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TIME AND THE COST OF CHILDREN

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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 economic model of the household to show how this information can be used to develop an equivalence scale for adult consumption that takes account of both the expenditure and time costs of children. Preliminary estimates using Australian data suggest a very large cost—much higher than that typically assumed for expenditure costs. The full cost of children declines with age, despite the expenditure cost rising. The paper discusses the limitations of the adult good method and the assumptions needed to draw welfare conclusions from these and other estimates of child costs.

1. Introduction

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

But children have a wide-ranging impact upon the allocation of resources within the household. Time-use data show how the presence of children is associated with large reallocations of parental time from personal activities (sleep, leisure, and personal care) toward 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 cost of children.

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[1]For an introduction to the literature, see Deaton and Muellbauer (1980) and Buhmann *et al.* (1988).

Why should we be interested in the cost of children, full or otherwise? From the perspective of children, children's consumption is obviously important. This consumption is related to the parents' cost of raising children, but it is not the same. Children can consume more than they cost because of the presence of household public goods and because children receive many services directly from outside the household.

From the perspective of parents, the fact that they 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 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 the resource input needed to raise a child of given "quality." The cost of a child, on the other hand, 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 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 the average child.[3] In practice, such substitution effects are probably small and so information on variations in the cost of children (the resources that parents actually commit to child-raising) may still be useful to behavioral 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. The benefits of parenthood are best seen as a characteristic of one's lifetime. We remain parents after our children have left home, and most people 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 Ejrnæs, 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 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 tend to have the opposite pattern, increasing with age. Even if parents purchase childcare when children are young, they still have substantial inputs of their own time into the care of their

[2]In Bradbury (2003), the literature examining the rationale for parental compensation for the cost of children is reviewed.

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

children. 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 modeling framework used in this paper is outlined in the next section. If we are prepared to assume that household behavior can be described by a simple separable structure with no change in the consumption of 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 labor-supply responses it is possible to obtain approximate estimates of the full cost of children.

Some preliminary estimates based on recent Australian data are shown in Section 3. The full costs of children estimated on the basis of these assumptions are large and they 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 modeling framework and speculate on how the estimates might change if these could be addressed. Some of the restrictive assumptions required are specific to the adult goods approach, but others are more fundamental assumptions that must be made 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*

To define a sensible concept of the cost of children, it is necessary to assume a separable structure for household welfare. For a household comprising two adults plus their children, a general way of doing this is to assume that the household maximizes a current period household welfare function[5] given by $W(V_M(.),V_F(.),V_C(.))$.

The first two terms, $V_M(.)$ and $V_F(.)$ represent the current period welfare of each adult. The arguments to these welfare functions (defined more precisely below) are the goods, services and home production consumed by each adult. The last term, $V_C(.)$, can represent either the parents' perception of the welfare of the children, or might represent a current period "child quality production function." If we cannot observe child quality, the two interpretations cannot be empirically distinguished.

Now children generally provide benefits to their parents as well as entailing costs. It is explicitly assumed here that these "benefits of parenthood" are not included in any of the above welfare functions. Instead, it is assumed that $W(.)$ is in turn nested within a lifetime welfare function, which includes parenthood as one

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

[5]Bourguignon (1999) uses a similar algebraic structure to model within-household allocations. However, he makes fewer assumptions about preference stability and the role of the commodity "parenthood" and hence is only able to recover marginal changes in the within-household allocations. The assumptions made in this present paper imply that it follows the Rothbarth (1943) approach rather than that of Bourguignon.

of its arguments. This separation allows us to talk about the current period costs of children (which might vary across the lifecycle) while recognizing that "parenthood" is nonetheless a good.

