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**Using Time-Use Data to Estimate the Full Costs of Children
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Abstract

This paper uses the 'adult goods' method to estimate the full costs of children. Full costs include both expenditure and time costs. Adult personal time (comprising pure leisure, sleep and other personal care) is used as the adult good. Previous research has shown that the presence of children in the household leads to a reduction in adult personal time. This paper develops a simple household economic model to show how this information can be used to develop an equivalence scale for adult consumption which takes account of both the expenditure and time costs of children.

Preliminary estimates using Australian data suggest a very large cost. A couple with two children (one of which is in pre-school) require an income around 2.7 times as large as a couple with no children in order for the adults to have the same consumption level. The full cost of children appears to decline with age (despite the expenditure cost rising). The paper discusses the limitations of the adult good method and considers the broader welfare implications of these costs while taking into account the benefits that parents obtain from parenthood.

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1. Introduction

When parents rear children, they spend considerable time directly caring for the children, spend time undertaking home production tasks related to the child (eg cooking, cleaning, transport), and also purchase goods and services that contribute to the children's well-being. Conventional estimates of the 'cost of children' only take account of the last of these.¹ Even estimates of the 'opportunity cost of children' only take account of time costs to the extent to which they reduce parental labour force participation (and hence income).

But children have a much more wide-ranging impact upon the allocation of resources within the household. Time-use data show how the presence of children is associated with large re-allocations of parental time from personal activities (sleep, leisure, and personal care) towards home production and caring activities. What does this reallocation tell us about the full costs of children?

This paper addresses this question within the context of a simple within-household resource allocation model. Within this framework, it is concluded that children are *very* expensive. Though the model used here should only be considered as a first approximation to a very complex issue, it does provide useful 'ballpark' estimates and helps us think more systematically about the nature and relevance of the question of 'the costs of children'.

* * *

Why should we be interested in the cost of children, full or otherwise?

From the perspective of children, children's consumption is related to the cost of children – but it is not the same. Children can consume more than they cost because of the presence of public goods within the household and because children receive many services from outside the household.

From the perspective of parents, the fact that parents generally choose to have children means that the benefits of 'parenthood', by definition, must outweigh the costs. So there is no automatic welfare rationale for any compensation for the costs of children.²

We might expect that the 'price' of children would be an important factor influencing parental fertility decisions. Information on the cost of children may thus be relevant to behaviour studies of the determinants of fertility. However, there are some differences between the concepts of cost and price in this context. The most economically meaningful definition of the price of children is the value of resource input needed to raise a child of given 'quality'. The cost of a child is the value of the resources needed to raise a child (irrespective of 'quality'). Conceivably, these could vary in different directions. For example, an increase in the price of toys implies an increase in the price of children (following standard production function theory). However, it is

¹ For introductions to the literature see Deaton and Muellbauer (1980) and Buhmann (1988).

² See Bradbury (2004 and 2003) respectively for a more detailed discussion of children's consumption and the welfare rationales for compensation for the cost of children child.

possible that substitution effects might be such that parents might respond to such a price rise by reducing expenditure on children – implying a fall in the cost of raising an individual child.³ In practice, such substitution effects are probably small compared to the other factors that lead to the establishment of social norms for the commitment of resources to children, and so information on variations in the cost of children (the resources that parents actually commit to child-raising) may still be useful to behavioural studies of fertility.

Perhaps the most direct policy relevance of the full costs of children comes from a consideration of the lifecycle costs and benefits of raising children. To a large extent, the benefits of parenthood are usually seen as a characteristic of one's lifetime. We remain parents after our children have left home, and many of us anticipate becoming parents prior to having children. However, the costs of raising children are concentrated at particular stages of our lives. An understanding of the costs of children in the single-period context can thus be used to aid our understanding of saving patterns across the lifecycle (Browning and Ejrnaes, 2000). If there are capital market imperfections, there may also be an efficiency role for transfers to families when they have high child costs.

One particular policy-relevant question addressed in this paper is that of identifying the stages of child-rearing that have the highest costs. On the one hand, requirements for parental caring time inputs are very high when children are first born and diminish as children mature. Parental expenditure requirements have the opposite pattern, increasing with age (until the children leave the household or bring their own income into the household). A priori, it is not obvious which of these effects dominates. The estimates of the full costs of children presented here provide a start at answering this question.

The modelling framework used in this paper is outlined in the next section. If we are prepared to assume that household behaviour can be described by a simple separable structure with no household public goods, then the 'adult goods' method can be used to estimate the cost of children to parents. The adult good used here is parental leisure and personal time.⁴ By combining information from time-budget studies with estimates of labour-supply responses it is possible to obtain approximate estimates of the full cost of children.

Some preliminary estimates based on recent Australia data are shown in Section 3. The full costs of children are very large and they (mainly) tend to diminish with age up to age 11 (older ages are not examined here).

In Section 4 I return to consider the limitations of the modelling framework and speculate on how the estimates might change if these limitations could be addressed. Some of the limitations are specific to the adult goods approach, but others are more

³ See Becker (1981, Chapter 5) for a discussion of trade-offs between quantity and quality of children.

