

Optimal Tax Treatment of Families with Children

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Abstract

Over the past 15 years, the real value of child tax benefits approximately doubled and were valued at \$140 billion in 2006, or about \$1,900 per child. This paper is focused on the efficiency implications of child tax benefits using a representative agent model where the agent decides how much time to spend working and how many children to have. The implications depend on several key parameters of the model: the responsiveness of labor supply to the income tax rate, the responsiveness of fertility to the child subsidy level, and the cross-price substitution effect between leisure and children. Because this cross-price substitution effect has not been established in the applied literature, this paper uses data from the National Longitudinal Survey of Youth (NLSY) to estimate the parameter. Using the resulting parameter estimates, this paper computes the efficiency cost of child subsidies and show that in a world with no equity considerations (no welfare gains from redistribution) that a tax on children rather than a child subsidy would be optimal. This implies that the full cost of providing child tax benefits is larger than the reported tax expenditure. Distributional considerations are briefly considered in a model with heterogeneous agents. Numerical approximations of the optimal nonlinear income tax are calculated for to show how the optimal child tax benefits depend on certain characteristics of the utility specification and social welfare function.

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1 Introduction

Families with children receive preferential treatment in the U.S. federal income tax. The budgetary cost of these child tax benefits is about \$140 billion in 2006, or about \$1,900 per child.¹ This is larger than the tax expenditure from the deductibility of mortgage interest for owner-occupied homes, larger than the tax expenditure from the deductibility of state and local taxes (including property taxes), and even larger than the tax expenditure from the exclusion of employer contributions to medical insurance premiums. The \$300 per child subsidy in the 2008 tax rebate stimulus package will increase the budgetary cost of child tax benefits by about \$20 billion. As shown in Table 1, the real value of child tax benefits approximately doubled over the past decade and a half due to the expansion of existing tax provisions and the creation of new provisions.

Table 1: Estimated Budgetary Cost of Child Tax Benefits
(billions of dollars)

	1992	1996	1999	2004	2006
Dependent Exemption	24.1	30.7	35.8	36.4	35.9
Earned Income Credit	13.0	28.2	31.3	38.0	40.2
Child Tax Credit	–	–	19.9	31.2*	56.2
Child Care Expenses	3.4	3.4	3.1	3.6	3.9
Head of Household Status	3.0	3.5	3.7	3.9	4.1
TOTAL	43.5	65.8	93.8	113.1	140.3
Number of Children (millions)	66.5	70.2	71.9	73.3	73.7
Expenditure per Child	\$654	\$937	\$1,305	\$1,543	\$1,904
Real Expenditure per Child	\$940	\$1,204	\$1,579	\$1,647	\$1,904

* does not include the early child tax credit payments made in 2003

Sources: OMB analytical perspectives tables 5-1 and 19-1 various years, IRS statistics of income publications 1304, U.S. Census Bureau Table CH-1 (2007) Living Arrangements of Children Under 18 Years Old, and author's calculations.

The \$140 billion annual cost of child tax benefits is a direct measure of the value of tax revenue not received and payment made to families with children due to child tax benefit provisions. However, a measure of the true cost of providing child tax benefits should also incorporate economic efficiency considerations. Understanding the efficiency implications of child tax benefits (child sub-

¹The budgetary cost of child tax benefits is the government expenditure on refundable child tax benefits combined with the tax expenditure of child tax benefits. The tax expenditure for a tax policy is a measure of the loss of government revenue due to the policy.

sidies) is the focus of this paper. They are derived using a representative agent model where the agent decides how much time to spend working and how many children to have. The assumption is that parents, to a large extent, determine the number of children in their family. Therefore, government subsidization of children may distort fertility choices. I derive the efficiency cost of child subsidies in the model and illustrate how the various parameters influence the cost.

The three key parameters of the model are the responsiveness of labor supply to the income tax rate, the responsiveness of fertility to the child subsidy level, and the cross-price substitution effect between leisure and children. The cross-price substitution effect between leisure and children has not been established in the applied literature. Thus, I use data from the National Longitudinal Survey of Youth (NLSY) to estimate these parameters of the model. Using the estimates, I compute the efficiency cost of child subsidies and show that in a world with no equity considerations (no welfare gains from redistribution), a tax on children rather than a child subsidy would be optimal.

This result does not say that provisions of the U.S. tax code that provide child tax benefits should be eliminated. To make a claim of this sort would require specification of social welfare over heterogeneous agents and an assumption about the social value of children, including those unborn that would have been born under alternative tax policies. Rather than a full benefit analysis, this paper simply examines the cost of providing child tax benefits and shows that when one considers the distortions associated with child subsidies, the cost is estimated to be even larger than the reported tax expenditure or budgetary cost. However, I briefly consider a model with heterogeneous agents and use numerical approximations of the optimal nonlinear income tax to show how the optimal child tax benefits would depend on certain characteristics of the utility specification and social welfare function.

2 Representative Agent Model

Consider a simple representative agent model where the agent chooses how much time to spend working and the number of children to have. Social welfare in this model is represented by the following utility function

$$U(C, L, N) \tag{1}$$

where L is leisure (time endowment less market work time), N is the number of children, and C is the consumption of other goods. In this specification of the model, raising children does not require time, only money. Or alternatively, time spent raising children is considered leisure time by the parents. By assumption, each argument of the utility function is a good, meaning that children are a net source of enjoyment to their parents. The government has the ability to impose a linear income tax and can either subsidize or tax children, but must raise revenue R . There are no lump-sum taxes or subsidies and consumption is untaxed.²

In this model it is possible to derive conditions under which it is optimal to subsidize, rather than tax, the presence of children in a family. The optimal tax policy is the policy that is most efficient at raising the required government revenue. As will be shown, the optimal tax treatment of children in this simple model primarily depends on the cross-price substitution effect between leisure and children.

The efficiency cost of a tax policy is measured by its excess burden, that is, the loss of utility greater than would have occurred had the tax revenue been collected as a lump sum (Rosen, 1978).³ In other words, the excess burden of a tax policy is the loss in social welfare due to the distortion in relative prices only and not that which is due to the tax-induced loss of income. Exact measures of excess burden are defined by Diamond and McFadden (1974) and Auerbach and Rosen (1980). However, in general, it is necessary to have an explicitly-specified utility function in order to calculate the exact excess burden. Rather than assume a particular utility function, we will use the well-known approximation developed by Hotelling (1938), Hicks (1939), and Harberger (1964):

$$EB = -\frac{1}{2} \sum_{i=1}^N \sum_{j=1}^N t_i t_j S_{ij} \quad (2)$$

where t_i is the tax rate on good i and S_{ij} is the substitution effect for good i given an increase in the price of good j .