One interpretation of the function $W(.)$ is that it represents the household decision-maker's perceptions of the relative weight to give to the consumption of each household member in the current period. A different interpretation can be found in the "collective consumption" literature, where this function represents the outcome of a Pareto-efficient bargaining process between the household members. In this case $W(.)$ is an additive function of the individual welfare functions, with the weight given to each household member depending on "distribution factors"—factors that influence bargaining within the household (see for example, Bourguignon and Chiappori, 1994 and Browning *et al.*, 2006). Potentially observable distribution factors might include the relative wealth and wages of husband and wife, their personality traits and physical attributes and the opportunities outside of marriage for each adult. Though less directly observable, we would also expect $W(.)$ to depend upon the preferences of each parent for the welfare of the other partner and of their children. The latter in turn might depend upon the social norms of child-rearing (which might differ across cultural groups).

For the questions considered in this paper, it is not necessary to assume an additive form for $W(.)$. It is sufficient to assume that $W(.)$ and the $V_i(.)$ functions satisfy the usual monotonicity and concavity restrictions for welfare functions.[6] Nonetheless, the structure of the model is essentially the same as that in the collective consumption literature, though we do not consider the impact of distribution factors here.

It is common in this field to define current period adult welfare in terms of commodity consumption. That is, the arguments to $V_i(.)$ are the current period consumption of market-purchased goods and services. However, to restrict attention to monetary cost alone misses key aspects of the cost of children. Here, this approach is generalized to include the value of home production and leisure. The model is deliberately chosen to be as simple as possible in order to make transparent its structure and key assumptions.

Given the separable structure described above, the cost of children is defined by comparing the situation of each adult when they are living with the children, to their situation when there are no children in the household. This type of comparison has been called a "situation comparison" (Pollack and Wales, 1992) or a comparison that generates an "indifference scale" (Browning *et al.*, 2006). For some level of full income for each adult, F_i^* (defined more precisely below) the adult without a child will be able to achieve a current-period welfare level of v_i^*. When they are living with their child, they will need a higher level of household 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 the cost of the child.[7]

[6]This implies that the overall household welfare function will also satisfy these conditions. See the discussion in Samuelson (1956).

[7]The interest here is on the cost of the child to the parents rather than the consumption level of the child. Household public goods mean that the latter will generally be greater than the former.

The adult goods method[8] identifies the required income compensation by observing the relationship between (full) income and the consumption of a good that is only consumed by adults. The level of adult good consumption in the households of different composition is then used as an indicator of the full income received by the adult. This approach effectively assumes that children have only an income effect on adult consumption rather than a relative price effect. To the extent to which there are changes in the consumption of household public goods (goods jointly consumed by the household members) this will not be correct. However, if we are prepared to assume that household public goods are a separable component of welfare, we can first consider the impact of children on non-public consumption, and then later consider the impact of any changes in public good consumption on adult welfare. This is the strategy adopted here.

To incorporate household public goods, the household welfare function described above is specified as $W'(V_M(U_M(.),G),V_F(U_F(.),G),V_C(U_C(.),G))$. Each member's welfare is thus a separable function of the vector of public goods G and a function of privately consumed commodities and home production outputs $U_i(.)$. Without loss of generality, this can be written as $W(U_M(.), U_F(.), U_C(.),G))$—the household chooses between the non-public consumption of each member and consumption of the household public good. We first consider how the full income of the household needs to vary in order to maintain $U_i(.)$ constant as household composition changes. If G does not change, this is also the income variation required to maintain $V_i(U_i(.),G)$ constant. Once we have considered this, we can then consider the possible implications of changes in G due to household compositional changes.

2.2. *The Household Welfare Model*

More specifically, assume that the household with children maximizes the household welfare function

$$W(u_M, u_F, u_C, G) \text{ with } u_i = U_i(x_i, l_i, h_{iM}, h_{iF}) \quad i = M, F, C \text{ and} \tag{1}$$

x_i = commodity consumption of person i,
l_i = leisure time of person i, and
h_{iM} = home production time of the mother allocated to the consumption of person i
h_{iF} = home production time of the father allocated to the consumption of person i

Only the home production of the parents is considered here, with the total home production of parent j summarized as $h_{+j} = h_{Mj} + h_{Fj} + h_{Cj}$.