⁴ The closest antecedent in the literature appears to be Apps and Rees (2002) use of adult leisure in the identification of their child costs model, though their estimation approach is quite different to that used here.

fundamental limitations that might be faced by any attempt to value the cost of children to their parents. Section 5 concludes.

2. The Within-Household Allocation Model

2.1 The Concept of Child Cost

In order to sensibly define the concept of the cost of children, it is necessary to assume a separable structure for household welfare. For a household with one adult and one child, household welfare in the current period is represented by $W(U_A(\cdot), U_C(\cdot))$. The first term, $U_A(\cdot)$, represents adult consumption-based welfare, which is in turn a function of the consumption of goods, services and home production by the adult (defined more precisely below). The second term might similarly represent the parent's perception of the welfare of the child, or $U_C(\cdot)$ might represent a 'child quality production function'. Since we cannot observe child quality (at least in the data considered here), the two interpretations cannot be distinguished. The function $W(\cdot)$ represents the adult's perceptions of the relative weight to give to adult vs child consumption based welfare, or, alternatively, the adult's perceptions of the relative weight to be given to adult consumption welfare vs 'child quality'.

In order to separate the cost of children from the benefits of children it is necessary to separate the welfare impact of the good 'parenthood' from the adult current-period welfare function. Instead, we can think of this current period welfare function as being nested within a lifetime welfare function, which includes parenthood as one of its arguments. A welfare model that separates adult consumption (of goods other than parenthood) from other aspects of consumption is a necessary feature for any easily interpreted economic model of the cost of children. Most of the pre-existing literature on this topic defines this adult welfare in terms of commodity consumption. That is, the arguments to $U_A(\cdot)$ are current period consumption of market-purchased goods and services.

However, as Apps and Rees (2002) argue, to restrict attention to monetary costs alone misses out on a key aspects of the cost of children. In this paper, therefore, this approach is generalised to include the value of home production and leisure.

Given this separable structure, the cost of children is defined by comparing the situation of the adult when they are living with the child, to their situation when they are living alone (a 'situation comparison' in the terminology of Pollack and Wales, 1992). For some level of full income, F_A^* , the adult when living alone will be able to achieve a welfare level of u_A^* . When the adult has a child, they will need a higher level of full income in order to reach the same level of adult welfare (because some resources are diverted to the child). The difference between these two (full) income levels is defined as the cost of the child. That is, the cost of the child is defined as *the increase in (full) income required so that adult welfare remains constant*.

This cost to parents will be a function of the social norms for the raising of children, as well as the extent of support received from outside the household. For example, a reduction in state subsidies to education will increase the cost of children to parents (other things equal).

This model can be generalised to include multiple adults and children in several ways. The simplest is just to let $U_A(.)$ represent a joint welfare function for all the adults and $U_C(.)$ the corresponding function for the children. We then compare the situation of the household with just the adults to that of the household with all the children. Alternatively, different welfare functions for each adult can be introduced. This then allows us to define child costs as being different for each adult. This approach is followed for some of the empirical results below.

2.2 The Adult-Goods Model

In order to estimate the costs of children, additional structure is required. As well as the separability assumptions outlined above, the key additional assumption used here is that there are no household public goods – goods jointly consumed by the household members.⁵ Since there are many goods which have at least some degree of joint consumption, this is an approximation at best. The implications of this simplification are discussed further in Section 4.

If we can observe the full-income/consumption pattern of at least one good that is only consumed by adults, then these assumptions imply that we can use the ‘adult goods’ method to estimate the cost of children.⁶ The model assumptions imply that consumption on this adult good can be used as an indicator of the adult’s welfare level, both when living alone and with children. Comparing adult good consumption at different full income levels can then be used to obtain an estimate of the cost of the child.

More concretely, assume that when the adult lives alone he or she allocates their time so as to maximise $U_A(x_A, h_L, h_A)$ where,

$$\begin{aligned} x_A &= \text{adult commodity consumption} & (1) \\ h_L &= \text{adult leisure time} \\ h_A &= \text{home production time for adult consumption} \\ h_M &= \text{time spent in the labour market} \end{aligned}$$

This choice is made subject to a time budget constraint $h_M + h_L + h_A = T$ and an income budget constraint $x_A = Y + wh_M$. (Y is labour supply-invariant income from other sources). The two constraints can be combined as $x_A + wh_L + wh_A = Y + wT = F$ where F is the ‘full income’ when all available time is devoted to market work.

Implied by this decision process are demand functions for the three goods, income, home production and leisure as a function of the wage rate and full income.

⁵ From the perspective of models where individuals consume goods produced via a home production function with purchased goods and time as inputs, this assumption can be re-stated as an assumption that adult and child goods are not jointly produced.

