and child attributes influence child-related costs through parental resource shares, I employ a logistic function.[14] This specification aligns with prior studies by Browning et al. (1994), Lise and Seitz (2011), and BDH, among others.

$$\phi(s, \kappa) = \frac{e^{\Phi_i(s,\kappa)}}{1 + e^{\Phi_i(s,\kappa)}} \tag{16}$$

Unlike previous studies, I refrain from applying a Taylor expansion to linearize the sharing rule. Although an error term could account for unobserved heterogeneity, I follow the standard approach of modeling Φ_i as a deterministic function of, respectively, parents and children attributes, say s and k:

$$\Phi(\boldsymbol{s}, \boldsymbol{\kappa}) = \boldsymbol{s}'\Delta_s + \boldsymbol{\kappa}'\Delta_\kappa \tag{17}$$

Here, Δ_s and Δ_k are vectors of parameters, with s including a constant and four covariates which are the adult's education level, age, labor market status, and the logarithm of total expenditures. The vector κ consists of child-related variables,

[13] The regions for which dummy variables have been defined are described in the sample selection subsection.

[14] This formulation ensures that the parent's total expenditures transferred to children cannot exceed or fall below permissible levels.

such as the number of children and its square, the average age of the children, the proportion of boys, and a dummy for presence of siblings of same gender, with the latter three multiplied by the number of children. This specification assumes that the allocation of resources to children depends on both the parent's socio-demographic factors (s) and the children's attributes (κ). Following BDH, κ is assumed to be independent of total expenditures.

Recall that the decision-making process governing resource allocation is assumed not to be subject to children's wishes, where bargaining power considerations are irrelevant. Nonetheless, the model still includes a sharing rule that determines how parental and children characteristics may drive the distribution of resources within the household. For example, older children may incur higher costs, and the presence of more children may increase total expenditures on them.

Finally, shadow prices vary with total expenditures and the number of children, specified as:

$$\pi_i = \Pi_i \ln y_i \sqrt{n_i} \tag{18}$$

where π_i is a parameter to be estimated. For simplicity, the constant term is assumed to be zero.

3.2 Estimation Strategy and Instruments

The demand equations for men and women are estimated separately, given that our study focuses on unpartnered adults. Specifically, we estimate the demand equations for individuals without children (14) and for those with children (15), ensuring identification through the hypothesis of stable preferences. The full structural model, which includes individual preferences, the sharing rule, and the shadow price, is estimated in a single step.

For each adult individual, we estimate the budget share devoted to clothing, defined as the ratio of weekly clothing expenditures to total weekly expenditures on non-durable goods.[15] The demand equations' covariates, previously enumerated, in-

[15] In the data, we observe consumption expenditures on clothing for adults (men and women), as well as consumption expenditures on children's clothing. Additionally, we observe the consumption of composite goods.

clude relevant demographic and economic factors. For parents, we further estimate the sharing rule parameters, enabling us to infer the cost of raising children. The identification of the sharing rule is strengthened by the exclusion restriction, as detailed in Proposition 1.[16] In this context, we exclude several variables — house owner, prices, year and its square and region — from the sharing rule function, while controlling for the presence of siblings to capture the potential economies of scale among children.

Our model addresses two potential sources of endogeneity. The first arises from measurement error in total expenditures, which can result from the infrequency of purchases or recall errors in household surveys. Such errors may induce a correlation between total expenditures and the error term in the budget share function, leading to biased estimates. To correct for this, we follow the approach of Dunbar, Lewbel, and Pendakur (2013, hereafter DLP[1]), using total income as an instrumental variable for total expenditures. In this context, total income is uncorrelated with the consumption allocation error within a given time period, but correlated with total expenditures, making it a valid instrument. Total income also serves to address endogeneity stemming from recall errors, as long as income measurement errors are orthogonal to consumption recall errors, and income remains correlated with total expenditures.

As previous studies suggest, expectations regarding marriage can significantly influence fertility decisions (Nakamura and Nakamura, 1992; Apps and Rees, 2001).[17] However, the econometric model includes a decent set of controls that help mitigate this issue. Furthermore, recent empirical evidence by Bargain, Lacroix, and Tiberti (2022) demonstrates that the predictions regarding individual resource shares, particularly when using assignable goods like clothing, perform satisfactorily under the assumption of stable preferences.

To set the instruments suitably, I write the budget share equations (14) and (15)

However, the consumption of private goods by adults is sufficient to infer the cost of children. We do not estimate the budget share allocated to composite goods, as the budget shares must add up to one.

[16] Please refer to point in Proposition 1.

[17] Single women can easily have children without resorting to adoption or assisted reproductive technologies. Consequently, single parents and childless individuals may have fundamentally different preferences regarding children, which undermines the assumption of stable preferences across marital statuses. This selection issue presents a challenge to inferring single parents' preferences from those of observably similar childless singles.

as a unique budget share equation. To do this, multiply equation (14) by $(1-\mathcal{I}_i)$ if single individual and equation (15) by $\mathcal{I}_i$ if single parent to obtain:

$$\epsilon_i = (1-\mathcal{I}_i)\left[\omega_i - \alpha_i z_i - \beta_i \ln p_i - \gamma_i \ln y_i - \eta_i (\ln y_i)^2\right] + \mathcal{I}_i\left[\frac{\omega_i}{\phi_i} - \alpha_i z_i - \beta_i \ln\left(\frac{p_i}{\pi_i}\right)\right.$$
$$\left. - \gamma_i \ln\left(\frac{\phi_i y_i}{\pi_i}\right) - \eta_i \left(\ln\left(\frac{\phi_i y_i}{\pi_i}\right)\right)^2\right]$$

Rearranging the right-hand side and obtains:

$$\omega_i = \alpha_i z_i + \beta_i \ln p_i + \gamma_i \ln y_i + \eta_i (\ln y_i)^2 + \mathcal{I}_i A_i + \epsilon_i \tag{19}$$

with

$$A_i \quad = \quad \beta_i \ln\left(\frac{1}{\pi_i}\right) + \ln\left(\frac{\phi_i}{\pi_i}\right)\left[\gamma_i + \eta_i \ln\left(\frac{y_i^2 \phi_i}{\pi_i}\right)\right] - \omega_i \frac{1-\phi_i}{\phi_i}.$$

To deal with endogeneity issues, I estimate the system of no simultaneous budget share equations by setting the iterated Two Stage Least Square Method.[18] The non-linear estimators are iterated until the estimated parameters and error/orthogonality condition covariance matrices settle.

I use all the exogenous variables as instruments, except total expenditures which are instrumented by total income. Furthermore, I set as instruments the product $\mathcal{I}_i$ and a second-order polynomial of all the exogenous variables that enter A_i and total income. This yields 19 instruments for each equation.

To obtain adequate initial values, I first estimate the budget shares on clothing equations for individuals without children (14). These initial estimates serve as starting points for the estimation of the complete model, which includes individuals with (15) and without children (14). By using the simpler model (without children) first, we can efficiently derive starting values for the parameters of the full system.

For more efficient and robust estimation of the full system, we leverage the cross-equation covariance matrix obtained from the first step as the initial matrix for the

[18]Recall that the female budget share equation is estimated separately from the male's one as household decisions are unilateraly taken.

iterative procedure. This matrix captures the relationships between the residuals (errors) across the different equations in the system and helps to inform the estimation process. By using it as the starting point, the iterative 2SLS estimation methods can converge more quickly and accurately, improving the overall efficiency of the estimation.

4 Data

This section presents the sample selection process and summarizes the descriptive statistics.

4.1 Sample Selection

To measure the cost of children in single-parent households, I use data from the UK Family Expenditure Survey (FES) for the period 1978–2020.[19] The FES was replaced by the Expenditure and Food Survey (EFS) in 2001, which later became the Living Costs and Food Survey (LCF) in 2008.[20] These surveys provide detailed socio-economic information on households, including income, expenditure patterns, and regional location.

Over the entire period, the sample comprises data on 135,642 households, including single individuals, couples with and without children, and unpartnered parents. The adults range from 18 to 60 years of age. For the empirical analysis, I focus on childless adults and single parents aged up to 55. I further restrict the sample by excluding households with negative total expenditures, outliers in expenditure data, and cases with missing key information. This results in a final sample of 40,079 households: 13,921 single males, 10,726 single females, 1,644 single fathers, and 13,788 single mothers. Notably, single fathers represent only 11% of single-parent households. Among parents, 57% of fathers and 51% of mothers have only one child.

The empirical analysis focuses on budget shares for clothing, using only non-durable goods, as expenditures on durable goods do not accurately capture consump-

[19] I thank Olivier Bargain for providing the first wave of data used in the initial versions of this paper.

[20] For simplicity, I refer to these surveys collectively as FES. They have been used previously by Lise and Seitz (2011) and BDH.

tion expenditures. The demand system includes two exclusive goods—adult male and female clothing—alongside a composite good, which represents all other omitted goods to ensure total budget shares sum to one. Prices for all goods are measured annually at the national level.