Corlett and Hague (1954) were the first to examine the excess burden of a tax policy in the

²The price of consumption is the numeraire. This model with a linear income tax is equivalent to a model with a consumption tax and no income tax. One can either think of an income tax that decreases the price of leisure relative to the price of consumption, or a consumption tax that increases the price of consumption relative to the price of leisure. The tax or subsidy of children is simply disproportionate taxation of children relative to consumption goods.

³Auerbach (1985) provides a comprehensive mathematical and graphical descriptions of the excess burden and its relation to optimal tax theory.

3-good representative agent model. Their basic framework has been used many times over the past 50 years as a tool to understand the efficiency cost of a tax policy. One particularly important application, which examine a question that is quite similar to the one considered in this paper, is Boskin and Sheshinski (1983). Their application was the optimal tax treatment of the labor supply for married couples where the three goods are consumption, the leisure of the husband, and the leisure of the wife. Here, I follow the Boskin and Sheshinski terminology in that the optimal tax policy is the one that minimizes the Hotelling-Hicks-Harberger approximation of excess burden while still raising revenue R .

Assuming that the prices of all goods are constant in the relevant range and that there are no distortions in the economy (other than those caused by taxation), the excess burden of a tax policy is approximated by the following expression:

$$EB = -\frac{1}{2} (\Delta P_C \Delta C^c + \Delta P_L \Delta L^c + \Delta P_N \Delta N^c) \quad (3)$$

where P_C , P_L , and P_N are the prices and C^c , L^c , N^c are the compensated demands. The excess burden is simply the sum of the three compensated deadweight loss triangles for consumption, leisure, and children. By assumption the only price distortions in the economy are those caused by the tax policy.⁴ Consumption is untaxed (see footnote 2), thus the change in the price of consumption is always zero. This enables us to drop the first of the three compensated deadweight loss triangles in the expression. The remaining compensated demands for leisure and children are both potentially affected by changes in either price:

$$EB = -\frac{1}{2} \left[\Delta P_L \left(\frac{\partial L^c}{\partial P_L} \Delta P_L + \frac{\partial L^c}{\partial P_N} \Delta P_N \right) + \Delta P_N \left(\frac{\partial N^c}{\partial P_N} \Delta P_N + \frac{\partial N^c}{\partial P_L} \Delta P_L \right) \right]. \quad (4)$$

If the compensated demand curves are highly linear, equation (4) will be a close approximation of the true excess burden of the tax policy.⁵ Once again using the assumption that the only distortions in the economy are those caused by the tax policy, the price change for leisure is given

⁴All goods are produced under constant returns by competitive firms employing labor as the only input, so there are no profits.

⁵Green and Sheshinski (1979) show when this method provides an accurate approximation (even for large tax changes) and derive an approximation built from a higher order Taylor series expansion.

by $\Delta P_L = (1 - \tau)P_L - P_L = -\tau P_L$, where τ is the income tax rate. Similarly for children, $\Delta P_N = (1 + \theta)P_N - P_N = \theta P_N$, where θ defines the tax treatment of children. A positive value of θ is a tax on children whereas a negative value of θ is a child subsidy.

While it is natural to think of the price of leisure as the after-tax wage, it is less clear what is meant by the price of children. We will take P_N to represent the level of expenditure necessary to raise a child. By assumption, the agent cannot chose to spend less than P_N for each child and any child-related expenditure above the necessary level will be considered consumption.⁶

The agent has an endowment of time, T , that can be taken as leisure L , or market work, H . The assumption that $T - H = L$ is less restrictive than it first appears because T can be defined to exclude time required for household and personal maintenance including sleep. However, we are assuming that T is given exogenously and does not depend on the number of children. This must be taken to mean that the agent considers time spent raising children as leisure because it is unlikely that the amount of time spent raising children does not increase with the number of children.

Returning to the approximation of excess burden, the symmetry of the Slutsky matrix allows (4) to be rewritten as:

$$EB = -\frac{1}{2} \left((-\tau P_L)^2 S_{LL} + (\theta P_N)^2 S_{NN} + 2 S_{LN} (-\tau P_L) (\theta P_N) \right) \quad (5)$$

where S represents the substitution effect. For example, S_{XY} is the change in the compensated demand for good X due to a one unit change in the price of good Y . For analytical convenience, we will scale the units of each good so that prices are unity. This means that consumption, leisure, and children are all expressed in dollar terms. For example, two children implies a value for N of $2P_N$. This normalization allows us to express the agent's "full income" budget constraint as:

$$T(1 - \tau) = C + L(1 - \tau) + N(1 + \theta). \quad (6)$$

The optimal tax policy is the one that minimizes the excess burden of the tax policy subject to

⁶This assumption can be relaxed by adding a fourth good, child quality, to the model. The main result of this paper (Result 2.1) still holds if the number of children and the quality of children (additional expenditure on children) are substitutes and leisure time and expenditure on children are also substitutes.

raising government revenue R :

$$\min_{\tau, \theta} \left\{ -\frac{1}{2} [\tau^2 S_{LL} + \theta^2 S_{NN} - 2\tau\theta S_{LN}] - \lambda [\tau H + \theta N - R] \right\}. \quad (7)$$

The first order conditions with respect to τ and θ can be solved to yield:

$$\tau = \frac{-\lambda(S_{NN}H + S_{LN}N)}{S_{NN}S_{LL} - (S_{LN})^2} \quad (8)$$

$$\theta = \frac{-\lambda(S_{LL}N + S_{LN}H)}{S_{NN}S_{LL} - (S_{LN})^2} \quad (9)$$

where λ is the multiplier on the government budget constraint. The denominator for either expression is non-negative because it is the determinant of a second-order principal minor of the Slutsky matrix which is negative semidefinite. The multiplier λ is positive because the excess burden of a tax policy increases in the revenue requirement, R .⁷ Determining whether it is optimal to subsidize or tax the presence of children in a family is then reduced to signing the following expression:

$$S_{LL}N + S_{LN}H. \quad (10)$$

A child subsidy is optimal if and only if $S_{LL}N + S_{LN}H > 0$. Both N and H are constrained to be non-negative and S_{LL} is non-positive by definition, so it is the value of S_{LN} that is key in determining if a child subsidy is optimal. Thus, a necessary condition for the optimal tax policy to include child subsidies is that children and leisure be substitutes.