⁶ Sometimes called the ‘Rothbarth’ method after Rothbarth (1943). See Deaton and Muellbauer (1986), Bradbury (1994) and Nelson (1992) for further discussion.

$$\begin{aligned}
x_A &= X_A(w, F) \\
h_A &= H_A(w, F) \\
h_L &= H_L(w, F)
\end{aligned}
\tag{2}$$

When they have a child in their household, the adult must now allocate some time to home production for the child (including direct child care) and some income must be allocated to child expenditures. This is represented by a maximisation of a household welfare function $W(u_A, u_C)$ ⁷ where

$$\begin{aligned}
u_A &= U_A(x_A, h_L, h_A) \\
u_C &= U_C(x_C, h_C)
\end{aligned}
\tag{3}$$

x_A, h_L, h_A, h_M are defined as above, and
 x_C = child commodity consumption
 h_C = childcare time and home production time for child consumption

The full income budget constraint is now

$$\begin{aligned}
F &= F_A + F_C \text{ where} \\
F_A &= x_A + wh_A + wh_L, \\
F_C &= x_C + wh_C, \\
F &= Y + wT
\end{aligned}$$

Note that all the time allocations here refer to parental time. Child time allocation is ignored. The separable structure of the household welfare function without public goods means that we can consider this as a two-stage problem. In the first stage, full income is divided into adult and child components (F_A and F_C). In the second stage, this income is allocated to consumption of the adult and child goods and time respectively. That is, adult demands will be a function of w and F_A and child demands a function of w and F_C . For adults, this second stage will be the same as for the single adult (though with F_A replacing F in the demand functions).

Typically, we cannot observe x_A separately from x_C . When we can observe components of x_A (eg adult goods such as adult clothing, alcohol, tobacco), they only form a small part of the budget and are not very reliably estimated.⁸

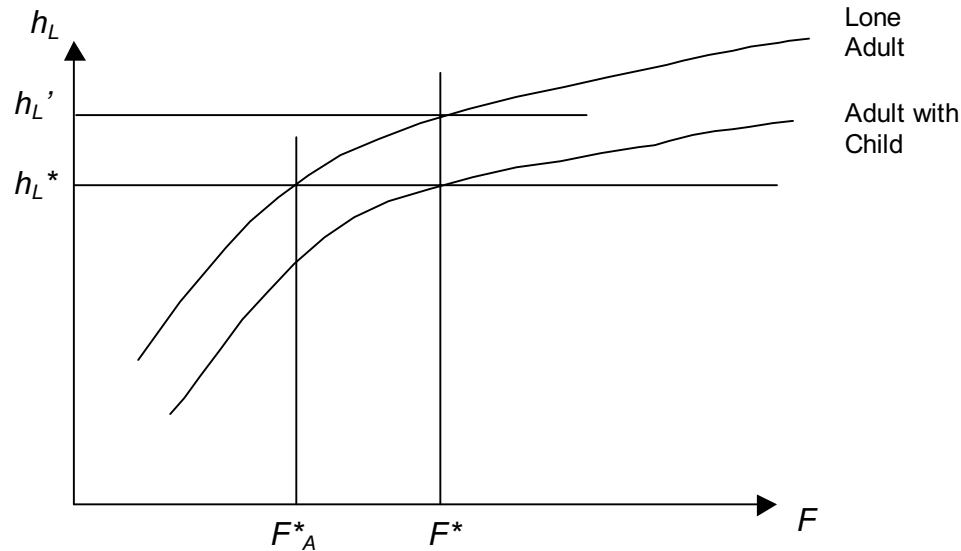
We also may not be able to separately observe h_A from h_C (home production for adult and child). But we can observe h_L . This is time spent on personal care, sleep, and leisure activities for the adult. We describe this here as ‘adult leisure and personal

⁷ The functions $W(\cdot)$, $U_A(\cdot)$ and $U_C(\cdot)$ are assumed to satisfy the usual monotonicity and concavity restrictions for welfare functions, which implies that the overall household welfare function $W(\cdot)$ will also. See the discussion in Samuelson (1956, p18, note 1).

⁸ If we did have data on adult expenditure goods then, in this model, they could also be used to estimate full child costs and be used to test the assumptions of the model (See Deaton, Ruiz-Castillo and Thomas, 1989). However this would require estimates of adult good demand as a function of full rather than money income.

time'. The observed demand function for this can, in principle, be used to recover the full costs of children.

Figure 1 Adult Goods Estimation of the Full Cost of Children



The estimation process is illustrated in Figure 1. We assume that adult leisure and personal time is a normal good, with demand increasing with full income. (The method will also work if the good is inferior as long as the income relationship is monotonic).

For the single adult living alone, we choose a value of full income, F_A^* and a wage rate (w^*). We estimate (2) and obtain the corresponding expected value of adult leisure hours, h_L^* . The family, however, needs to have a higher full income, F^* , before it reaches the same level of adult hours. The two-stage budgeting implied by separability means that adult hours will depend only upon the adult share of full income. Hence, when the family has income F^* , the adult's share of income is F_A^* . Because of separability and the monotonicity of the hours function, equality of adult's income means equality of adult welfare. The cost of children is thus $F^* - F_A^*$. This is the amount by which the family's full income must be higher in order for adult consumption (and hence welfare) in the single adult and family households to be identical.