The covariates include adult socio-demographic variables such as educational attainment, age, labor force participation, and homeownership. For children, I consider the number of children, their average age, and the proportion of boys, along with a dummy variable for same-gender siblings to account for economies of scale. Education is measured as years of schooling completed, while labor force participation and homeownership are captured through binary variables. I also include year fixed effects and weekly total expenditures in pounds. To control for regional variation, I include twelve regions of Great Britain: Northern, Northern Ireland, York and Humberside, East Midlands, West Midlands, East Anglia, Greater London, South-East, North Western, South Western, Wales, and Scotland.

4.2 Sum up the Data

Table 1 reports descriptive statistics of the sample for the main variables, facilitating a preliminary analysis in the Rothbarth sense. Here are the following analyzes of clothing spending by adults. Descriptive statistics provide evidence of a reduction in adult clothing expenses due to the presence of children, regardless of the adults' gender. As illustrated in the first two columns, women and men living alone spend on average respectively £9.4 and £5.3 on clothing per week. These expenditures decrease to £7.4 and £4.3, respectively, for single mothers and single fathers with a child, representing respective declines of 21% and 19%. Furthermore, the more children parents have, the lower their clothing expenses. For instance, the average weekly expenditure on clothing for fathers drops significantly, reaching a minimum of £1.4 (£5.2 for mothers). These findings echo Rothbarth's view, as household size appears to diminish parents' welfare derived from consumption. Finally, Table 1 also reports the high proportion of zero values for adult clothing expenses. This pattern supports the notion that infrequent purchases introduce endogeneity in total expenditure, as noted by Keen (1986).

Table 1: Descriptive statistics from the FES 1978-2001: Single adults and single parents

		Single Women	Single Men	Single Mother			Single Father		
				Children					
				1	2	3	1	2	3
Expenditure data									
Female clothing	Weekly expenditure (in £)	9.36	-	7.43	6.10	5.18	-	-	-
		(17.82)		(14.74)	(13.10)	(11.35)			
	Percentage of zeros	0.43	-	0.44	0.47	0.48			
		(0.50)		(0.50)	(0.50)	(0.50)			
Male clothing	Weekly expenditure (in £)	-	5.25	-	-	-	4.30	3.76	1.35
			(15.10)				(11.78)	(10.90)	(4.51)
	Percentage of zeros	-	0.72	-	-	-	0.71	0.71	0.84
			(0.45)				(0.46)	(0.46)	(0.37)
Total weekly expenditure		105.72	111.60	126.32	132.76	135.05	144.94	150.62	143.62
		(73.99)	(82.06)	(86.89)	(86.28)	(86.39)	(90.02)	(96.48)	(75.64)
Individual and household characteristics									
Women's labor participation		0.71	-	0.50	0.43	0.29	-	-	-
		(0.45)		(0.50)	(0.50)	(0.45)			
Men's labor participation		-	0.65	-	-	-	0.55	0.52	0.39
			(0.48)				(0.50)	(0.50)	(0.49)
Women's education (in years)		12.43	-	11.70	11.57	11.27	-	-	-
		(3.40)		(2.39)	(2.25)	(2.04)			
Mens's education (in years)		-	12.28	-	-	-	11.32	11.46	11.31
			(3.44)				(2.18)	(2.19)	(2.11)
Women's age		39.10	-	34.84	33.90	33.33	-	-	-
		(11.15)		(9.17)	(7.02)	(5.92)			
Men's age		-	38.32	-	-	-	38.39	37.10	35.95
			(10.20				(9.14)	(7.90)	(7.05)
House owner		0.52	0.50	0.28	0.28	0.19	0.46	0.46	0.27
		(0.50)	(0.50)	(0.45)	(0.45)	(0.39)	(0.50)	(0.50)	(0.45)
Average age of children		-	-	7.81	7.85	7.82	8.81	8.02	8.04
				(4.84)	(3.73)	(3.09)	(5.26)	(4.10)	(3.27)
Proportion of boys		-	-	0.51	0.50	0.52	0.58	0.52	0.55
				(0.50)	(0.35)	(0.30)	(0.49)	(0.35)	(0.31)
Number of observations		10726	13921	7038	4629	1577	941	505	150

Notes: Expenditures are in 1987 pounds. Standard deviations are in parentheses.

5 Estimation Results and Discussion

This section describes and analyzes findings related to the budget share equation detailed above.

5.1 Budget Share Equations

Table 6 presents results from the budget share equations. I estimate clothing budget share equations separately for men and women using the iterative two-stage least squares method. The results indicate that socio-demographic preference parameters do not always affect the budget share for both genders in the same way. My findings partially confirm those of BDH. For women, the clothing budget share decreases with education and age but increases at a certain age. This age-related trend is significant for both genders. Additionally, the results suggest that, all else being equal, male homeowners spend less on clothing compared to non-homeowners.

5.2 Resource Share Equations

A key focus of this study is the effect of children on parental resource shares. Table 2 presents the results, showing how resource allocation reflects both parental and child-related characteristics. As discussed, ϕ_i represents the parent's retained resources, with $\phi_k = 1 - \phi_i$ allocated to children. A negative coefficient in the sharing function indicates an increase in child-related resource allocation.

The results indicate that children have an augmenting effect on parental resources (both fathers and mothers). Specifically, the negative sign of the intercept suggests that the cost of children rises significantly with the number of children, while the resources allocated per child decrease as family size increases ($\hat{\kappa}_{\text{Number of children}}$). These findings are consistent with previous studies, including Bargain and Donni (2012a), DLP[1], Penglase (2021), and BDH. Further, the results indicate that older children impose higher costs on parents. Although most parameters related to children's characteristics for fathers are not statistically significant, the signs of the variables remain consistent with those observed for mothers.

As expected, the parameter for same-gender siblings is positive. Specifically, the coefficient indicates that mothers retain a larger share of total expenditures when the household includes siblings of the same gender, suggesting potential economies of scale. A similar trend is observed for fathers, although this parameter is not statistically significant. An illustrative example involves same-gender siblings close-in-age siblings who ofter share clothing. This variable thus captures both family size effects and the influence of gender composition.

5.3 The Two-Child Limit: Blessing or Burden?

Given the variability in family expenditures, Figure 1 illustrates the per-child resource shares across different points in the household expenditure distribution, divided into 20 vigintiles. Focusing on the second panel, the resource shares per child at the bot-

Table 2: Estimated paramaters of the individual resource shares and individual prices

		With Siblings		Without Siblings	
		Women	Men	Women	Men
Parent characteristics					
$\boldsymbol{s}$	Intercept	1.831***	1.007	1.780***	0.932
		(0.449)	(1.063)	(0.452)	(1.044)
	Education	0.004	-0.031	0.005	-0.026
		(0.020)	(0.064)	(0.020)	(0.064)
	Age (in years)	0.007	-0.040**	0.007	0.037**
		(0.008)	(0.018)	(0.008)	(0.018)
	Labor participation	-0.167	0.304***	-0.175	0.219
		(0.155)	(0.254)	(0.159)	(0.247)
	Log total expenditures	-0.061	1.928***	-0.115	1.930***
		(0.675)	(0.597)	(0.701)	(0.646)
Children characteristics					
$\boldsymbol{\kappa}$	Intercept	-0.752***	-1.088***	-0.675***	-0.915**
		(0.143)	(0.423)	(0.139)	(0.380)
	Number of children	0.092***	0.104	0.080***	0.067
		(0.025)	(0.082)	(0.024)	(0.075)
	Age (in years)	-0.013**	-0.003	-0.013**	0.001
		(0.006)	(0.017)	(0.006)	(0.017)
	Proportion of boys	-0.054	-0.136	-0.043	-0.129
		(0.042)	(0.145)	(0.039)	(0.128)
	Same-gender siblings	0.068**	0.130		
		(0.034)	(0.111)		
Shadow prices					
$\boldsymbol{\Pi}$	Log total expenditures	-0.535	0.833	-0.567	0.805
		(0.327)	(0.560)	(0.332)	(0.587)
Sample size		25 514	15 565	25 514	15 565
(Number of free parameters, Instruments)		(33,43)	(33,43)	(32,42)	(32,42)

Notes: * $p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Standard errors are in parentheses. This table presents the impact of parental and child characteristics on individual resource shares. Note that the child-related variables are multiplied by the number of children, making the intercept the key parameter of interest. The dependent variable is the budget share allocated to adult clothing expenditures. The demand equation for individuals without children (14) is estimated simultaneously using the 2SLS method along with the equation for individuals with children (15). The demand system for women is estimated separately from that of men, based on the assumption of preference stability, which posits that an adult's utility reflects the same relative preferences for the exclusive good as a single individual of the same gender. Columns (1) and (3) report the results for females - and columns (2) and (4) that of males.

tom of the distribution show significant divergence: for families with one child, the share hovers around 30%, while for families with two and three children, it ranges from 40% to 67%, respectively. This suggests that single-child households with limited means can allocate more resources per child compared to families with multiple children. However, as total parental expenditures increase, the per-child resource share converges to approximately 12%, indicating a more uniform distribution of resources per child in wealthier households, regardless of family size.