Result 2.1. *If leisure and children are complements ($S_{LN} < 0$) then it is not optimal to subsidize children.*

An intuitive explanation for this result comes from considering how the compensated demand for each good is affected by the tax policy. By totally differentiating the first order conditions from

⁷The optimal tax policy as a function of the required government revenue, R , is given by the following:

$$\tau = \frac{R(S_{LN}N + S_{NN}H)}{S_{NN}H^2 + 2S_{LN}HN + S_{LL}N^2} \quad \theta = \frac{R(S_{LL}N + S_{LN}H)}{S_{NN}H^2 + 2S_{LN}HN + S_{LL}N^2}.$$

These expressions are used later in the chapter as part of a back of the envelope calculation of the optimal tax treatment of children.

the optimal tax problem, we can derive how the agent's demand for leisure and children are affected by τ and θ :

$$\begin{aligned}\frac{\partial L}{\partial \tau} &= -S_{LL} - Hi_L & \frac{\partial L}{\partial \theta} &= S_{LN} - Ni_L \\ \frac{\partial N}{\partial \tau} &= -S_{LN} - Hi_N & \frac{\partial N}{\partial \theta} &= S_{NN} - Ni_N.\end{aligned}$$

The income effects, i_L and i_N , are not relevant in the excess burden measure because the same level of tax revenue, R , is raised under any policy considered. The sign of S_{LN} is crucial in signing the effect of the tax policy. If leisure and children are complements ($S_{LN} < 0$) then an increase in τ increases the compensated demand for both leisure and children whereas an increase in θ decreases the compensated demand for both leisure and children. The income tax distortions are reduced by imposing a tax on children ($\theta > 0$) because it pushes the compensated demands back in the opposite direction. A tax on children also raises revenue, enabling the government to raise R with a lower income tax rate.

If leisure and children are substitutes ($S_{LN} > 0$), an increase in τ increases the compensated demand for leisure but decreases the compensated demand for children. The income tax distortions are reduced by giving a child subsidy ($\theta < 0$). Providing child tax benefits is costly in that τ must be increased in order to finance the benefits, so only when leisure and children are strong substitutes (as defined below) is it optimal to provide child tax benefits.

Result 2.1 implies that $S_{LN} > 0$ is a necessary condition for the optimal tax policy to include a child subsidy. However, leisure and children as substitutes is not a sufficient condition for the optimality of a child subsidy unless the demand for children is zero under a lump sum tax of size R . Result 2.2 shows how strongly substitutable leisure and children must be for a child subsidy to be optimal.

Result 2.2. *If $S_{LN} > -S_{LL} \left(\frac{N}{H}\right)$ then it is optimal to subsidize children.*

From Result 2.2 we see that subsidizing children is more likely to be optimal if there is a low demand for children and a high supply of labor. In fact, if work effort, H , is zero then regardless

of the value of S_{LN} it is never optimal to subsidize children.⁸ The intuition for Result 2.2 is that the income tax distortion can be somewhat offset by a child tax subsidy if leisure and children are substitutes. Figure 1 shows this graphically by depicting how the optimal child tax treatment varies with the cross-price substitution effect for leisure and children.

It appears from Result 2.2 that if labor is very inelastically supplied (S_{LL} close to zero), this would make the optimal tax policy more likely to include a child subsidy instead of a tax. Note however that the properties of the Slutsky matrix put bounds on the relationship between S_{LN} and S_{LL} . We know that $S_{NN}S_{LL} > (S_{LN})^2$ which implies that inelastic labor supply is associated with a smaller absolute value of S_{LN} . A similar reasoning about the demand for children is expressed as Result 2.3.

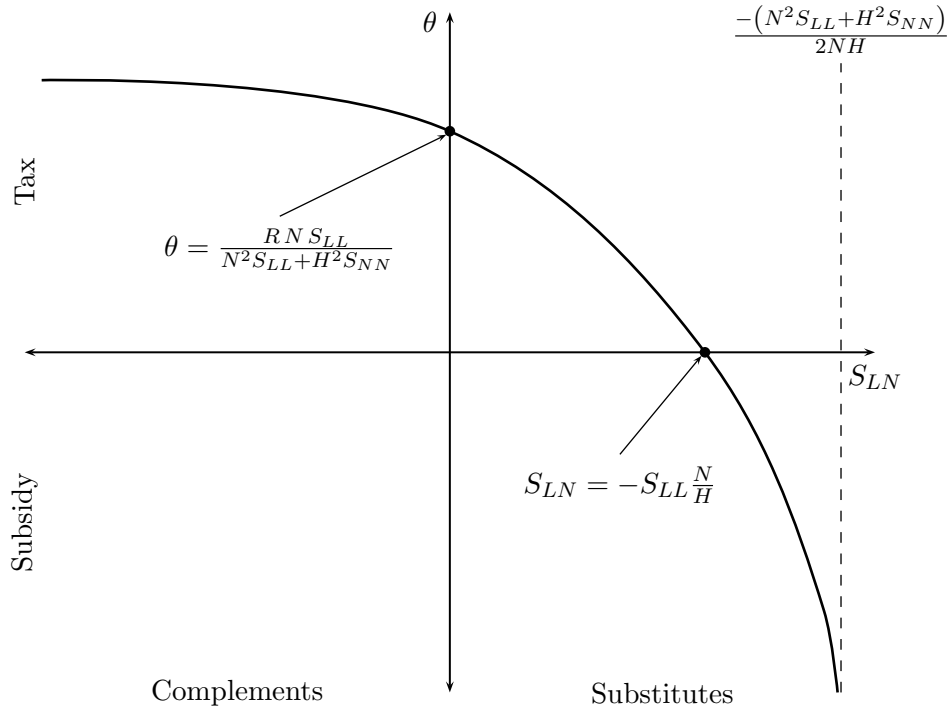
Result 2.3. *If $|S_{NN}| < \left| S_{LL} \left(\frac{N}{H} \right)^2 \right|$ then it is not optimal to subsidize children.*

There is no widely accepted estimate of the own-price substitution effect for children in the literature, but it does seem generally accepted that S_{NN} should be close to zero. Common experience leads us to believe that the demand for children is just not very price sensitive and empirical work by Baughman and Dickert-Conlin (2003) confirms this. Result 2.3 points out that if this is correct, the theoretically implied bound on S_{LN} may make it impossible for leisure and children to be strong substitutes (as defined in Result 2.2). In fact, if the compensated demand for children is completely inelastic ($S_{NN} = 0$), then the optimal tax policy is to tax children quite heavily. In this case, a child tax would have the ability to raise a large amount of revenue while causing no distortions.