This household welfare function is maximized subject to (assumed binding) parental time constraints of

$$l_j + h_{+j} + m_j = T_j \quad j = M, F \tag{2}$$

[8]Sometimes called the "Rothbarth" method after Rothbarth (1943). See Deaton and Muellbauer (1986), Bradbury (1994) and Nelson (1992) for further discussion of this in the context of the expenditure costs of children.

where
m_j = market work time of parent j and
T_j = total time of parent j

and a household income budget constraint of

$$x_M + x_F + x_C + p_G G = Y + w_M m_M + w_F m_F \tag{3}$$

where
Y = other (labor supply invariant) income of the household,
w_M, w_F are the wage rates of the mother and father, and
p_G = price of the public good (x_M, x_F and x_C are normalized to have unit price)

Substituting m_j from (2) into (3) and rearranging yields the household full-income budget constraint of

$$F = p_G G + F_M + F_F + F_C \tag{4}$$

where
$F = Y + w_M T_M + w_F T_F$
$F_M = x_M + w_M l_M + w_M h_{MM} + w_F h_{MF}$
$F_F = x_F + w_F l_F + w_M h_{FM} + w_F h_{FF}$
$F_C = x_C + w_M h_{CM} + w_F h_{CF}$

That is, household full income (comprising non-labor income plus the maximum earning potential of parents) can be divided into: expenditure on public goods; expenditure, leisure and home production for the mother; expenditure, leisure and home production for the father; and expenditure and home production for the child.

The allocation model for the household without children is assumed the same, but without all the child related terms. The $W(u_M,u_F,G)$ function will be different, reflecting the bargaining power and/or consensus decision-making patterns that take place in the household without children, though we assume that the $U_i(.)$ (i.e. the person-level welfare functions) remain the same across the different family structures.[9]

The separable household welfare function means that we can consider household current-period decision-making as a two-step process. First, full income is allocated to public good consumption and the consumption of the mother, father and child. Second, commodity consumption, leisure and home production for each person is decided based on the full income allocation of the respective person and the two wage rates.

Typically, we cannot observe x_M or x_F separately from x_C. When we can observe separate components such as adult clothing, alcohol or tobacco, they only

[9]Bourguignon (1999) shows how it is possible to develop household allocation models in the absence of this assumption. However, in this case one can only identify the relationship between changes in income and changes in child costs rather than the absolute level of costs.

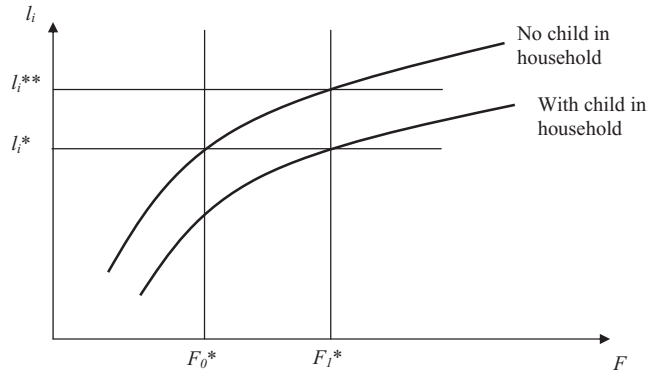

Figure 1. Adult Goods Estimation of the Full Cost of Children (for parent *i*)

form a small part of the budget and are not very reliably estimated.[10] It is even more difficult to observe the allocation of home production to the different household members. But household time-use surveys do collect detailed information on l_M and l_F. This is defined here as time spent on personal care, sleep, and leisure activities for each adult (i.e. all activities other than market work and home production). This is described here as "leisure and personal time" or simply "leisure."

As part of the second stage allocation described above, demand for leisure will be determined as a function of the full income allocation of each adult and the two wage rates. Leisure thus serves as an indicator of parental personal consumption.

If this relationship can be estimated, it can be inverted to estimate F_M and F_F as a function of the amount of leisure each adult consumes. When there are no children in the household all the allocations to children are set to zero, but otherwise the same separable allocation model applies and the full income of each adult can be derived as a function of their leisure consumption.