This graph conveys several key insights. First, it highlights that there exists a minimum expenditure threshold below which government intervention is crucial to ensure the well-being of children. In other words, parents whose income falls below or near this threshold should be targeted by social policy measures tailored to the specific needs of children. Typically, there is a baseline level of consumption, independent of the number of children. For instance, consider a single father earning £1500 per month, with no family benefits and subsistence expenditures amounting to £1400. If he has one child, that child receives the remaining £100. However, if he has two or more children, they must share the £100 between them, as the parent's minimum subsistence expenditures leave only £100 for all the children combined. Conversely, the graph also shows that children in affluent households experience nearly uniform levels of material well-being, irrespective of family size. Thus, for wealthier parents, the number of children has little impact on the resources allocated to each child, whereas in low-income families, having more siblings significantly disadvantages children.

Table 3: Children resource share estimates

	Single Mothers			Single Fathers		
Number of children	Mean	Lower bound	Upper bound	Mean	Lower bound	Upper bound
1	0.219	0.218	0.219	0.334	0.319	0.349
	(0.119)	(0.019)	(0.020)	(0.231)	(0.221)	(0.242)
2	0.324	0.323	0.325	0.467	0.446	0.487
	(0.034)	(0.033)	(0.034)	(0.238)	(0.225)	(0.254)
3	0.421	0.419	0.424	0.611	0.575	0.646
	(0.044)	(0.043)	(0.046)	(0.222)	(0.199)	(0.250)
Sample size		13 788			1 644	

Notes: Standard deviations are in parentheses. This table reports the average expenditure on children. I use the structural parameters associated to s and κ to compute ϕ_k for each parent, then I take the average to obtain $\bar{\phi_k}$.

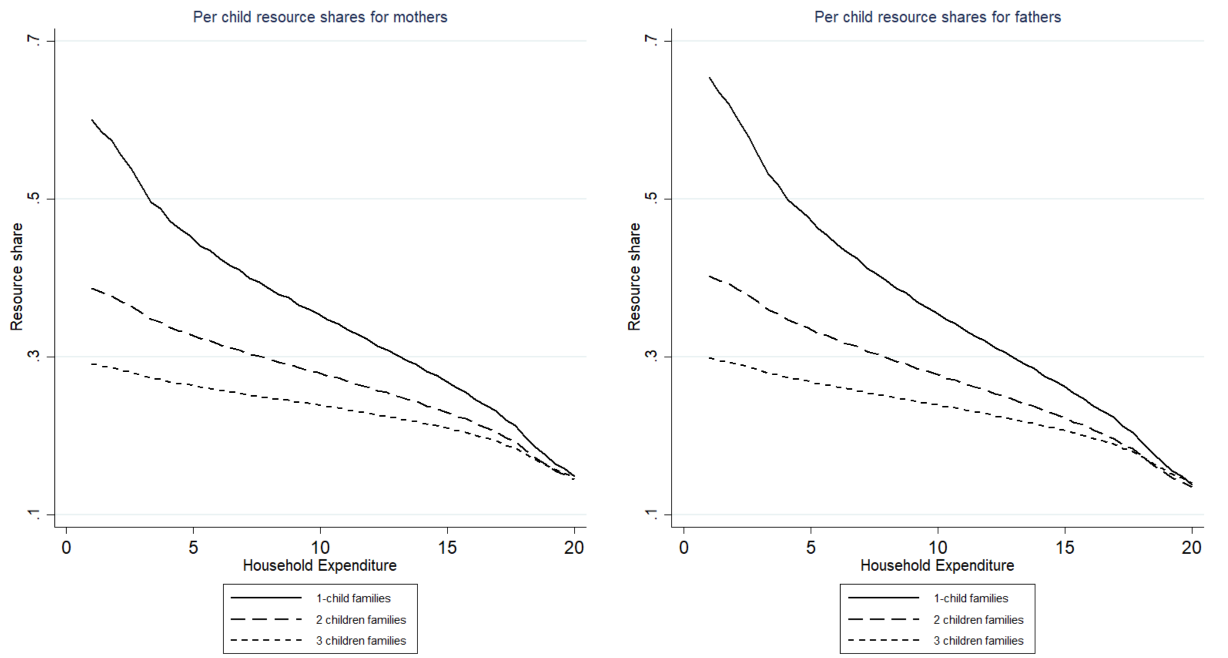

Figure 1: Children resource share by total expenditures

Notes: This figure plots the per-child resource shares allocated by parents across different points of the household expenditure distribution. The x-axis shows the distribution of total household expenditures divided into 20 vigintiles, ranging from the 1st to the 20th. The y-axis displays the per-child resource shares for mothers (left panel) and fathers (right panel). The solid line represents households with one child, the dashed line indicates households with two children, and the densely dashed line corresponds to households with three children.

5.4 Intra-household Resource Allocation

Table 3 presents the average cost of children. Our findings indicate that single mothers and single fathers allocate 21.9% and 33.4% of their resources to their children, respectively. In comparison, estimates from studies on couples with children, such as those by BDH, using the same dataset from 1978 to 2007, indicate that in households with one child, mothers allocate 16.6% of resources, while fathers allocate 11.6%. These results suggest that couple-based estimates may underestimate the cost of children borne by single parents. Specifically, child cost estimates for mothers in couples, as derived from BDH, tend to underestimate by 5.3 percentage points the costs in-

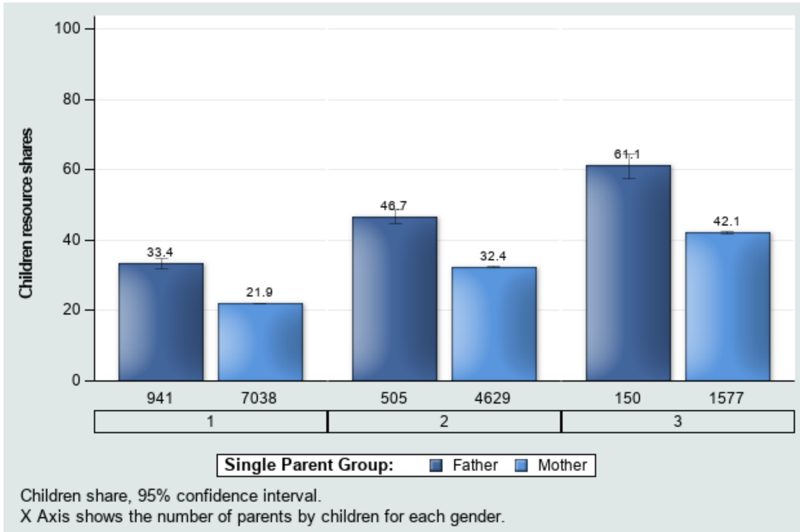

Figure 2: Share of parents total expenditures devoted to children

Notes: This figure illustrates parental expenditures on children, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

curred by single mothers. This pattern is consistent with the structural differences between these two types of households, as highlighted by DeLeire et al. (2005) and Nieuwenhuis and Maldonado (2018).

In two-parent households, resource pooling and joint decision-making help mitigate inequalities, while single parents, lacking both financial and caregiving support from a partner, face greater resource constraints and heightened financial pressure. Given these differences in intrahousehold dynamics, resource shares computed for two-parent households may not fully capture the well-being of single parents and should be interpreted with caution.

Figure 2 plots the parental expenditures on children conditional on family size. We note that, regardless of the number of children, the cost is consistently higher for fathers than for mothers. This finding is somewhat unexpected.[21] The smaller sample of single fathers, combined with the likelihood that they represent a highly selected population group with distinct characteristics, motivations, and life histories

[21] Cherchye et al. (2012) suggest that empowering fathers may benefit children more than empowering mothers.

compared to single mothers, makes it difficult to draw firm conclusions from this result. A potential explanation is that single mothers may receive additional support from individuals outside the household.

Furthermore, we observe that the cost of children follows a nonlinear pattern. A similar trend applies to mothers, possibly indicating a notable decrease in the per-child income share. For instance, the cost attributed to children for a father with three children falls short of doubling that of a father with a unique child.

5.5 Comparison with OECD-modified Equivalence Scale

The OECD-modified equivalence scale is widely used in income comparisons to adjust for household size and composition. Under this scale, children under 14 are assigned a value of 0.3 and children 14 and over a value of 0.5 relative to the first adult, who is assigned a value of 1.0. The estimates of children resource shares can be compared directly to the child resource shares implied by the OECD scale.