While this simple model of labor supply and fertility choice abstracts from various characteristics of children, externalities associated with children, pre-existing taxes and subsidies, and differences across families, it provides a useful starting point to examine the efficiency cost of child tax benefits. In this model, the case for subsidizing children primarily depends on the cross-price substitution effect for leisure and children, a parameter that has received little attention in the empirical literature. The following section uses cross-sectional variation in the NLSY to estimate

⁸This does not imply that a particular tax unit with no earned income should receive no child subsidy. This result only applies in the representative agent model and so implies that if no one in the economy is working, it would not be optimal to subsidize children. Of course, with no earned income, the income tax would produce no revenue and children would have to be taxed in order to meet the revenue requirement.

Figure 1: Optimal Child Tax Treatment.



this cross-price substitution effect. The resulting estimate is then used in a numerical calculation of the optimal child subsidy.

3 Data and Estimation

The data for this exercise is a sample of women from the 1979 National Longitudinal Survey of Youth (NLSY). The NLSY contains detailed labor supply and fertility information for each respondent from 1979 to 2004. The sample is restricted to women who were 16 to 20 when first interviewed in 1979. This restriction enables labor supply and earnings histories to be constructed from age 19 until age 43. The number of children born to each woman by age 43 is also obtained.⁹ While it would be preferable to extend the age range, data availability limits this. Some women in the sample may have children after age 43 and we would ideally have this in the data; however, this would be only a small number of births. The U.S. National Center for Health Statistics reports that less than 1 percent of women have a child after age 40 and that only 0.05 percent of women

⁹For the youngest cohort, birth at age 42 is assumed if pregnancy is reported in 2004.

have a child after age 45 (Martin et al., 2005).

The women in the sample were interviewed annually from 1979 to 1994 and then biennially from 1996 to 2004. Missed interviews do not necessarily prevent the construction of a complete labor supply history because interviewers attempt to ask questions from the previous interviews if missed. However, multiple missed interviews, especially if consecutive, do prevent the creation of the labor supply history. Women for which it is not possible to construct a complete labor supply or fertility history are dropped from the sample.

The decision to use a sample of women rather than a sample of married couples is motivated by the fact that approximately one-third of all births in the United States are to unmarried women. This is not simply due to teenage mothers. While about 90 percent of teenage mothers are unmarried at the time they give birth, teenage mothers make up less than a quarter of the total number of births to unmarried women each year. Births to unmarried women age 20 or higher accounted for 26 percent of total births in 2003 (Martin et al., 2005).

Three relationship categories are defined: married, partnership, single. Nearly all of the women in the sample are single at age 19 and about 88 percent are married for some period of time between age 19 and 43. Only 8 percent never report being married or in a partnership. Some women move between relationship categories several times. A more complete model would allow the relationship status to be influenced by the woman's choices; however, in this exercise, the relationship history is taken as exogenous. Like the relationship status, the labor supply and earnings of husbands and partners is also taken as exogenous. This requires the addition of nonwage income to the model of Section 2. The agent's budget constraint becomes:

$$T(1 - \tau) + M(1 - \tau) = C + L(1 - \tau) + N(1 + \theta) \quad (11)$$

where M is male earnings and other nonwage income (including transfer payments). The government budget constraint is also adjusted to reflect this addition:

$$R = \tau H + \tau M + \theta N. \quad (12)$$

In the model, male and other income is subject to the linear income tax, but does not respond

to changes in tax treatment. This common assumption is often justified by the finding that the labor supply elasticity for men is very low; thus while changes in tax treatment have an influence on female labor supply, men are less responsive. For example, MaCurdy, Green, and Paarsch (1990) estimate that both the substitution and income effects for male labor supply are close to zero.¹⁰

The choice variables in the static representative agent model of Section 2 are the average labor supply of the woman (age 19 to 43) and the total number of children that she has. The average hours of market work over this period is not the answer to a particular survey question asking how many hours per week she works when employed. Rather, it is created from a series of more than a thousand questions asking how many hours she worked week by week over the previous period.¹¹

After removing observations that do not have complete birth, work, and earnings histories, the sample used in this analysis consists of 4,169 of the 6,283 women in the NLSY. All dollar amounts are inflation-adjusted to year 2000 dollars using the CPI-U before averaging. An implied wage is calculated as the real average annual earnings divided by the average annual hours. The summary statistics for this sample are given in Table 2.

The married, partner, and single variables measure the fraction of time from age 19 until 43 that the individual is either married, living with a partner, or single. The income of the husband or partner as well as any nonwage income, including welfare benefits, are combined into a single nonwage income variable. The “Moved” variable indicates whether the individual’s family moved to a different town while she was growing up. The summary statistics for variables indicating whether the individual lived with both biological parents until age 14 and whether either parent is an immigrant are also listed.

As indicated in the summary statistics, the real average hourly wage from age 19 to 43 is \$12.45. For those women with no reported hours of market work over the full time period, no wage calculation can be made. This is unfortunate because an observed wage rate is essential in estimating the cross-price substitution effect for leisure and children. Therefore, the 110 women with no observed hours of market work are dropped from the sample. The characteristics of the

¹⁰There is considerable evidence that investment and other non-wage income is quite responsive to the tax treatment, thus a worthwhile extension of the model that I have not attempted would be to explicitly model investment behavior.

¹¹This measure of the average hours of work does not distinguish between a part-time worker who is employed continuously from age 19 to 43 and a full-time worker who is employed for only half that time period.