As is clear from Figure 1, the estimation of this cost requires information on both the slope of the adult personal hours function as a function of full income (holding wage rates constant), and the difference in the adult leisure and personal hours function between the two family types (the vertical distance between the curves).

It is generally difficult to estimate both these relationships within the same dataset. We therefore decompose the difference between F^* and F_A^* by noting that

$$F^* - F_A^* \approx (h_L' - h_L^*) / \frac{\partial h_L}{\partial F} \quad (4)$$

where $\frac{\partial h_L}{\partial F}$ is the slope of the adult leisure demand curve for the adult living alone (with the wage rate held constant). The numerator of (4) is the (negative) increase in adult hours associated with the presence of the child in the household (holding the wage rate and full income constant). This can be estimated from time-use data collections by controlling for proxy variables for wage rates and full income.

With wage rates constant, the only part of F that varies is Y , and so we can write $\frac{\partial h_L}{\partial F} = \frac{\partial h_L}{\partial Y}$ and then use the constraint $h_M + h_A + h_L = T$ to write $\frac{\partial h_L}{\partial Y} = -\frac{\partial h_A}{\partial Y} - \frac{\partial h_M}{\partial Y}$. The last term is the labour supply income derivative, for which there is a substantial (if not conclusive) body of empirical research.

The term $\frac{\partial h_A}{\partial Y}$ is the income derivative of home production time. There are no research results on this,⁹ so here we consider two assumptions. For a low response assumption, we assume that this is zero. That is, an exogenous change in income has no impact upon home production time. For a high response assumption, we assume that the elasticity of home production with respect to income is equal to the elasticity of labour supply with respect to income.

Labour supply responses to exogenous changes in income are usually described in terms of the ‘total income elasticity’ (Pencavel, 1986). This is defined as $e = w \frac{\partial h_M}{\partial Y}$ and describes the increase in earnings associated with a one-unit increase in non-wage income (if non-work is a normal good, e is negative).¹⁰ Using this notation, and drawing upon the two alternative assumptions for the magnitude of the home production income response leads to estimates of child costs of

$$F^* - F_A^* \approx w(h_L^* - h_L') / \alpha e \quad (5)$$

where $\alpha = \begin{cases} 1 \text{ or,} & \text{(zero home production income elasticity)} \\ \left(1 + \frac{\bar{h}_A}{\bar{h}_M}\right) & \text{(home production elasticity equal to labour supply elasticity)} \end{cases}$

where \bar{h}_A and \bar{h}_M are the mean hours of home production and labour market time for the no-child household respectively.

⁹ Though time use studies have studied the relationship between money income and time use, what we require here is the relationship between time use and exogenous income, ie income that does not vary with labour market time.

¹⁰ e is not an elasticity, but it is conveniently unitless. It is equal to the uncompensated labour supply elasticity minus the income-compensated labour supply elasticity.

The cost of children is thus the wage rate times the drop in adult leisure personal hours, divided by a scaling of the total income elasticity of labour supply. If we were not dividing by the total income elasticity, this measure would simply be the opportunity cost of lost leisure, valued at the (net) market wage rate. Dividing by the total income elasticity (the absolute value of which is smaller than 1), increases this cost estimate. This is necessary because the reduction in parental leisure is only one impact of the presence of children in the household. There may also be reductions in adult consumption of commodities (x_A) as well as home production for the adult (h_A). The maintained assumption of this model is that the diversion of resources to child consumption will have an income effect on all these aspects of adult consumption rather than on just the one (personal and leisure) that we can easily observe. This seems reasonable in general, even if the separable structure of the welfare function that produces this result might not be a precise reflection of actual behaviour patterns.

The relative cost of the child is thus higher when there is a large drop in adult hours associated with the presence of a child and higher when the (absolute value of) the labour supply income response is lower. The impact of the labour supply response can be observed in Figure 1. A low total income elasticity of labour supply means that the curves will be flat. Holding the vertical distance between the curves constant, it can be seen that equality of adult hours will be achieved when there is a large difference in income levels in the two family types.

How would we expect these costs of children to vary with other factors that vary between households such as parental wage rates, the ages of the children, the patterns of childcare used in the household, and the magnitude of state support for families? There is little evidence of systematic variation in the total income elasticity between different groups (see below), and so we assume this is constant across groups.

Wages

The wage rate enters equation (5) explicitly: children cost more when parents have a higher wage rate (unless there are strong offsetting leisure hours responses).

However, if we express child costs as a proportion of money income there is no obvious pattern. For example, if all household income is from wages then the cost of children as a proportion of money income is given by

$$\frac{F^* - F_A^*}{wh_M} \approx \left((h_L^* - h_L') / h_M \right) / \alpha e \quad (6)$$

That is, the change in leisure hours as a proportion of market work hours, divided by the total income elasticity. If we are prepared to assume e constant, then this will only vary with the wage rate if the change in leisure hours (as a proportion of market work) is different for high and low wage workers. It is difficult to predict in which way this might vary.