For example, in a single-parent household with one child under 14, the OECD scale implies that the child's share of household resources would be $0.3/1.3 = 23\%$, which is close to my estimate for single mothers (21.9%) but lower than my estimate for single fathers (33.4%). For two children under 14, the OECD equivalence scale would imply a total child share of resources of $0.6/1.6 = 37.5\%$, which again aligns closely with my estimates for single mothers with two children (32.4%) but is lower than my estimate for single fathers with two children (46.7%). The OECD scale provides a simplified view of resource allocation, whereas my model captures actual household spending patterns, which can vary by factors such as gender and income. Although the OECD scales align with our estimates, our method is essential for capturing the influence of parent and child characteristics on expenditures and for accurately distinguishing the share of child-related costs borne by mothers and fathers.

5.6 Sensitivity Analysis

I implement three procedures to test the robustness of the results. First, I introduce seven variants of the model. Second, I test for overidentifying restrictions. Lastly,

Table 4: Robustness tests

Models		Female				Male			
		Sargan statistics	LR-type statistics	Degrees of freedom	p-value	Sargan statistics	LR-type statistics	Degrees of freedom	p-value
Reference model		20.79		10		6.63		10	
Models with	linear time trend in s	17.46	3.33	1	0.07	5.62	1.00	1	0.32
	linear time trend in κ	19.06	1.73	1	0.19	4.19	2.44	1	0.12
	prices of clothing in s	18.45	2.34	1	0.13	3.50	3.13	1	0.08
	prices of clothing in κ	19.58	1.21	1	0.27	3.49	3.14	1	0.08
	cubic term in Engel curves	20.61	0.14	1	0.93	3.12	3.51	1	0.06
Models without	economies of scale	29.79	0.60	1	0.44	9.02	2.39	1	0.12
	log total expenditures in s	23.51	2.72	1	0.10	10.45	3.83	1	0.05

Notes: This table reports Sargan and LR-type statistics for various specification of the model. The first column in each panel for both females and males shows the Sargan statistics, which are the objective function value times the number of observations. The LR-type statistics in the second column in each panel are computed as the absolute value of the difference between the Sargan statistics of the baseline model and those of the respective alternative model. It is worth noting that the objective function calculation for the alternative models is conducted using the identical baseline model weighting matrix.

I estimate the model on a restricted sample of households. The core results exhibit qualitative consistency, albeit less pronounced in significance.

One of the primary objectives of this paper is to assess whether the sharing rule function can provide accurate estimates of the cost of children over time. I assume that the sharing rule depends on both parent and child characteristics. The first two specifications I estimate introduce time progressively into the s (parent characteristics) and κ (child characteristics) components. Table 4 presents the results of Sargan's test and LR-type statistics. The null hypothesis—that the sharing rule is unaffected by a linear time trend in either s or κ—is not rejected at conventional significance levels. Therefore, the determinants of s and κ remain stable over time. In this context, year serves as a relevant variable for identifying the sharing rule (see Proposition 1). Consequently, shifts in child resources are unlikely to be driven by time through parent or child characteristics.

The second robustness check incorporates the price of clothing into the sharing rule function to account for potential variability. The results indicate that prices have an insignificant effect on individual resource shares. The next test assesses the sensitivity of the results by adding a third-order term to the Engel curves. The p-values (0.93 for females and 0.06 for males) do not reject the null hypothesis in the sharing rule equation at conventional significance levels.

The results from the final set of specifications are reported in the second panel

Table 5: Estimated paramaters of the individual resource shares: further results

		I-Simplified		II-Only Mixed Gender Siblings		III-Only Working Individuals	
		Women	Men	Women	Men	Women	Men
Parent characteristics							
$\boldsymbol{s}$	Intercept	2.327***	2.242	1.825***	-0.860	1.830***	-0.259
		(0.543)	(1.479)	(0.463)	(1.357)	(0.552)	(2.503)
	Education	0.002	-0.021	0.011	0.066	0.008	0.004
		(0.018)	(0.075)	(0.020)	(0.113)	(0.026)	(0.195)
	Age (in years)	0.005	0.038*	0.004	0.076***	-0.002	0.056
		(0.007)	(0.020)	(0.007)	(0.025)	(0.009)	(0.045)
	Labor	-0.096	0.323	-0.135	0.810***	-	-
		(0.136)	(0.309)	(0.158)	(0.305)	-	-
	Log total expenditures	0.273	1.846**	0.274	2.922***	0.093	2.900***
		(0.682)	(0.763)	(0.614)	0.855	(1.338)	(0.895)
Children characteristics							
$\boldsymbol{\kappa}$	Intercept	-1.314***	-2.581	-0.713***	-1.442***	-0.694***	0.394
		(0.393)	(1.650)	(0.134)	(0.557)	(0.198)	(1.517)
	Number of children	0.211***	0.448	0.090***	0.177*	0.067*	-0.192
		(0.085)	(0.406)	(0.024)	(0.099)	(0.037)	(0.387)
	Age (in years)	-0.012**	-0.006	-0.012*	-0.052**	-0.011	-0.003
		(0.005)	(0.020)	(0.007)	(0.027)	(0.009)	(0.044)
	Proportion of boys	-0.057	-0.126	-0.134*	0.627	-0.020	-0.186
		(0.039)	(0.157)	(0.069)	(0.410)	(0.062)	(0.495)
	Same-sex siblings	0.097**	0.207	-	-	0.091*	-0.509
		(0.040)	(0.132)			(0.051)	(0.451)
Shadow prices							
$\boldsymbol{\Pi}$	Log total expenditures	-0.312	0.763	-0.337	1.311*	-0.269	1.075**
		(0.396)	(0.670)	(0.351)	(0.693)	(0.737)	(0.442)
Sample size		24514	15565	21713	15268	13685	9823
Sargan statistics		13.285	5.508	15.461	9.153	15.173	11.422
(Number of free parameters, Instruments)		(33,38)	(33,38)	(32,42)	(32,42)	(31,38)	(31,38)

Notes: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. This table reports additional results on the sharing rule to test the robustness of the baseline model. The three models estimate the clothing demand equations separately for men and women. Model I uses a limited number of instruments by removing the second-degree polynomials for the variables included in the A_i function. Model II estimates the demand equations on a sample where parents with same-gender children are excluded. Model III uses a sample of individuals who are employed.

of Table 4. First, I empirically test the hypothesis of economies of scale within households using LR-type statistics, which measure the difference between the Sargan statistics of constrained and unconstrained models. Under the null hypothesis, both models (with and without economies of scale) are equivalent. However, the findings do not support the theoretical assumption of economies of scale in households and may also suggest potential issues with the functional form of the economies of scale function. Finally, I find evidence supporting the inclusion of log total expenditures in the $\boldsymbol{s}$ part of the sharing rule function, although this approach lacks strong empirical validation in the female sample.

Table 5 provides additional robustness checks. Given the relatively small sample size, particularly for single fathers, the estimates may suffer from overidentification bias. To address this, I re-estimate the model using fewer instruments, removing second-order polynomials for the exogenous variables in A_i. The results in Model I show that the core conclusions remain consistent, though coefficient estimates and standard errors increase. In Model II, I exclude parents with children of the same gender, and the results are comparable to those of the benchmark model. The fifth and final columns present the results when only individuals participating in the labor market are included. While the significance is reduced, the qualitative conclusions remain consistent.

6 Conclusion

Several models have attempted to assess the cost of children for parents, but most focus exclusively on two-parent households, overlooking the increasing prevalence of single-parent families in OECD countries (Nieuwenhuis and Maldonado, 2018). In this paper, I adapt the collective approach to better capture the decision-making processes of single parents. The primary objective is to estimate the cost of children borne by single parents. To do so, I employ a consumption model, leveraging the stability of preferences and the observation of adult exclusive goods to retrieve information from the sharing rule function in one-adult households.

Using a sample of single adults with and without children from the UK Family Expenditure Survey (FES) spanning 1978–2020, we find that standard resource shares, typically calculated for two-parent households, may not fully apply to single-parent families. Specifically, our findings suggest that the costs incurred by single parents are underestimated when using these measures. Furthermore, our results highlight that family size significantly influences the allocation of resources to children in low-income households, whereas it has little impact in high-income families. In other words, having more siblings disadvantages children in low-income families, but this factor becomes irrelevant in wealthier households. These findings suggest that parents operate with a minimum expenditure threshold, below which public intervention through family allowance policies is necessary to ensure children's needs are met, particularly for families with incomes below this critical level.

The main limitation of this paper concerns the potential endogeneity of having children. Fertility decisions are often influenced by expectations about marriage, which can introduce a selection bias that challenges the assumption of stable preferences across different marital statuses. While this issue could be addressed by employing revealed preference techniques, as proposed by Cherchye et al. (2015) to estimate bounds on household sharing, this approach remains a topic for future research.

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7 Appendix

A Identification Proof

Proof.