Table 2: Summary Statistics

	Obs	Mean	Sd.Dev.	Min	Max
Weekly Hours	4169	26.43	11.71	0	65.67
Annual Earnings	4169	18,084.51	13,435.37	0	104,252.40
Nonwage Income	4169	27,867.33	19,347.70	131.47	123,649.40
Hourly Wage	4059	12.45	6.48	4.81	65.14
Children	4169	1.958	1.340	0	11
Married	4169	0.566	0.327	0	1
Partner	4169	0.071	0.137	0	1
Single	4169	0.363	0.306	0	1
White	4169	0.776	0.417	0	1
Hispanic	4169	0.062	0.242	0	1
Black	4169	0.144	0.351	0	1
Other Race	4169	0.017	0.131	0	1
Rural	4169	0.219	0.414	0	1
Moved	4169	0.570	0.495	0	1
Mother Education	4169	11.54	2.734	0	20
Lived w/ 2 parents	4169	0.618	0.486	0	1
Immigrant Parents	4169	0.086	0.281	0	1

The reported summary statistics are computed using sample weights.

full sample, those with positive hours of work, and those with no market work are shown in Table 3.

It is apparent from Table 3 that the women for whom it is not possible to calculate an average wage rate are quite different from the remaining sample. This is particularly true with respect to their family background and fertility choices. No effort is made to correct for the selected nature of the remaining sample. Therefore, estimates are interpreted as only applying to the 99 percent of women in the full sample with an observable wage.¹²

A common approach to estimating a substitution effect in a static model is to estimate a linear demand equation that includes a wage variable and a nonwage income variable. This is particularly common in the labor supply literature where an econometrician estimates a labor supply function of this form:

$$\text{Hours}_i = \alpha_0 + \alpha_1 \text{Wage}_i + \alpha_2 \text{Nonwage Income}_i + \alpha_3 X_i + \epsilon_i. \quad (13)$$

¹²Sample selection correction would require the specification of a participation equation, a wage equation, and an exclusion restriction. Because nearly 99 percent of the sample has an observable wage, the sample selection correction would not likely yield much additional insight, but would certainly add to the complexity.

Table 3: Sample Average by Hours of Work

	All	Hours > 0	Hours = 0
Observations	4,169	4,059	110
Sample Weight	1	0.985	0.015
Weekly Hours	26.43	26.83	0
Annual Earnings	18,084.51	18,362.11	0
Nonwage Income	27,867.33	28,001.11	19,152.40
Hourly Wage	12.45	12.45	-
Children	1.958	1.944	2.856
Married	0.566	0.569	0.366
Partner	0.071	0.070	0.123
Single	0.363	0.361	0.511
White	0.776	0.782	0.394
Hispanic	0.062	0.060	0.191
Black	0.144	0.140	0.382
Other Race	0.017	0.017	0.033
Rural	0.219	0.220	0.132
Moved	0.570	0.571	0.517
Mother Education	11.54	11.57	9.20
Both Parents (14)	0.616	0.618	0.439
Immigrant Parents	0.086	0.086	0.111

The reported summary statistics are computed using sample weights.

The vector X_i represents the predetermined characteristics of the individual that are observed by the econometrician and ϵ_i represents those unobserved characteristics that affect labor supply. A true labor supply function would depend not only on the wage, but also on the prices of all other goods. In practice, other prices are not frequently included in the regression equation, particularly when using cross-sectional data. The usual assumption used to justify this is that the prices for all other goods are not individual-specific. Among other things, this assumption implies that there are no geographical differences in other prices.

In the labor supply equation, α_1 is the change in labor supply due to a one dollar increase in the hourly wage. This total effect is comprised of an income effect and a substitution effect as given by the Slutsky equation:

$$\frac{\partial \text{Hours}}{\partial \text{Wage}} = \left(\frac{\partial \text{Hours}}{\partial \text{Wage}} \right)^c + \text{Hours} \frac{\partial \text{Hours}}{\partial \text{Income}}. \quad (14)$$

This same approach to estimating an own-price substitution effect for labor supply (or leisure demand) can be used to estimate the cross-price substitution effect for leisure and children. We specify a linear child demand function that depends on the wage, nonwage income, a vector of predetermined and observed characteristics, and an error term that represents those unobserved characteristics that affect child demand:

$$\text{Children}_i = \beta_0 + \beta_1 \text{Wage}_i + \beta_2 \text{Nonwage Income}_i + \beta_3 X_i + \eta_i. \quad (15)$$

Ideally, the “price” of children (cost of raising children) should also be included in this specification. The absence of this variable is cause for some concern because the demand of a good clearly depends on its own price. The high degree of uncertainty about the level of expenditure required to raise a child—and how this level changes with family size, family income, and other factors—severely complicates determining an individual-specific cost of raising a child. Similar to the argument for the exclusion of other prices in a labor supply equation, one could argue that there is little individual specific variation in the direct cost of raising a child. However, differences in child tax benefits by income level, family economies of scale, and geographical differences in the cost of food, housing, and health care suggest that this may not be the case. The direction of any bias in the estimates of β_1 and β_2 from this heterogeneity in the cost of raising children is not clear.

Thus, for this exercise, we make the assumption that there are no individual differences in the monetary cost of children. This does not rule out differences in the opportunity cost of raising children. Rather, the assumption is that each woman faces the same out-of-pocket expenditure necessary to raise a child. If it were possible to determine an individual specific P_{Ni} , this variable could be used in an alternative method for identifying the cross-price substitution effect for leisure and children: a regression of labor supply on P_{Ni} , the wage rate, and nonwage income.

For the identification of β_1 , there is a serious concern that the decision to have a child has a direct influence on the wage. For example, Miller (2006) shows that the timing of the first birth has a strong effect on a woman’s future wage growth. The child demand equation in this paper is in regards to the number of children, not the timing of children, thus the Miller (2006) result does not apply directly. A valid instrument for wage in the child demand equation is a predetermined

characteristic that affects the individual’s wage but not the demand for children or other factors that affect the demand for children. Several observed characteristics like the month and year of birth and measures of the reading habits of the individual’s parents satisfy the definition in this sample. However, instrumental variables estimation gives very similar estimates of β_1 as OLS and using a Hausman test of endogeneity, we fail to reject that the wage is exogenous.¹³ This is not conclusive evidence, however, the assumption that the wage is exogenous is maintained in the discussion that follows.