The estimation process (for parent *i*) is illustrated in Figure 1, where the curves describe the relationship between household full income and the leisure and personal time of one of the parents. Leisure is assumed to be a normal good, with demand increasing with household full income. When there is a child in the household, some of the household full income is directed toward the consumption of the child, the parent receives a smaller share of household full income and so has a reduced consumption of leisure (and all other normal goods). The separability assumptions mean that these two curves only differ because of this diversion of resources to other household members and (public goods).

When there is a child in the household, the parent will require a household full income of F_1* to have a leisure consumption of l_i*. When there is no child, the income requirement is lower at F_0*. Holding wage rates constant, leisure consumption is a function solely of the parent's full income allocation. Equal levels of leisure in different household structures thus imply equal levels of overall welfare,

[10]If we did have data on adult expenditure goods, they could also be used in this model to estimate full child costs and be used to test the assumptions of the model (see Deaton *et al.*, 1989). However, this would require estimates of adult good demand as a function of full rather than money income.

u_i. Hence the difference in household income required to maintain leisure constant, $F_1^* - F_0^*$ is the cost of the child as measured from the perspective of parent i (assuming no change in public good consumption).

The curves for each family type shown in Figure 1 will be a function of both the share of household full income allocated to parent i's consumption, as well as this parent's demand for leisure as a function of their own full income. In principle, given information on the consumption patterns of people in single-person, couple and child-containing households together with suitable exogenous variation in non-wage income, both relationships could be estimated. Here, however, we use a more indirect estimation approach, that shows more clearly how the cost of children can be related to previous sociological research on family time-use patterns and the substantial body of economic research on labor supply behavior.

From Figure 1 it can be seen that the difference between F_1^* and F_0^* can be approximated by

$$F_1^* - F_0^* \approx (l_i^{**} - l_i^*) \Big/ \frac{\partial l_i}{\partial F} \tag{5}$$

where $\frac{\partial l_i}{\partial F}$ is the slope of the leisure demand curve with respect to household full income for the parent when there is no child in the household (with wage rates held constant). The numerator of (5) is the decrease in the parent's leisure associated with the presence of the child in the household (holding wage rates and household full income constant). This can be estimated from time-use data collections by controlling for proxy variables for wage rates and full income.

Note that the left-hand side of (5) refers to the change in household full income, while the right-hand side refers to the leisure of one of the parents. Equation (5) can thus be estimated separately for each parent, but the costs thus estimated should not be added together, as each is already an estimate of the amount by which household income much increase in order to compensate for the cost of the child.

With wage rates constant, the only part of F that varies is Y, and so we can write $\frac{\partial l_i}{\partial F} = \frac{\partial l_i}{\partial Y}$ and then use the time budget constraint (2) to write $\frac{\partial l_i}{\partial Y} = -\frac{\partial h_{+i}}{\partial Y} - \frac{\partial m_i}{\partial Y}$. The last term is the labor supply income derivative, for which there is a substantial body of empirical research.

The term $\frac{\partial h_{+i}}{\partial Y}$ is the income derivative of home production time. There are no research results on this,[11] 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

[11]Time use studies have studied the relationship between money income and time use. However, we require the relationship between time use and exogenous income, i.e. income that does not vary with labor market time.

assume that the elasticity of home production with respect to income is equal to the elasticity of labor supply with respect to income.

Labor supply responses to exogenous changes in income are usually described in terms of the "total income elasticity" (Pencavel, 1986). This is defined as $e_i = w_i \frac{\partial m_i}{\partial Y}$ 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.[12] 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

$$F_1^* - F_0^* \approx w_i(l_i^{**} - l_i^*)/\alpha_i(-e_i) \tag{6}$$

where

$$\alpha_i = \begin{cases} 1 \text{ or,} & \text{(zero home production income elasticity)} \\ (1 + \bar{h}_{+i}/\bar{m}_i) & \text{(home production elasticity equal to labor supply elasticity)} \end{cases}$$

where $\bar{h}_{+i}$ and $\bar{m}_i$ are the mean hours of home production and labor market time for parent i in the no-child household respectively.