1. Let's write $z_\omega = (z_{\omega 0}, z_{\omega 1})$ where $z_{\omega 1} \notin z_\pi$ and $z_{\omega 1} \notin z_\phi$. Then consider two values of $z_{\omega 1}$, say $z_{\omega 1}^1$ and $z_{\omega 1}^2$. This provides a system of two equations with two unknowns:

$$\omega(\bar{p}, z_\omega, \bar{z}_\pi, \bar{z}_\phi, \bar{y}, \bar{n}) = g(\bar{p}, z_{\omega 1}^1, \pi(\bar{p}, \bar{z}_\pi, \bar{y}, \bar{n}) \cdot \bar{p}, \phi(\bar{p}, \bar{z}_\phi, \bar{y}, \bar{n}) \cdot \bar{y})$$

$$\omega(\bar{p}, z_\omega, \bar{z}_\pi, \bar{z}_\phi, \bar{y}, \bar{n}) = g(\bar{p}, z_{\omega 1}^2, \pi(\bar{p}, \bar{z}_\pi, \bar{y}, \bar{n}) \cdot \bar{p}, \phi(\bar{p}, \bar{z}_\phi, \bar{y}, \bar{n}) \cdot \bar{y})$$

Under some regularity conditions, this system of two equations generally has a unique solution for $\pi(\bar{p}, \bar{z}_\pi, \bar{y}, \bar{n})$ and $\phi(\bar{p}, \bar{z}_\phi, \bar{y}, \bar{n})$, and another for each choice of $(\bar{p}, \bar{z}_\pi, \bar{z}_\phi, \bar{y}, \bar{n})$.

2-3. Combine (2) and (3), the proof of this statement is similar to the previous one.[22]

4. Let's consider choosing a parametric specification for the sharing function, specifically a linear form that depends on k parameters. There are k degrees of freedom, representing the k identifiable parameters. The idea is that we need k equations to determine the unknown parameters.

5. Let

$$\omega = g(z_\omega, \pi_1(p, z_\pi, y) \cdot \pi_2(n) \cdot p, \phi_1(p, z_\phi, y) \cdot \phi_2(n) \cdot y)$$

[22] The complete proof for the statement 2 is given by (Dunbar et al., 2013, online appendix) and (Penglase, 2021, online appendix).

By varying the values of y and n, we might obtain the following equations:

$$\omega = g(z_\omega, \pi_1(\bar{p}, \bar{z}_\pi, y_1) \cdot \pi_2(n_1) \cdot \bar{p}, \phi_1(\bar{p}, \bar{z}_\phi, y_1) \cdot \phi_2(n_1) \cdot y_1)$$

$$\omega = g(z_\omega, \pi_1(\bar{p}, \bar{z}_\pi, y_1) \cdot \pi_2(n_2) \cdot \bar{p}, \phi_1(\bar{p}, \bar{z}_\phi, y_1) \cdot \phi_2(n_2) \cdot y_1)$$

$$\omega = g(z_\omega, \pi_1(\bar{p}, \bar{z}_\pi, y_2) \cdot \pi_2(n_1) \cdot \bar{p}, \phi_1(\bar{p}, \bar{z}_\phi, y_2) \cdot \phi_2(n_1) \cdot y_2)$$

$$\omega = g(z_\omega, \pi_1(\bar{p}, \bar{z}_\pi, y_2) \cdot \pi_2(n_2) \cdot \bar{p}, \phi_1(\bar{p}, \bar{z}_\phi, y_2) \cdot \phi_2(n_2) \cdot y_2)$$

The above example shows a set of 4 equations with 4 unknowns. Then we can identify the sharing function as well as the economies of scales. This completes the proof.

■

B Additional Estimation Results

Table 6: Results for budget share equations

	With siblings				Without siblings			
	Women's budget equation		Men's budget equation		Women's budget equation		Men's budget equation	
Parameters	Est. val.	Std. err.	Est. val.	Std. err.	Est. val.	Std. err.	Est. val.	Std. err.
Intercept	0.190***	(0.014)	0.150***	(0.013)	0.190***	(0.014)	0.150***	(0.013)
Education	-0.001*	(0.000)	0.000	(0.000)	-0.001*	(0.000)	0.000	(0.000)
Age (in years)	-0.004***	(0.001)	-0.004***	(0.001)	-0.004***	(0.001)	-0.004***	(0.001)
Age2 (in years)	0.004***	(0.001)	0.004***	(0.001)	0.004***	(0.001)	0.004***	(0.001)
Year	0.904***	(0.329)	1.051***	(0.379)	0.902***	(0.329)	1.062***	(0.379)
year2	-0.904***	(0.328)	-1.048***	(0.378)	-0.902***	(0.328)	-1.059***	(0.378)
House owner	-0.000	(0.002)	-0.003*	(0.002)	-0.000	(0.002)	-0.003*	(0.002)
Labor participation	0.004	(0.003)	0.001	(0.002)	0.004	(0.003)	0.001	(0.002)
Region:								
Norhern	-0.001	(0.004)	-0.008	(0.005)	-0.001	(0.004)	-0.008	(0.005)
York & Humberside	-0.000	(0.004)	-0.016***	(0.004)	-0.000	(0.004)	-0.016***	(0.004)
East Midlands	0.003	(0.004)	-0.021***	(0.005)	0.003	(0.004)	-0.021***	(0.005)
East Anglia	-0.001	(0.004)	-0.018***	(0.005)	-0.001	(0.004)	-0.018***	(0.005)
Greater London	0.002	(0.004)	-0.018***	(0.004)	0.001	(0.004)	-0.018***	(0.004)
South-East	-0.001	(0.004)	-0.021***	(0.004)	-0.001	(0.004)	-0.021***	(0.004)
South-West	-0.003	(0.004)	-0.024***	(0.004)	-0.003	(0.004)	-0.023***	(0.004)
Wales	-0.003	(0.004)	-0.014***	(0.005)	-0.003	(0.004)	-0.014***	(0.005)
West-Midlands	0.001	(0.004)	-0.016***	(0.004)	0.001	(0.004)	-0.016***	(0.004)
North-West	-0.000	(0.004)	-0.019***	(0.004)	-0.000	(0.004)	-0.019***	(0.004)
Scotland	-0.003	(0.004)	-0.015***	(0.004)	-0.003	(0.004)	-0.015***	(0.004)
Log relative price	-0.001	(0.004)	0.011	(0.007)	-0.001	(0.004)	0.011	(0.007)
Log total expenditures	0.013	(0.012)	0.016*	(0.008)	-0.014	(0.012)	0.015*	(0.009)
(Log total expenditures)2	-0.014*	(0.008)	-0.001	(0.006)	-0.014	(0.009)	-0.001	(0.006)
Sample size	24 514		15 565		24 514		15 565	

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are in parentheses. This table presents partial results from the demand equations for women - columns (1-2) and (5-6) - and men - columns (3-4) and (7-8). The demand equation for individuals without children (14) is estimated simultaneously using the 2SLS method along with the equation for individuals with children (15). The demand system for women is estimated separately from that of men, based on the assumption of preference stability, which posits that an adult's utility reflects the same relative preferences for the exclusive good as a single individual of the same gender.

Table 7: Estimates of the difference of the average cost of children by parent

Parents	Method	N	95% LC Mean	Mean	95% UC Mean	95% LC SDV	SDV	95% UC SDV
Panel 1: Unweighed mean								
I-Fathers		1596	0.397	0.409	0.421	0.242	0.250	0.259
II-Mothers		13244	0.342	0.344	0.346	0.095	0.096	0.097
Diff(I-II)	Pooled	-	0.059	0.065	0.071	0.121	0.122	0.123
Diff(I-II)	Satterthwaite	-	0.053	0.065	0.077	-	-	-
Panel 2: Weighed mean								
I-Fathers		1596	0.433	0.445	0.457	0.300	0.310	0.321
II-Mothers		13244	0.378	0.379	0.381	0.124	0.125	0.127
Diff(I-II)	Pooled	-	0.059	0.066	0.072	0.154	0.156	0.158
Diff(I-II)	Satterthwaite	-	0.053	0.066	0.078			

Notes: N, LC, UC and SDV mean respectively sample size, Lower Confidence, Upper confidence and Standard Deviation. DF for Degree of Freedom.

Table 8: Estimates of the difference in the average cost of children by the gender of child/children

Parents	Method	N	95% LC Mean	Mean	95% UC Mean	95% LC SDV	SDV	95% UC SDV
Panel 1: Cost of boys								
I-Fathers		1596	0.410	0.423	0.435	0.244	0.253	0.262
II-Mothers		13244	0.350	0.352	0.353	0.098	0.099	0.100
Diff(I-II)	Pooled	-	0.065	0.071	0.078	0.124	0.125	0.126
Diff(I-II)	Satterthwaite	-	0.059	0.071	0.084	-	-	-
Panel 2: Cost of girls								
I-Fathers		1596	0.380	0.392	0.404	0.237	0.246	0.254
II-Mothers		13244	0.335	0.336	0.338	0.091	0.092	0.093
Diff(I-II)	Pooled	-	0.050	0.056	0.062	0.117	0.118	0.120
Diff(I-II)	Satterthwaite	-	0.044	0.056	0.068			

Notes: See the notes to Table 7.