Gender

Since men have higher average wages than women, the above discussion implies that the costs of children for men will be correspondingly higher. However, as we shall see

below, the drop in leisure hours is generally greater for women (at least for young children). This also assumes that the total income elasticity of labour supply is equal for men and women, and that the home production derivative is identical.

Age

Older children require less time parental time, suggesting that the drop in adult leisure and personal time will be less for older children. However, older children also require greater monetary expenditures than younger children. This lowers the parents' living standards. In response, they might reduce their leisure and increase their labour supply. The associated drop in adult personal time could, in principle, be large enough for us to find that older children cost more than younger children.

This example emphasises the fact that though this approach is derived from time-use data, it provides an estimate of *total* child costs including those that find expression in commodity expenditures.

Childcare and other Child Services

Consider first state-provided or subsidised services for children that do not vary with the parent's labour market time. These might include schooling, health care and childcare for non labour market time. In the simple model presented here, the provision of these non-cash services reduces parental expenditure on children (x_C) by the amount that the parents save on these services (which depends in part on whether the parents would have chosen these services in the absence of state provision). These additional resources effectively increase parental income, should be reflected in an increase in parental leisure and personal time and hence will be captured in the measure of child costs presented.

However, the value of some childcare subsidies also depends upon the extent of parental labour market time. Even though this is not explicitly incorporated into the model, these effects are, in principle, captured. If parents of young children increase their hours of labour market time, they often¹¹ adjust the inputs to child welfare $U_C(x_C, h_C)$ by decreasing h_C (spending less time caring for their children) and increasing x_C (purchasing childcare services). The introduction of a childcare subsidy reduces the price of childcare services, leading to a substitution towards x_C and away from h_C , which may in turn lead to an increase in h_M , market work. It also produces an income effect. It is this income effect that should, in principle, be captured by the patterns of adult leisure time.

3. Initial Estimates of the Full Cost of Children

3.1 Estimates of the Total-Income Elasticity of Labour Supply

A number of studies have surveyed the estimates of the total-income elasticity e arising from the labour supply literature. Pencavel (1986) surveys the US and UK non-experimental labour supply literature. Across the 15 studies that he summarises

¹¹ Alternative strategies are to reduce h_A or h_L (adult home production or leisure). For example, parents might arrange non-overlapping work times to reduce the need to purchase formal childcare.

the median estimate of e for men is -0.29 .¹² However, the range of estimates is broad. Excluding the 2 most extreme values at either end, e ranges from -0.06 to -0.44 . He concludes that a ‘best’ estimate of e for men is -0.20 . Killingsworth and Heckman (1986) conduct a similar survey for women, finding a median total-income elasticity of -0.09 . The variation of estimates is similarly broad.¹³ Blundell and MaCurdy (2000) survey more recent studies. They find a median total-income elasticity of -0.07 for men and -0.17 for women. Again, however the range of estimates is broad.

In most of these studies, the primary question of interest is the magnitude of the wage elasticity of labour supply. Identification of the income effect is usually achieved via strong assumptions about the exogeneity of capital or spouse income. A limited number of studies have more directly addressed income effects by seeking empirical examples where there is exogenous variation in incomes. A recent example is Imbens, Rubin and Sacerdote (1999) who look at the changes in behaviour associated with lottery winnings. They estimate a total income elasticity of around -0.03 to -0.06 . They find little variation by sex and age.

It is clear that there is no simple consensus value of e arising from the research literature. The exogeneity of lottery winnings makes the results of Imbens et al particularly appealing. However, many of the labour supply surveys estimated a much stronger income response. As a compromise I take -0.1 as my preferred value for e . However, values of e ranging from -0.05 to -0.2 could be justified on the basis of some sub-sets of the research literature. This implies that the estimates of child costs could be between half and double those presented here.

3.2 Estimates of the Full Cost of Children

The estimates presented here are based on time-use patterns estimated by Craig and Bittman (2004). They describe how parental time use patterns vary as the composition of their household changes. Here, the key relationship is that between parental leisure/personal time and family composition. Table 1 presents Craig and Bittman’s estimates of this relationship controlling for the age and education level of the parents.¹⁴ The estimates presented differ slightly from those in their original paper for the reasons described in the note to the table. Leisure and personal time is defined as all time other than time spent in market work or in home production/childcare.

¹² Calculated from his Table 1.19 and 1.20. This excludes the Wales and Woodland study (for the reasons mentioned by Pencavel) and also excludes those studies which estimate a negative compensated price elasticity for labour supply. The median result for experimental studies is somewhat lower -0.10 which is consistent with Metcalf’s (1974) hypothesis of the impact of the non-permanent nature of the experimental change.

¹³ This is the median of the 82 estimates of the total-income elasticity presented in their Table 2.26.