The cost of children for the parent is thus his or her (net) wage rate times the drop in their leisure hours associated with having children, divided by a scaling of the total income elasticity of labor supply. The first part of this estimate is simply the opportunity cost of lost leisure, valued at the market wage rate. Dividing by the total income elasticity (the absolute value of which is smaller than 1), increases this cost estimate. This scaling up will be greater when the income elasticity is closer to zero (the curves in Figure 1 will be flatter).

This scaling up is appropriate 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_M and x_F) as well as home production for the consumption of the adults (h_{M+} and h_{F+}). The model implies 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 (leisure and personal time) that we can easily observe.

2.3. *Household Public Goods*

How do these conclusions change if we take account of household public goods? Many aspects of household consumption include goods whose consumption can at least be partly shared between the members. These might include the dwelling's location, the common areas of the dwelling, household appliances and aspects of home production that jointly produce goods for multiple household members.[13]

[12]Despite the terminology, e is not an elasticity, but it is conveniently unit-less. It is equal to the uncompensated labor supply elasticity minus the income-compensated labor supply elasticity.

[13]For simplicity, the model used here includes only non-public and pure public goods. Goods which have some degree of joint consumption can be considered as comprising part of each. The characteristics of semi-public household goods are considered in Lau (1985) and Bradbury (1997).

These "household goods" have both income and substitution effects. As household size increases the same quantity of a pure household good can provide services to more members—increasing total household consumption. This higher effective income will be reflected in increased consumption of all (normal) goods, and so will be incorporated into the estimates of child costs calculated using the method described above. However, the joint consumption also means that the household public good is relatively cheaper, which might lead to a substitution toward that good. This is not accounted for in the adult good model (Nelson, 1992).

To see this, note that the calculations described above provide information on the compensating income required to maintain $U_i(x_i,l_i,h_{iM},h_{iF})$ constant as household composition changes. This is the sub-component of personal welfare due to personally ascribable consumption of market goods, leisure and home production time. If the household-level consumption of the public good G remains constant as the household size changes and this income compensation is applied, then $V_i(U_i(.),G)$ will also remain constant (even though total person-level consumption of G has increased because there are more household members, each of whom consume G). Hence the income compensation described above will also be sufficient to compensate individuals under the broader measure of welfare which takes public goods into account.

However, the substitution effect means that household-level consumption of G will probably increase as household size increases.[14] For example, larger households might tend to spend their money on DVD hire rather than on movie tickets. Similarly, they might choose to do more home cooking because of the economies of scale of cooking for several people.[15] If G does increase, then a compensating income increase that maintains U_i constant will imply an increase in $V_i(U_i(.),G)$. That is, the cost of children will be over-estimated.

2.4. *Exogenous Factors Influencing Child Costs*

Within the structure provided by this simple model, how would we expect the costs of children to vary with factors such as parental gender and wage rates, and the ages of the children?

Wages: The wage rate enters equation (6) explicitly: children cost more when parents have a higher wage rate (other things constant). However, child costs as a proportion of the money income of the respective parent could vary in either direction. For example, if all of the parent's income is from wages then the cost of children as a proportion of their personal money income is given by

$$\frac{F_1^* - F_0^*}{w_i m_i} \approx ((l_i^{**} - l_i^*)/m_i)/\alpha_i(-e_i) \tag{7}$$

[14]If G is separable as outlined above, this will always be the case. For a more general model, where (some component of) G is a complement to some other goods, this might not happen.

[15]They might also eat at home more frequently because their income has not increased enough in order to afford eat-out meals for all members. This separate income effect *is* included in the basic model.

That is, the change in leisure hours as a proportion of market work hours, divided by the scaled total income elasticity. We cannot predict, a priori, how this will vary with the wage rate.

Gender: Here there are may be offsetting effects. Men generally have higher wages, but at least for young children, the loss of leisure time may be greater for women. Moreover, we would also expect the income elasticity (and possibly the home production elasticity) to vary according to within-household bargaining patterns. The greater the husband's marginal bargaining power, then the more he will reduce his labor supply in response to a positive income shock. This will imply a smaller child cost.