C Informal Investigation

I present a linear regression model to estimate the share of total resources devoted to children on both parent and children characteristics. The objective is simply to explore and confirm the existing correlation between parental preferences and the average cost of children.

While caution is needed in interpreting these results as causal effects, asserting that these findings validate a highly pronounced correlation between individual characteristics (parent and children) and the average cost of children remains valid. Furthermore, these estimates corroborate the signs of the different coefficients obtained

Table 9: Estimates of the average cost of children

		Women		Men	
	Parameters	Est. value	Std. Err.	Est. value	Std. Err.
$\boldsymbol{z}$	Intercept	0.055***	(0.001)	0.338***	(0.012)
	Education	-0.002***	(0.000)	0.004***	(0.001)
	Age (in years)	-0.001***	(0.000)	-0.007***	(0.000)
	Labor	0.017***	(0.000)	-0.062***	(0.002)
	Log total expenditures	-0.096***	(0.000)	-0.367***	(0.002)
$\boldsymbol{k}$	Number of children	0.209***	(0.001)	0.182***	(0.011)
	(Number of children)^2	-0.021***	(0.000)	-0.013***	(0.003)
	Age (in years)	0.003***	(0.000)	0.001**	(0.000)
	Proportion of boys	0.013***	(0.000)	0.027***	(0.003)
	Same-sex siblings	-0.026***	(0.000)	-0.028***	(0.003)
Sample size		13 244		1 596	

Notes: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

in the structural model estimation.

D Additional Figures

Figure 3 represents the distribution of resource devoted to children by parents. The resource shares devoted to children by fathers appear to be more evenly distributed across a broader range. The histogram indicates that fathers allocate varying levels of resources to children, with a noticeable peak around 0.4. Mothers resources allocated to children are much more concentrated in the lower range of the distribution, peaking sharply around 0.1. There is a steep drop-off, and very few mothers seem to allocate shares beyond 0.3.

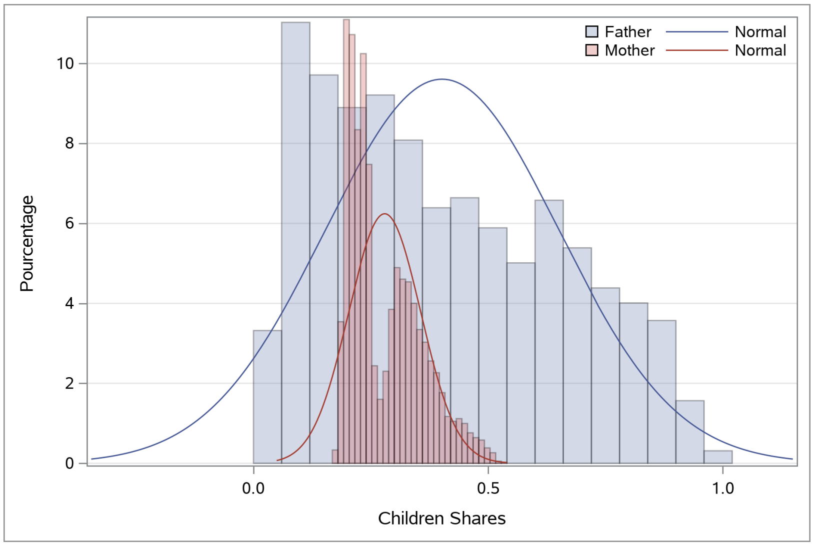

Figure 3: Histogram of children's share

Note: This figure plots the density of the cost of children across parents. Based on the sharing rule estimates, the mean share of resources devoted to children is 0.28 and 0.40 respectively for mothers and fathers.

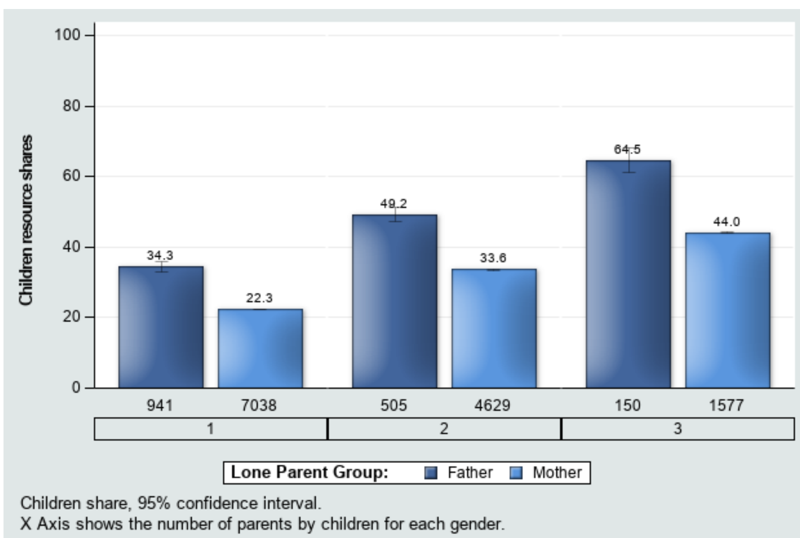

Figure 4: Share of parents' total expenditures devoted to boys

Notes: This figure illustrates parental expenditures on boys, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

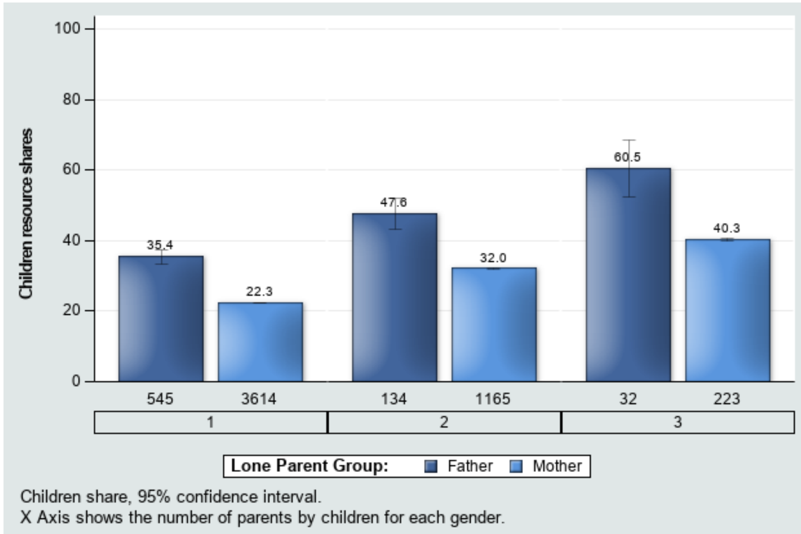

Figure 5: Share of parents' total expenditures devoted to children in families with only boys

Notes: This figure illustrates parental expenditures on boys in families with only male children, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

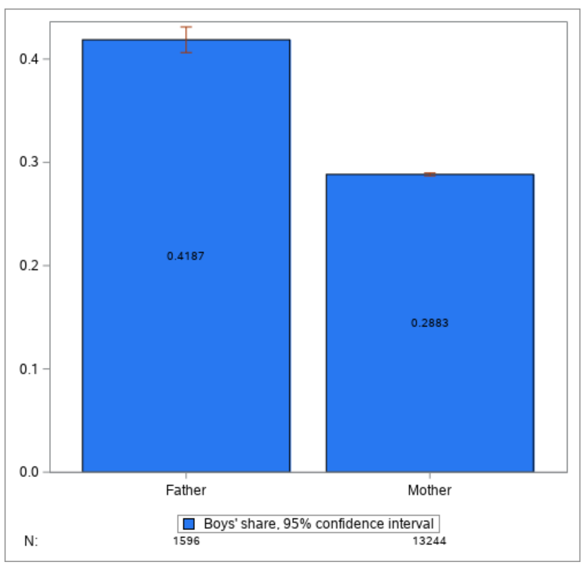

Figure 6: Cost of boys borne by each single parent

Notes: This figure compares the average expenditure on boys by parents, based on their gender.

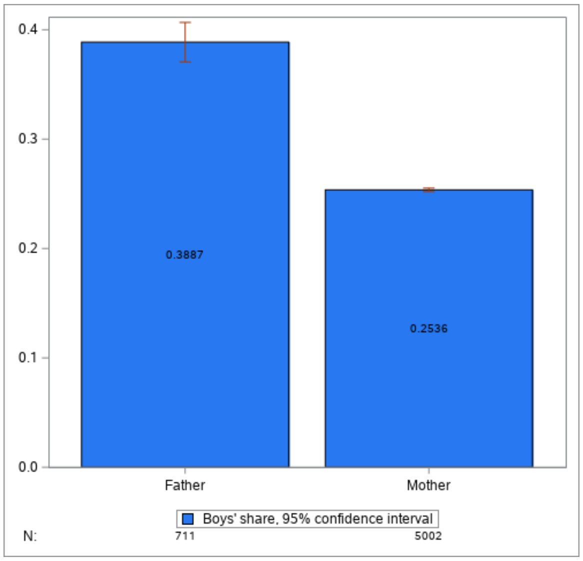

Figure 7: Cost of children borne by each single parent in families with only boys

Notes: This figure compares the average expenditure on boys by parents in families with only male children, based on their gender.