Using the estimates for β_1 and β_2 , the cross-price substitution effect for leisure and children are given by $(\beta_1 - \text{Hours} \beta_2)$ as indicated by the Slutsky decomposition:

$$\frac{\partial \text{Children}}{\partial \text{Wage}} = \left(\frac{\partial \text{Children}}{\partial \text{Wage}} \right)^c + \text{Hours} \frac{\partial \text{Children}}{\partial \text{Income}}. \quad (16)$$

In the representative agent model of Section 2, we normalize the units of all goods so that prices are unity. This same normalization is easily made to the total, income, and substitution effects by multiplying through by the appropriate prices:

$$S_{LN} = P_N \left(P_L \hat{\beta}_1 - H \hat{\beta}_2 \right). \quad (17)$$

Given this normalization, S_{LN} is the change in the compensated demand for children for a doubling of the wage. At the average wage in the sample, a 100 percent wage increase would place it at about the 95th wage percentile.

The estimation of equation (15) is given in Table 4. The region controls include indicators for the region of the country the individual was raised in, either the Northeast, South, Central, or West. The family controls provide information about the family during the woman’s growing-up years, whether it was a rural or urban area, if the family had access to a local library, and if the family ever moved. Also included is the number of siblings and indicators for oldest or youngest child,

¹³The two-stage least squares results are available from the author by request. In each regression, the estimate of β_1 was larger in magnitude (more negative, although not statistically different) using instrumental variables estimation than the corresponding OLS regression. If having an additional child (not the timing of the birth) had a direct effect on the wage, one would expect the instrumental variables estimation to produce estimates of β_1 that were smaller in magnitude.

immigrant parents, and if the woman grew up in a home with both biological parents.¹⁴ Religion controls are for the religion that the individual was raised in and also a measure of how often the family went to religious services.¹⁵ The religion categories (in order of size in the sample) are: Catholic, Baptist, Other Christian Religion, Methodist, Lutheran, Presbyterian, None, Pentecostal, Episcopalian, Jewish, and Non-Christian Religion.

Table 4: Linear Child Demand Estimation

	(1)	(2)	(3)	(4)	(5)
Wage	-0.0308 (0.0031)**	-0.0232 (0.0032)**	-0.0160 (0.0031)**	-0.0157 (0.0031)**	-0.0229 (0.0032)**
Nonwage Income (thousands)	0.0191 (0.0011)**	0.0206 (0.0011)**	0.0080 (0.0013)**	0.0078 (0.0013)**	0.0203 (0.0011)**
Hispanic	0.603 (0.086)**	0.316 (0.092)**	0.383 (0.089)**	0.374 (0.093)**	0.309 (0.096)**
Black	0.499 (0.061)**	0.331 (0.062)**	0.615 (0.062)**	0.575 (0.065)**	0.281 (0.065)**
Other race	-0.029 (0.154)	-0.229 (0.152)	-0.059 (0.147)	-0.020 (0.156)	-0.182 (0.161)
Married			1.372 (0.080)**	1.372 (0.080)**	
Partner			0.571 (0.153)**	0.593 (0.153)**	
Constant	1.701 (0.072)**	1.996 (0.133)**	1.156 (0.084)**	1.208 (0.165)**	1.918 (0.162)**
Region controls	yes	yes	yes	yes	yes
Family controls	no	yes	yes	yes	yes
Religion controls	no	no	no	yes	yes
Observations	4059	4059	4059	4059	4059
R-squared	0.1005	0.1422	0.2020	0.2063	0.1473
Total Effect	-0.383	-0.289	-0.199	-0.195	-0.285
Income Effect	0.351	0.378	0.147	0.143	0.373
Substitution Effect	-0.734	-0.667	-0.346	-0.339	-0.658

* significant at 5% ** significant at 1%. The reported values are computed using sample weights. Standard errors in parentheses.

Region controls include: northeast, central, and south. Family controls include: number of siblings, youngest child indicator, oldest child indicator, biological parents (14), immigrant parents, mother's education level, rural, moved, and a library indicator. Religion controls include: Catholic, Baptist, Methodist, Lutheran, Presbyterian, Pentecostal, Episcopalian, Jewish, Other Christian Religion, Non-Christian Religion, and a measure of frequency of attendance.

¹⁴Youngest child is an indicator that the individual has at least one sibling and was the youngest child in her family; oldest child indicates that the individual has at least one sibling and was the oldest child in her family.

¹⁵Included in these variables are indicator for being raised in a family that went to religious services twice a month or more and an indicator of having converted to a religion other than the religion raised in.

There are several issues to consider in this type of estimation. Concern is often expressed about the measurement of nonwage income. The NLSY income variables are top-coded which puts a downward bias on both the average wage and the average nonwage income for an individual. The cutoff at which top-coding occurs and the procedure have changed over the 25 years of the survey. However, the number of individuals affected by top-coding is small. A second concern is that the procedure for calculating nonwage income is to subtract female earnings from total family income. This means that transfer payments that may not be independent of female earnings are included in the measure of nonwage. However, transfer payments are generally non-taxable and thus treating them as nonwage income is more appropriate. A third issue is the problem of nonresponse to income questions. Nearly all respondents in the NLSY report their own income and their spouse's income, however, approximately 30 percent of respondents living with a partner in a given year do not report their partner's income.¹⁶ Even if the individual keeps her finances completely separate from her partner's, living together suggests that they probably share some common expenses like rent or house payments. Quite often, a woman who refuses to answer the partner's income question will answer the question in the next year and since the average woman in the sample spends only about 7 percent of her time in a partnership, the nonresponse bias is likely small. A regression of the percentage of the time living with a partner on other factors including wage, race, region, and religion reveals very little correlation between time living with a partner and any other characteristics.¹⁷