¹⁴ Age and education serve as (an imperfect) proxy for the full income of the household. One possible improvement would be to take explicit account of the child-related income transfers received by families with children. Doing this would tend to increase the cost of children estimates shown here. Child-specific transfers mean that parents have a higher full income than an age and education matched group of non-parents. Removing this difference would reduce their full income and hence leisure hours.

The sample size for these calculations is not very large, and so some of the patterns observed here are likely to be due to sampling error.¹⁵ Nonetheless there are some interesting patterns. Starting with the ‘both parents’ panel, it can be seen that, when the youngest child is aged 0-2, the parents’ leisure time is reduced by around 2 hours (per day) when they have one child and 3.6 hours when they have two. Having three children actually leads to an increase in parental leisure time. Craig and Bittman speculate that this might be due to the capacity for the older child to supervise the younger.

When the youngest child is aged 3-4 the time cost is around 3 hours for both one or two children, and again lower for the three child household. With older children (up to age 11, Craig and Bittman don’t consider older children), the time cost is lower for the first child then increases more steadily with increasing numbers of children.

Table 1 Change in Parental Leisure and Personal Time Associated with the Presence of Children, Australia 1997 (hours per day)

Number of Children	Age of Youngest Child		
	0-2	3-4	5-11
Both Parents			
0	0	0	0
1	-1.9	-3.0	-0.8
2	-3.6	-2.9	-1.9
3+	-2.5	-1.9	-2.2
Mother			
0	0	0	0
1	-1.4	-1.5	-0.5
2	-2.3	-1.7	-0.9
3+	-1.7	-1.5	-1.1
Father			
0	0	0	0
1	-0.3	-1.5	-0.5
2	-1.4	-1.0	-1.1
3+	-0.6	-0.5	-0.9

Notes: ABS 1997 Time Use Survey, Confidentialised Unit Record File. Estimates provided by Craig and Bittman, based on those in Craig and Bittman (2004) using an OLS regression of combined paid and unpaid work time controlling for education, age, day of the week and disability status. Parental leisure and personal time is all time other than paid or unpaid work. The regression is estimated over couple-headed households where the head is aged 25 to 54, and there are either no children, or children aged under 12 only. The corresponding estimates in Craig and Bittman (2004, Figure 2.4) also control for household income.

The second and third panels of the table show how this time cost accrues to the mother and father respectively. As Craig and Bittman show, most of the adjustment of the mother comes about via increases in home production (including childcare) time, whereas most of the father’s adjustment arises through increases in labour market participation. For the youngest children, more of the time cost falls on mothers, while for the oldest age group the adjustment is more equally shared (though see below for the limitations of this time use measure).

¹⁵ See Craig and Bittman (2004) for approximate standard error estimates (based on the assumption of independent diary-days).

The data in this table represents the term $-(h_L^* - h_L')$ as defined in equation (5). This can be combined with estimates of the net marginal wage rate (\$12.00 and \$10.30/hour for men and women respectively)¹⁶ to obtain estimates of the cost of children as they accrue to mothers and fathers. Some initial estimates are shown in Table 2, for families with two children only.

Table 2 Full Cost of Two Children, Australia 1997, \$ Per Week

Age of Youngest Child	Change in Leisure/Personal Time (hours/week)	Home Production Elasticity	
		Zero	Same as Market Labour
Mother			
0-2	-16.1	\$1,658	\$1,036
3-4	-11.9	\$1,226	\$766
5-11	-6.3	\$649	\$406
Father			
0-2	-9.8	\$1,176	\$735
3-4	-7	\$840	\$525
5-11	-7.7	\$924	\$578

Notes: Calculated using expression (5) using wage rates of \$10.30 and \$12.00/hour for mother and father respectively. The parameter α is calculated using mean market and non-market hours of 3.0 and 5.0 hours for both men and women (in couples without children).

Apart from the large absolute value of child costs (discussed further below), the most interesting feature of this table is the relative values for men and women. For young children, mothers bear a higher cost, but this is reversed when the youngest child is aged 5-11. The latter result is due to the relatively equal hours cost as shown in Table 1, together with the higher wages (and hence higher opportunity cost) of fathers.

There are two main reasons why we should be very cautious with respect to this conclusion. First, it does assume that the labour supply and non-market home production income ‘elasticities’ are the same for men and women. Even though the literature doesn’t provide evidence of different elasticities, this has not been subject to tests of any great power.

Second, the time use patterns shown in Table 1 are based upon primary time patterns only. Craig and Bittman (2004) show that much time which is recorded in the survey as a primary activity of leisure or personal care, is also coded as having a secondary activity of child supervision. Moreover, this is more likely to happen for mothers rather than fathers. A narrower definition of leisure which excluded this time would show a greater share of the cost of children as falling on mothers.

¹⁶ In 1997 the mean gross weekly wage for male and female employees paid for between 35 and 39 hours was \$691 and \$591 respectively (ABS *Weekly Earnings of Employees (Distribution), August 1997*, Cat No. 6310.0, Table 6. For both men and women, this is the modal hours category presented in this table). Assuming a mid-point of 37 hours implies gross wage rates of \$18.68 and \$15.97 per hour for men and women. For people earning this wage all year, the marginal income tax rate (including Medicare levy) was 35.5%. We therefore use net marginal wage rates of \$12.00 and \$10.30 per hour for men and women respectively.