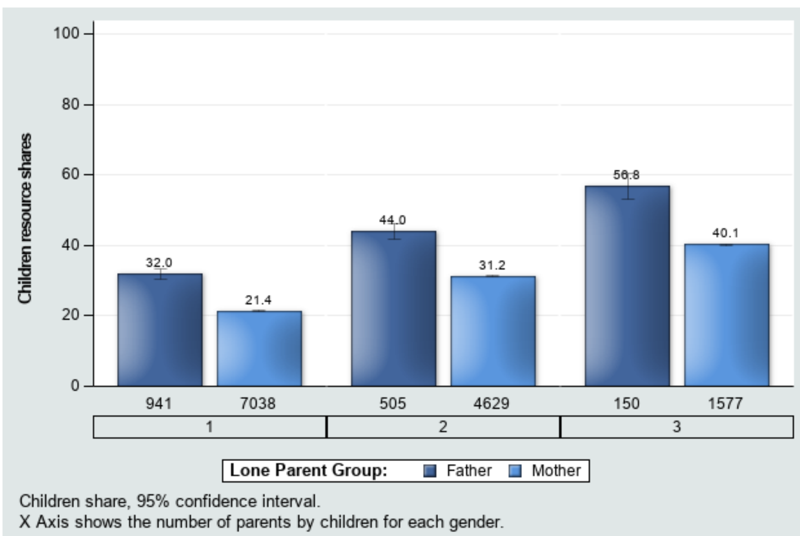

Figure 8: Share of parents' total expenditures devoted to girls

Notes: This figure illustrates parental expenditures on girls, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

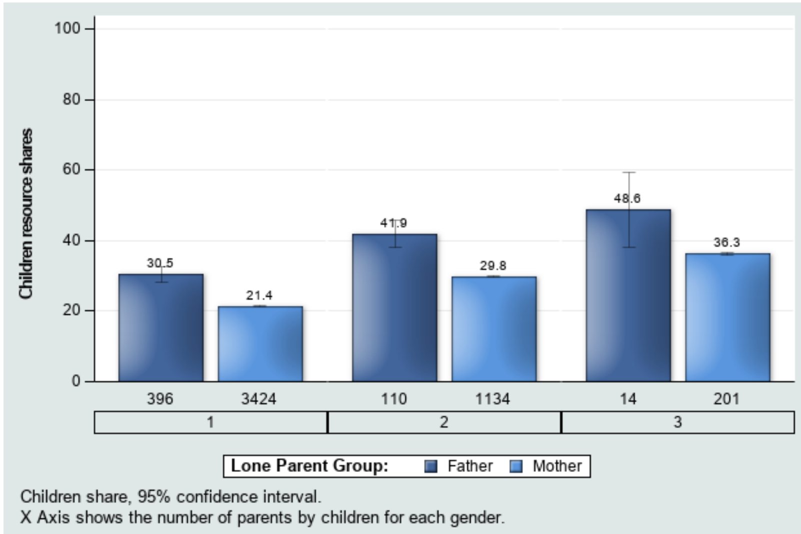

Figure 9: Share of parents' total expenditures devoted to children in families with only girls

Notes: This figure illustrates parental expenditures on girls in families with only male children, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

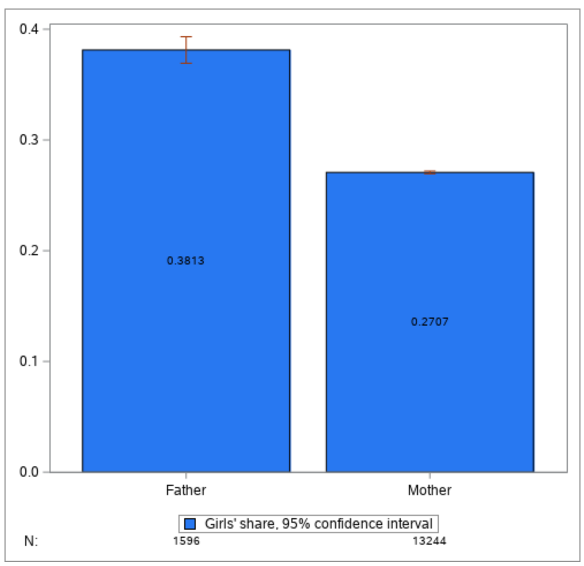

Figure 10: Cost of girls borne by each single parent

Notes: This figure compares the average expenditure on girls by parents, based on their gender.

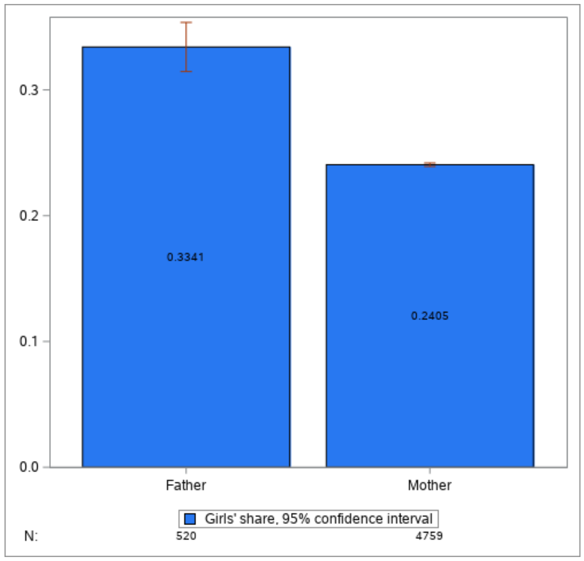

Figure 11: Cost of children borne by each single parent in families with only girls

Notes: This figure compares the average expenditure on girls by parents in families with only male children, based on their gender.

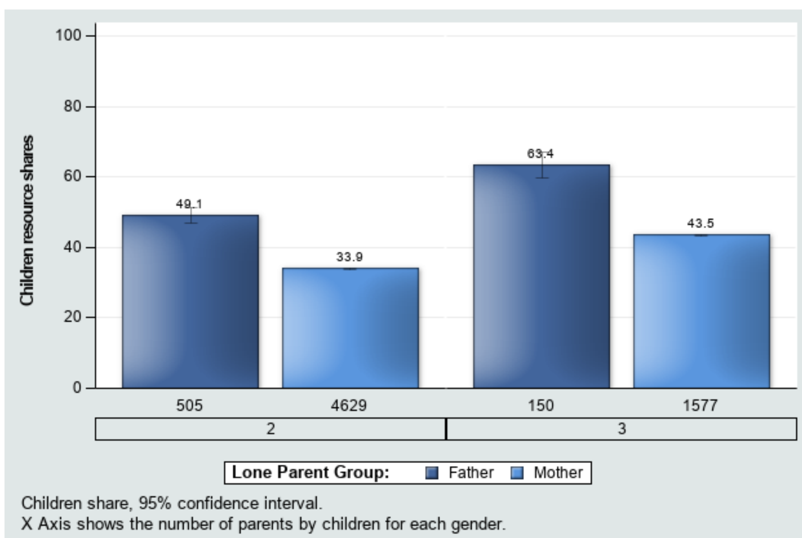

Figure 12: Share of parents' total expenditures devoted to children of mixed-gender

Notes: This figure illustrates parental expenditures on mixed-gender children, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

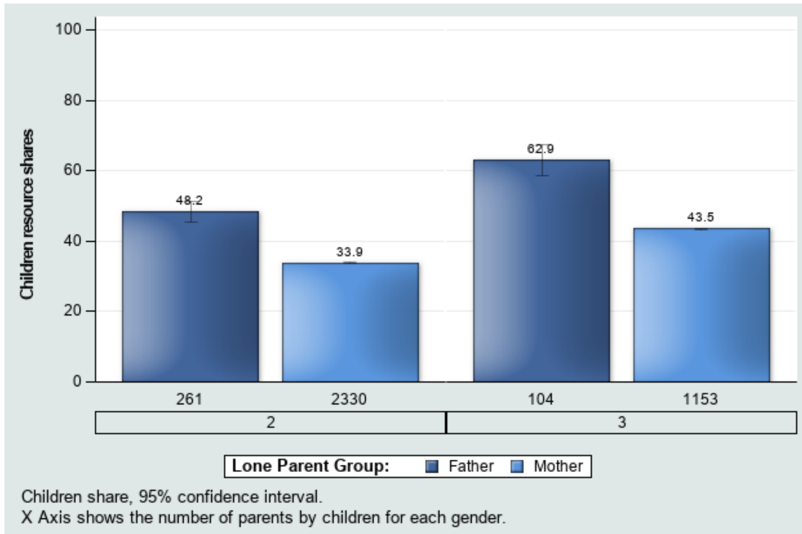

Figure 13: Share of parents' total expenditures devoted to children in families with only mixed-gender siblings