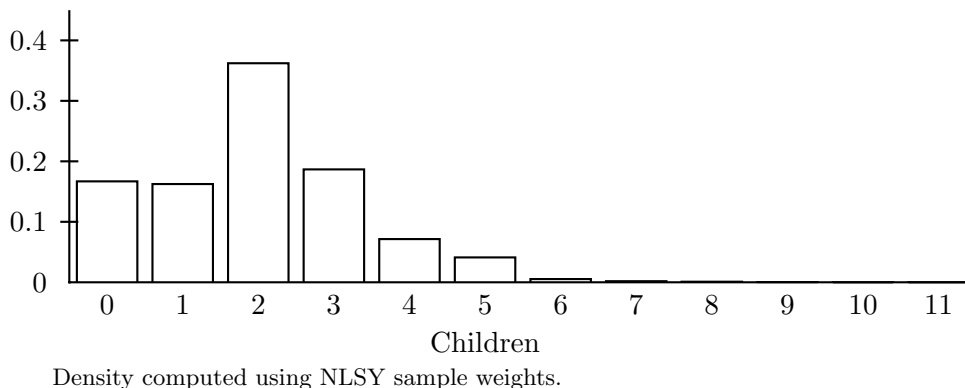
The assumption of a linear child demand function implies a specific form of the utility function.¹⁸ An alternate functional form assumption for the direct utility could yield different estimates for the substitution effects. Using OLS to estimate the child demand function may also be inappropriate because of the nature of the dependent variable. For example, it is not possible for a woman to have a negative number of children. As Figure 2 shows, there is more bunching at zero than would

¹⁶In the NLSY, partner income is not included in the constructed total family income variable. For this study, partner income was added to the constructed family income variable and then the respondent's earnings were subtracted to give nonwage income. Note that from 1979-1994 the partner income variables are separate from spouse income variables, but after 1994, these variables are combined.

¹⁷This regression shows that women who live in the west and those who have lower wage rates spend more time living with a partner. None of the religion variables were significantly different than zero. The R-squared from the regression was 0.021, implying that the variables used in this analysis are not strongly correlated with time spent living with a partner.

¹⁸See Pencavel (1986) for a discussion of the direct and indirect utility functions implied by linear demand equations.

Figure 2: Number of Children Histogram



be expected if children were distributed normally. While this suggests the possibility of censoring at zero (because individuals cannot have a negative number of children), the more serious issue is that the dependent variable that is not even approximately continuous and thus the normally distributed error term is probably not reasonable. The dependent variable in this exercise takes on only 12 different values, the natural numbers from 0 to 11. A discrete distribution, such as the Poisson is commonly used for this type of count data.

The Poisson distribution is determined by a single parameter, μ that indicates the intensity of the Poisson process. The value of μ is both the mean and the variance of the distribution. Thus, we only need to specify $\mu = E(\text{children}_i | \text{wage}_i, \text{nonwage income}_i, X_i)$, which we assume is given by the exponential function:

$$E(\text{children}_i | \text{wage}_i, \text{nonwage income}_i, X_i) = e^{(\beta_0 + \beta_1 \text{wage}_i + \beta_2 \text{nonwage income}_i + \beta_3 X_i)}. \quad (18)$$

This specification assures that μ will be positive for all values of wage, nonwage income, and X . In this model, the probability that the number of children equals the value j , conditional on the independent variables, is

$$\Pr(\text{children} = j | X) = \frac{e^{-e^{(X\beta)}} (e^{(X\beta)})^j}{j!} \quad \text{for } j = 0, 1, 2, \dots \quad (19)$$

where X represents the full set of explanatory variables, including wage and nonwage income.

Maximum likelihood estimation is used to obtain the parameter estimates. The estimated marginal effects evaluated at the mean are reported as the first two columns of Table 5.

Table 5: Poisson and Ordered Probit Child Demand Estimation

	Poisson	Poisson	Ordered Probit	Ordered Probit
Wage	-0.0170 (0.0051)**	-0.0252 (0.0056)**	-0.0148 (0.0040)**	-0.0208 (0.0042)**
Nonwage Income (thousands)	0.0074 (0.0013)**	0.0185 (0.0011)**	0.0074 (0.0013)**	0.0183 (0.0012)**
Hispanic	0.347 (0.081)**	0.281 (0.082)**	0.319 (0.068)**	0.244 (0.066)**
Black	0.646 (0.075)**	0.282 (0.066)**	0.545 (0.059)**	0.235 (0.054)**
Other race	0.006 (0.216)	-0.168 (0.194)	-0.005 (0.197)	-0.162 (0.183)
Married	1.450 (0.093)**		1.356 (0.086)**	
Partner	0.792 (0.204)**		0.635 (0.171)**	
Region controls	yes	yes	yes	yes
Family controls	yes	yes	yes	yes
Religion controls	yes	yes	yes	yes
Observations	4059	4059	4059	4059
Total Effect	-0.212	-0.314	-0.184	-0.259
Income Effect	0.136	0.340	0.136	0.336
Substitution Effect	-0.348	-0.653	-0.320	-0.595

* significant at 5% ** significant at 1%. The reported values are computed using sample weights. Standard errors in parentheses.

Region controls include: northeast, central, and south. Family controls include: number of siblings, youngest child indicator, oldest child indicator, biological parents (14), immigrant parents, mother's education level, rural, moved, and a library indicator. Religion controls include: Catholic, Baptist, Methodist, Lutheran, Presbyterian, Pentecostal, Episcopalian, Jewish, Other Christian Religion, Non-Christian Religion, and a measure of frequency of attendance.

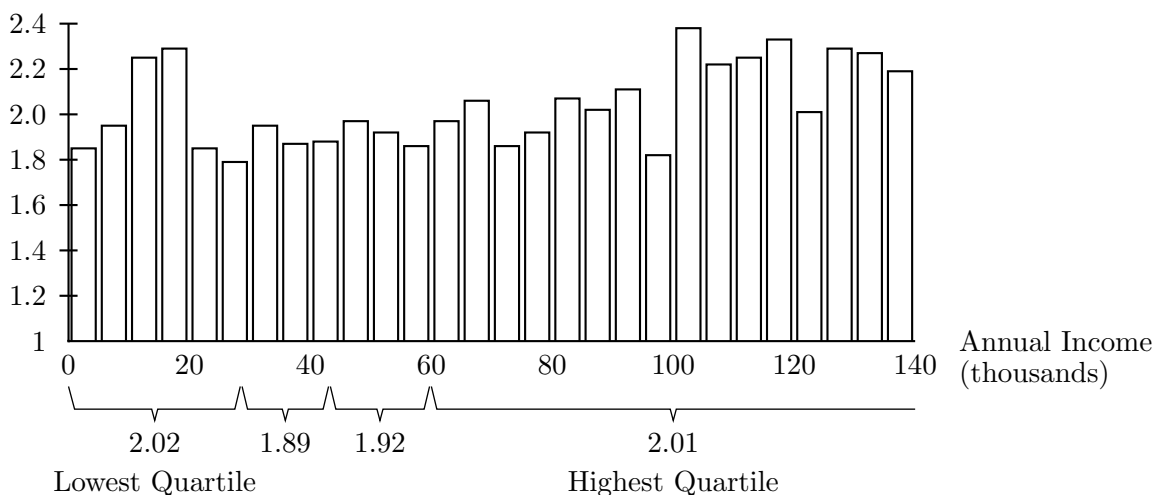
As an alternative, an ordered probit model is also considered. The model is built around the concept of a latent demand for children that, conditioning on X , is normally distributed. This latent demand for children is continuously distributed with nothing preventing it from taking on negative values. However, this latent demand is not observed. What we do observe is the actual number of children $(0, 1, 2, \dots)$ selected by each individual. A set of cutoff values for the latent variable, for example $\{0.5, 1.5, 2.5, 3.5, \dots\}$, determine the observed number of children. If the latent variable were to have a value that falls between 0.5 and 1.5 (given the cutoff values in the example)