A more meaningful way to gain a feeling for the magnitude of these child costs is to compare them with the money income level of the average household. One way of doing this is to use expression (6). The time use survey reports mean hours of market work as 39 hours per week for fathers and 19 hours for mothers.¹⁷ Using the total of these hours (58) as h_M in expression (6) yields the estimates shown in Table 3.

Table 3 Household Full Cost of Children Relative to Mean Money Income, Australia 1997

Number of Children	Age of Youngest Child		
	0-2	3-4	5-11
Home Production Elasticity = 0			
1	2.2	3.6	1.0
2	4.3	3.5	2.3
3+	3.1	2.3	2.7
Home Production Elasticity = Market Labour Elasticity			
1	1.4	2.3	0.6
2	2.7	2.2	1.4
3+	1.9	1.4	1.7

Notes: Calculated using expression (6) using a mean weekly market hours of 58, $e=-0.1$, and $\theta=1$ or 1.6.

It is clear, first of all, that the estimates are very sensitive to our ignorance of the magnitude of the income response of home production. Recall also, that arguable values for the total income elasticity of labour supply could lead to results that were between half and double these estimates. Nonetheless, even with these caveats these results do serve to illustrate the large magnitude of the full cost of children to their parents.

By way of comparison we could note that the simple square root equivalence scale often used in income distribution analysis implies that a two-child family requires an income 1.4 times that of the couple without children. In other words, the additional cost of two children is 0.4 times the money income of the couple without children. The per-capita equivalence scale (usually considered the largest feasible scale) implies an additional cost ratio of 1.0. For a two-child household where one child is aged 0-2, Table 3 shows a corresponding ratio of either 2.7 or 4.3. Even if we were to double the income elasticity, this would still be well above the per-capita equivalence scale.

However, this result is not implausible. The idea that the per-capita scale is an upper bound arises from the assumption that children consume less than adults (and that there are no dis-economies of household scale). When time costs are included, there is every reason to believe that young children will have a greater impact upon the parents' living standard than would the presence of another adult in the household.

Finally, the table also shows how costs vary with the age of the youngest child. For the two-child household they decrease with age, but for larger and smaller

¹⁷ This is mean hours of work per week as reported in the questionnaire part of the survey rather than the time diaries. It is for all families included in Table 1. Corresponding hours for couples without children would be somewhat higher.

households there are U and inverse-U shaped patterns. A decline with age is what we would expect with respect to the time spent caring for children. However, these results also include the impact of expenditures on children (via their impact on parental labour supply). Though these particular patterns might not be statistically significant, there is no theoretical reason that would require the total cost of children to fall with age.

4. Limitations

First, and most obvious, are the econometric limitations of the estimates presented here. Even though concepts such as the income elasticity of labour supply have been subject to much econometric research they still remain very imprecisely measured. Even less is known about the income elasticity of home production time. The model does also not explicitly incorporate any labour market rigidities. The estimates presented here should thus be considered as indicating the type of information required to estimate the costs of children, and only as very broad estimates of likely magnitudes.

Assuming that we could indeed reliably estimate it, what are the theoretical limitations of the model and what do these suggest more generally about other attempts to measure the cost of children? I list some key issues here, starting with an issue particular to the adult good model, but then moving on to consider issues that also have wider applicability.

4.1 Joint consumption/production in the household

This is a standard criticism of the adult good model. The adult good model, whether in expenditure or in time, does not take account of the economies of household scale in consumption and/or home production. For example, elements of household expenditure may include household public goods. In this case, each unit of the good provides consumption services to all household members, and there is no need to purchase more when there are more people in the household. Similarly, the home production for the adult may be produced jointly with home production for the child. For example, sweeping the house requires much the same effort irrespective of the amount of dirt, and cooking a larger meal requires only a little more effort (assuming the tastes of adult and child are sufficiently similar).

Though joint consumption/production clearly has major implications for household economic behaviour and welfare, the omission of this from the model is not as serious as it might seem at first glance. We can think of joint consumption/production as having both an income and a substitution effect. The income effect arises because it is now possible to produce more final consumption for the same amount of expenditure or time input. The substitution effect arises because these jointly produced goods are now effectively cheaper than in smaller households.

The adult good model captures the income effects of joint consumption, but not the substitution effects. To the extent to which joint consumption raises the real income of the household, this will (appropriately) be reflected in demand for the adult good.