In the literature discussed below, there does not seem to be any strong evidence for different income elasticities between husbands and wives (or men and women more generally). However, these results cannot be considered robust. Given this, plus the lack of evidence on home production elasticities, we should not use the empirical results presented below to draw conclusions about the distribution of the child cost burden between spouses.

Age of child: Older children require less caring time inputs, 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 labor 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.

3. Some Illustrative Estimates of the Full Cost of Children

3.1. *Estimates of the Total-Income Elasticity of Labor Supply*

A number of studies have surveyed the estimates of the total-income elasticity e arising from the labor supply literature. Pencavel (1986) surveys the U.S. and U.K. non-experimental labor supply literature. Across the 15 studies that he summarizes the median estimate of e for men is –0.29.[16] However, the range of estimates is broad. Excluding the two 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.[17] 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 wide.

In most of these studies, the primary question of interest is the magnitude of the wage elasticity of labor supply. Identification of the income effect is usually achieved via strong assumptions about the exogeneity of capital or spouse income.

[16]Calculated from his tables 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 labor 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.

[17]This is the median of the 82 estimates of the total-income elasticity presented in their table 2.26.

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 *et al.* (2001) who look at the changes in behavior associated with lottery winnings. Their preferred result for the total income elasticity is –0.11. They find little variation with sex and age (across the child-rearing years).

It is clear that there is no consensus value of e arising from the research literature. The exogeneity of lottery winnings makes the results of Imbens *et al.* particularly appealing. Consequently, I take –0.1 as my preferred value for e, and assume the same value for men and women. 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. Finally, it should be noted that the required estimate here is the response of individual wage income to shocks in household income. This appears to be the structure adopted by Imbens *et al.*, but might not be appropriate for many of the studies in the labor supply literature, particularly where the studies identify the income effect by using variation in spouse's income.

3.2. *Estimates of the Full Cost of Children*

The estimates presented here are based on these labor supply results, together with the time-use patterns estimated by Craig and Bittman (2003). 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 (serving as an, albeit imperfect, proxy for the full income of the household). 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.

The sample size for these calculations is not very large, and so some of the patterns shown here are likely to be due to sampling variation. Nonetheless there are some interesting (and plausible) 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 either one or two children, and again lower for the three-child household. With older children (up to age 11, Craig and Bittman do not consider greater ages), the time cost is lower for the first child, then increases more steadily with increasing numbers of children.

The second and third panels of the table show how this leisure time cost accrues to the mother and father respectively. For the youngest children, more of the time cost falls on mothers, while for the oldest age group the adjustment is more equally shared. Craig and Bittman show that most of the leisure time reduction of the mother is associated with increases in home production (including

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*, Confidentialized Unit Record File. Estimates provided by Craig and Bittman, based on those in Craig and Bittman (2003) 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. Only primary activities are considered. The regression is estimated for couple-headed households where the head is aged 25–54, and there are either no children, or children aged under 12 only. The corresponding estimates in Craig and Bittman (2003, figure 4) also control for household income.

childcare) time, whereas the father's leisure reduction is mainly associated with increases in labor market participation.

The data in this table represents $l_i^{**} - l_i^{*}$ in equation (6). This can be combined with the estimate of e given above and estimates of the average net marginal wage rate ($12.00 and $10.30/hour for men and women respectively)[18] to obtain estimates of the cost of children as they accrue to mothers and fathers. These are shown in Table 2, for families with two children only.

As noted above, these costs for the mother and father should not be added together in order to estimate household total costs. Rather each estimate is the household cost as evaluated from the perspective of the relevant parent. That is, it represents the amount by which household income would have to increase in order to give that parent the same leisure consumption as they had when they did not have the children.

[18]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 percent, implying net marginal wage rates of $12.00 and $10.30 per hour for men and women respectively.

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 Labor
	Mother		
0–2	–15.8	$1,627	$1,017
3–4	–11.6	$1,196	$748
5–11	–6.1	$625	$391
	Father		
0–2	–9.9	$1,190	$744
3–4	–7.1	$856	$535
5–11	–7.7	$919	$574

Notes: Calculated using expression (6) using wage rates of $10.30 and $12.00/hour for mother and father respectively. The parameter α is calculated using the 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.