Notes: This figure illustrates parental expenditures on mixed-gender children in families with only mixed-gender siblings, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

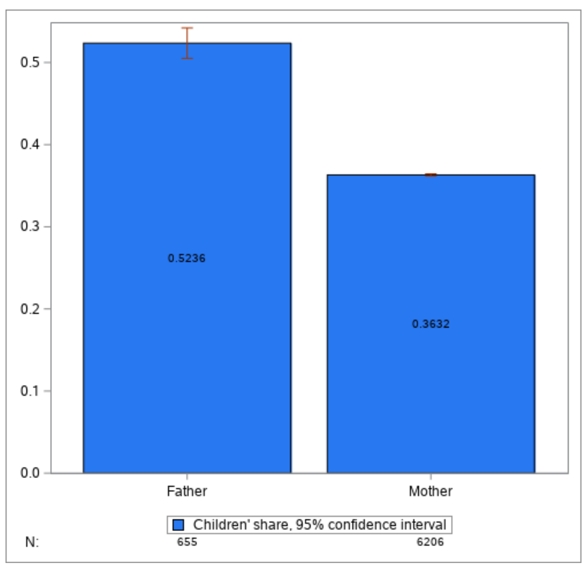

Figure 14: Cost of children of mixed-gender borne by each single parent

Notes: This figure compares the average expenditure on mixed-gender children by parents, based on their gender.

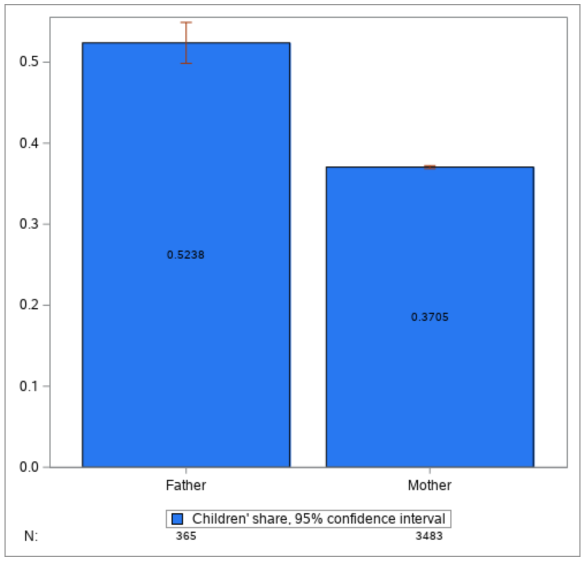

Figure 15: Cost of children borne by each single parent in families with only mixed-gender siblings

Notes: This figure compares the average expenditure on mixed-gender children by parents in families with only mixed-gender siblings, based on their gender.

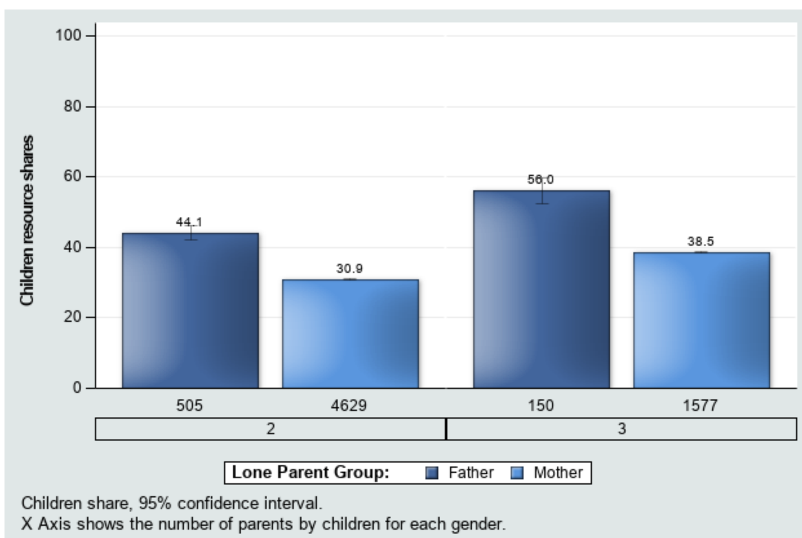

Figure 16: Share of parents' total expenditures devoted to same-gender children

Notes: This figure illustrates parental expenditures on same-gender children, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

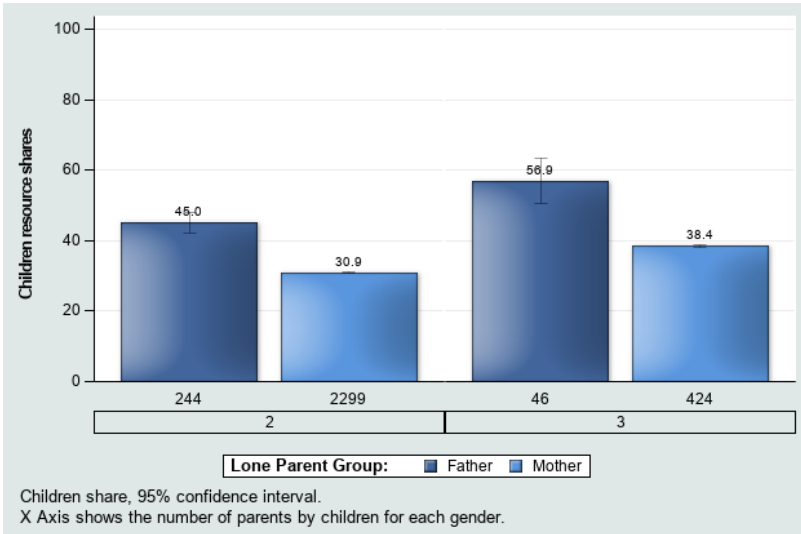

Figure 17: Share of parents' total expenditures devoted to children in families with only same-gender siblings

Notes: This figure illustrates parental expenditures on same-gender children in families with only same-gender siblings, conditional on family size. The x-axis represents the number of parents, categorized by the number of children.

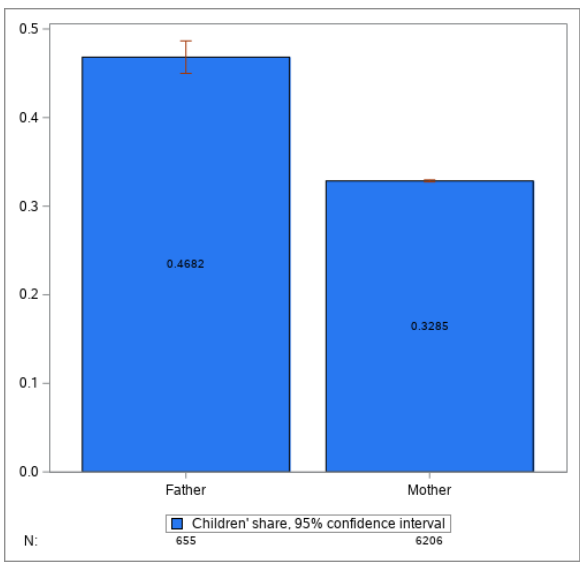

Figure 18: Cost of children of same-gender borne by each single parent

Notes: This figure compares the average expenditure on same-gender children by parents, based on their gender.

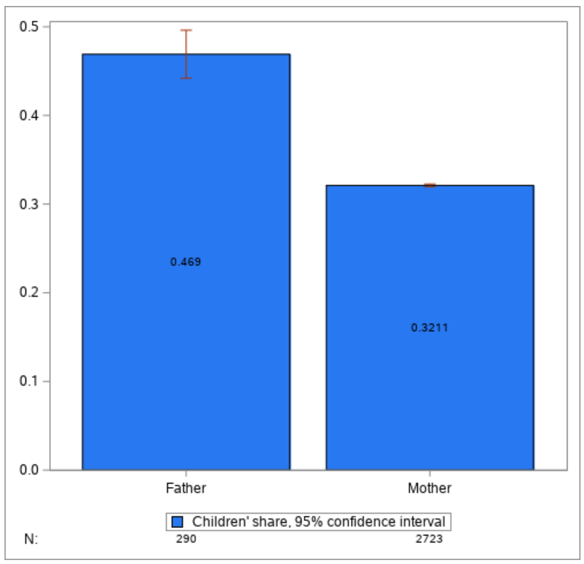

Figure 19: Cost of children borne by each single parent in families with only same-gender siblings

Notes: This figure compares the average expenditure on same-gender children by parents in families with only same-gender siblings, based on their gender.