The omission of public good substitution effects probably leads to an over-estimation of the cost of children. This is because joint consumption/production will make goods

other than adult personal time relatively cheaper in the larger household. (This assumes no joint production of adult personal time – this possibility is addressed separately below). The substitution effect will mean a shift towards these jointly consumed goods in the larger household, and hence less consumption of the adult good. The adult good method, however, will interpret this substitution as representing an income effect and hence will over-estimate the drop in real adult income, and hence over-estimate the cost of children.¹⁸

4.2 Direct Price Effects on Adult Leisure Consumption

A similar effect can occur because of the direct effects of children on the price of adult leisure and personal time. Some aspects of adult leisure consumption become relatively more expensive when children are present, for example, eating out or going to the movies might require expenditure on additional childcare. The impact of this is the same as for the previous case of non-leisure goods becoming less expensive – parents will tend to substitute away from leisure activities and this will erroneously be interpreted as an income effect of children.

The magnitude of child cost overestimation associated with these two price responses will depend upon many factors; the extent of joint production or consumption, the share of adult leisure/personal time that is subject to relative price changes, the price elasticity of adult personal time, and the possibility for substitution within leisure time.¹⁹

4.3 Secondary Time Activities

The time use described here only refers to ‘primary activities’. As mentioned above, many parents (particularly mothers) record a leisure/personal activity as primary, but are also undertaking a secondary childcare activity at the same time. If we were to conduct the adult good examination of the basis of the narrower activity of leisure and personal time where there is no secondary childcare, then the estimated costs of children would be larger.

4.4 Joint Consumption of Adult Personal Time

However, a different view of how to treat joint activities could provide support for yet another reason why we might view the child cost estimates as too high. What if adult personal time is jointly produced/consumed along with time devoted to childcare? This is a fundamental issue for this and any other method used to estimate the time costs of children.

Adult leisure and personal time includes sleep, personal care and leisure activities. If we think of the good ‘leisure’ then it is conceivable that time spent on some aspects of

¹⁸ This result might not occur if the adult good is a strongly complimentary to the goods that have joint production or consumption. However, given the wide range of goods that are likely to experience jointness, this does not seem very likely. This relationship was first pointed out by Nelson (1992). See Bradbury (1997) for a diagrammatic representation.

¹⁹ For example, if an increased price for going to the movies simply leads to the adult increasing their time watching videos at home, then there will be no price effect on aggregate adult personal/leisure time.

childcare might be effectively jointly producing leisure at the same time. Supervising children in play activities might both count as childcare service to the child, but also be an activity very close to leisure for the adult. If this is the case, then the adults are effectively consuming more leisure than time-use studies would reveal. In other words, they are not as badly off when they have children, and the method will over-estimate the cost of children.

Another way of thinking about this is to think of childcare (or part of childcare) and leisure as close substitutes in the household welfare function. Because childcare and adult leisure belong to different sub-branches of the separable welfare structure in (1) such a particular pattern of substitution is not incorporated into the model used here.

4.5 Violation of Preference Stability Assumption

Despite all these limitations, the conclusion that the total cost of raising children is extremely large does not seem implausible. Can we derive any welfare and/or policy conclusions from this?

The model used here assumes that adults maintain the same preferences for their own consumption whether they do or do not have children, and the real value of this consumption is used as the welfare index. Is this ‘situation comparison’ a sensible comparison?

Above, I have described this as being part of a lifetime welfare model where the benefits of being a parent enter at the lifetime level, with the costs entering each period’s sub-welfare function. If the sub-welfare functions enter the lifetime welfare function symmetrically, then the situation comparison is sensible. We can use methods like the adult good approach to talk about how child costs are spread across the lifecycle. However, there are reasons for thinking the actual function might be non-symmetrical.

Parents might be happy to have a relatively low standard of parental living when they are raising their children.²⁰ In part, this acceptance might reflect the fact that this pattern is the norm. In this case we might argue that this norm reflects an inefficient situation and so should be rejected. However, other reasons are harder to reject. For example, parents’ health and vitality generally diminishes as they age. The steady reduction in child time burden as children age might be seen as an appropriate complement to this.

Ultimately, these sorts of issues are not likely to be resolved easily. Nonetheless, we need to bear them in mind when interpreting the results of any child cost comparison.

5. Conclusion

Parent’s reduce their leisure and personal hours considerably when they are raising their children. In the model presented here, this change in time-use arises from a

²⁰ Indeed one might test this by identifying people who are not capital market constrained and observing how they move resources between their childrearing and other stages of their lifecycle.

combination of the time and the expenditure costs of children. The expenditure costs enter via the pressures they place on parental labour supply.

Some simple estimates based on the time use results of Craig and Bittman (2004) suggest that the full costs of raising children are very large indeed. Though difficult econometric problems (and theoretical simplifications) mean that these estimates should only be considered broad estimates of magnitude, some of the results are more robust.

For example, if we are prepared to assume that income elasticities are constant across groups, then the change in adult leisure across the lifecycle can be used to conclude whether the time costs of younger children are outweighed by expenditure costs of older children. Here, we find that children aged 5 to 11 generally cost less than younger children – at least for families with one or two children. This has implications for policies that might seek to assist parents spread their childrearing costs across the lifecycle.

Finally, we should remember that all these estimates of the costs of children to parents are specific to the social and economic context in which the families are located. Cross-national differences in state support for parents and children are likely to lead to different pattern of child costs, and different patterns of children's consumption.

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