The conclusion that the burden of child cost shifts from the mother to the father as children age and become less time- and more money-intensive is plausible. However, we should certainly not place too much weight on the overall distribution between mothers and fathers. First, as noted above, the assumptions of equal e and α for men and women are strong ones, and should not be considered robust.

Second, the time use patterns shown in Table 1 are based upon primary time-use patterns only. In the Australian time use data, much time that 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. In Craig and Bittman (2008) a narrower definition of leisure is used in which this time is coded as non-leisure. This shows a much larger impact of children on parental leisure time (non-work time), and this impact is always greater for mothers.

When considering the magnitude of these costs, it is more meaningful to compare them with the money income level of the average household. Table 3 shows the average of the mother and father costs, calculated as a fraction of the mean household income of childless couple households.

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 labor 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. The simple square root equivalence scale often used in income distribution analysis implies that a two-child family requires a money

TABLE 3

FULL COST OF CHILDREN RELATIVE TO AVERAGE DISPOSABLE INCOME OF COUPLE-ONLY HOUSEHOLD, AUSTRALIA 1997

Number of Children	Age of Youngest Child		
	0–2	3–4	5–11
Home Production Elasticity = 0			
1	0.8	1.4	0.5
2	1.7	1.2	0.9
3+	1.1	0.9	0.9
Home Production Elasticity = Market Labor Elasticity			
1	0.5	0.9	0.3
2	1.1	0.8	0.6
3+	0.7	0.6	0.6

Notes: The average of mother and father costs, expressed as a fraction of the mean weekly disposable income of couple-only households aged under 55 ($837). Costs calculated as for Table 2. Mean income calculated from ABS Income Distribution Survey 1997–98 confidentialized unit record file.

income 1.4 times that of a couple without children. In other words, the additional cost of two children is 0.4 times the income of the childless couple. 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 1.1 or 1.7. The lower bound is still above the per-capita scale and even if we were to double the income elasticity (halving the estimate), would still be well above the square-root scale.

However, these high costs are 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 at least some economies of household scale). When time costs are included, it is plausible 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. Caring time requirements decrease with child age, but income requirements might increase. In this model, the latter should be reflected in reduced leisure via increases in labor supply. Generally, Craig and Bittman find that leisure increases with child age, implying a decrease in overall costs (the exception, which might not be statistically significant, is the low costs of the youngest children in the largest households).

4. THE LIMITATIONS OF THE ADULT LEISURE METHOD

Should we believe the results from such a simple model of child costs? Would a more sophisticated approach lead to different conclusions? The most salient limitations of the adult leisure method can be grouped into three categories: econometric; the model of household consumption; and the model of lifecycle preferences.

4.1. *Econometric Challenges*

To estimate the relationship shown Figure 1, this paper has combined estimates of the relationship between family composition and adult leisure (holding full income constant) and the slope of the leisure demand curve with respect to full income (with wage rates constant). Though the estimation of both relationships is quite demanding of data, the latter is particularly so.

The slope of the leisure demand curve can be decomposed into the labor supply total income elasticity and the corresponding home production derivative. Despite the fact that the former is a central concept of labor economics, there is little consensus as to its magnitude. There is even less information about the relationship between home production and exogenous changes in income. At best, the estimates presented here can only be considered as indicating very broad estimates of likely magnitudes.

A more basic empirical question concerns the measurement of adult leisure and personal time. In time-use collections, respondents are often asked to describe both their primary and secondary activities during a period of time. The results shown here are based on primary activities only. However, many parents (particularly mothers) often code their primary time as leisure or personal care, while noting that they were also supervising children. It is not obvious how this should be counted. On the one hand parents do describe this as primarily leisure or personal care, so it should perhaps be treated as equivalent to this leisure among non-parents. On the other hand child supervision might change the leisure in a qualitative way.[19]

If we were to code these combined activity periods as non-leisure, then the drop in leisure associated with children would be greater than that shown here, and the costs correspondingly higher. This approach is taken in Craig and Bittman (2008) where the time impacts (and hence the costs) are in some cases double those shown here.

4.2. *The Model of Household Consumption*

How might these conclusions change if we were able to estimate a more sophisticated model of home production and household consumption?

As noted above, though the adult leisure good method is valid in the presence of a fixed level of household public good consumption, we might expect larger households to spend more of their income or time on household public goods. A model which included such substitution would most likely lead to a lower cost of children than given by the adult good method.

Another substitution effect can arise via 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 model outlined above does not incorporate such price effects. If they were

[19]Ideally, the preference model should incorporate some degree of substitutability between these two types of leisure.

included, some of the observed reduction in adult leisure would be ascribed to this substitution, rather than an income effect, and the estimated cost of children would be lower.

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. For example, if an increased price of cinema attendance simply means that the adult(s) watch more videos at home, then total adult leisure time might not change (or might even increase).

These substitution effects could, with some difficultly, be incorporated into a more comprehensive model of home production and consumption. However, a more fundamental problem arises if we wish to consider joint production of leisure and childcare. It is conceivable that time spent on some aspects of childcare might be effectively producing leisure at the same time. Supervising children's activities might both count as childcare service to the child, and be an activity very close to leisure for the adult. At the empirical level, this amounts to making a decision as to how to code this activity. Above we discussed the case where time coded as leisure has childcare as a secondary activity, and should possibly be not considered leisure. The opposite might also occur. Time coded as childcare might actually have some element of leisure.

In principle, this could be modeled by a joint production process that takes account of this close substitution between childcare and leisure. However, the separable structure of (1) rules out such joint consumption—adult and child welfare are encompassed in separate sub-welfare functions. It is not clear whether one can retain a sensible concept of child cost without such a separation.

4.3. *The Lifecycle Preference Model*

Despite all these limitations, the conclusion that the full cost of raising young children in particular is very large does not seem implausible. The most fundamental assumption driving this conclusion is that adults maintain the same preferences for their own consumption whether they do or do not have children, and that the real value of this consumption can be used as a welfare index. Is this "situation comparison" a sensible comparison?

Here, it has been assumed that this comparison is made as 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 welfare function. If the period welfare functions enter the lifetime welfare function symmetrically, then the situation comparison is sensible. We can use methods such as 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 content 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—which some might reject as reflecting particularly

[20]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.

myopic preferences. However, other reasons are harder to reject. For example, parents' health and vitality generally diminish 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. Though a lifecycle approach appears to be a useful response to the revealed preference critique of child costs, it does raise many questions which are difficult to resolve. These problems are not specific to the adult leisure good approach to child costs, but indeed are relevant to any method of estimating the cost of children (full or otherwise).

5. Conclusion

Parents 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 combination of the time and the expenditure costs of children. The expenditure costs enter via the pressures they place on parental labor supply. Changes in parental leisure and personal time can thus be used as an indicator of the full costs of children, including both time and expenditure costs.

Illustrative estimates calculated here, based on the time-use results of Craig and Bittman (2003), suggest that the full costs of raising children are large indeed, even if we use a broad definition of leisure based on primary time use activities only.[21] The model used here is very simple and for both theoretical and econometric reasons we should not place too much weight on these particular estimates. However, the most important assumptions of this simple model, particularly the assumptions of separability within the parental welfare function, are bound to reappear in any feasible model of the cost of children.

Nonetheless, this simple model does shed useful light on policy-relevant questions about the burden of child-rearing costs across the lifecycle. In particular, if we are prepared to assume that income elasticities are constant, then the change in adult leisure across the lifecycle can be used to test whether the time costs of younger children are outweighed by the expenditure costs of older children. The illustrative results presented here suggest that children aged 5–11 generally cost less than younger children. This has implications for policies that might seek to help parents spread their childrearing costs across the lifecycle.

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[21]The narrower definition of leisure (excluding leisure time where children were also being supervised) used in Craig and Bittman (2008) yields even greater estimates of child time impacts and hence costs.

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