then the individual would choose to have one child. The cutoff values and parameter estimates are obtained by maximum likelihood estimation. The estimated marginal effects evaluated at the mean are reported as the third and fourth columns of Table 5.

The results reported in Table 5 are consistent with those of Table 4 (page 17). A one dollar increase in the life time average hourly wage (evaluated at the mean wage) is associated with a decrease in the number of children between 0.014 and 0.031. The estimated income effect is positive, meaning that children are a normal good. Thus, the negative total effect implies that the substitution effect is larger in magnitude than the income effect.

For some, a positive value for the estimated income effect is perhaps surprising. It is sometimes claimed that high-income countries have lower fertility rates due to a negative income effect.¹⁹ These results are contrary to that claim. In fact, it is apparent from an examination of the unconditional average number of children by average annual real family income level that the number of children increases with income (see Figure 3). These results support the claim that higher female wages are an important factor in explaining fertility decline (Butz and Ward 1979; Schultz 1985; Heckman and Walker 1990).²⁰

Figure 3: Average Number of Children by Real Average Family Income



This estimation exercise suggests that leisure and children are complements. Therefore, from

¹⁹See Jones, Schoonbroodt, and Tertilt (2008) for a discussion of the relationship between income and fertility.

²⁰While it is argued that rising female wages in the last half of the 20th Century is an important explanation for the decline in fertility rates, it should be noted that fertility rates in the United States began to decline in the late 19th Century, long before any sizable increase in female wages.

Result 2.1 the optimal tax policy should include a tax on children rather than a child subsidy. Or, in a system with a consumption or sales tax, this estimate implies that goods associated with raising children should be taxed more heavily than other goods. Some may consider this to be a troubling result, viewing it as anti-family. In contrast, it is simply an indication of the efficiency cost of providing child tax benefits. Not only does provision of these benefits require higher income tax rates than would be necessary in order to raise an equal level of government revenue, but child tax benefits also augment the distortion of family labor supply. However, simply showing that child subsidies have an efficiency cost does not imply that they should be eliminated. Externalities, redistributive goals, ability-to-pay considerations, and other factors may provide a rationale for child tax benefits. The result from the representative agent model that children should be taxed and not subsidized indicate that careful consideration should be given to whether the benefits from providing child tax benefits outweigh the efficiency costs.

4 Efficiency Cost Computation

The sign of the estimated cross-price substitution effect for leisure and children implies that they are complements. This, in turn, implies that an optimal tax policy would involve a child tax rather than a subsidy. This section calculates the excess burden associated with the U.S. child tax benefits, given the estimated substitution effect for leisure and children and derives the optimal child tax.

We start by calculating the value of the child subsidy or tax, θ , that minimizes the excess burden. The addition of nonwage income to the model implies only a minor change to the denominator of the optimal child tax treatment equation as derived in Section 2:

$$\theta^* = \frac{R(S_{LL}N + S_{LN}H)}{S_{NN}(H^2 + HM) + S_{LN}(2NH + NM) + S_{LL}N^2}. \quad (20)$$

This expression is derived under the assumption that male and other income is subject to the linear income tax but does not respond to it. If male and other income was assumed to respond to the tax policy, the expression above would need additional terms representing the cross and own price substitution effects. Again, this is a fairly common assumption justified by empirical results suggesting the labor supply elasticity for men is approximately zero (MaCurdy, Green, and Paarsch,

1990).

We need estimates of each of the parameters in order to evaluate the expression. Sample averages for annual female earnings (\$18,362), nonwage and male income (\$28,001), and children (1.944) as reported in Table 3 (page 14) provide values for H and M , but there is an issue in how the model treats children. Children are measured in dollar terms, just as labor supply (H) is measured in dollars and not hours. This means that to proceed with the computation, we need to assign a value to the cost of raising a child, P_N . There are various estimates of P_N in the literature and rather than make a judgment on which estimate is best, we will proceed by selecting two values: one high and the other low. For the high value, the USDA calculates that the average annual child-related expenditure for a middle-income married couple is about \$11,000 (Lino, 2007). The USDA method measure education and clothing expenditure on children and also attributes a portion of food, housing, utilities, and transportation to children. For the low value, the U.S. poverty thresholds increase with the number in the household and this implies a cost of raising a child of about \$3,400. The high value implies $N = 21,384$; the low value implies $N = 6,610$. The Congressional Budget Office reports that taxpayers paid an average of \$6,100 in federal income tax in 2003, so I take this as the value for R .²¹

Estimation of the own-price substitution effect for children, S_{NN} , is not possible with this data because there is no observed cross-sectional variation in the cost of raising children. Instead, we turn to the literature on the fertility response to child tax benefits. Whittington et al. (1990) used time series data on U.S. fertility rates and the value of the dependent exemption in the federal income tax to estimate the fertility response. They estimated that a \$100 increase in child tax benefits (in \$2005) would result in a 3.2 to 6.5 percent increase in fertility. This total effect, swamps the income effect that I estimated from the NSLY data. It would imply a substitution effect larger than -2 in magnitude, meaning that doubling the cost of raising a child would cause the average number of children in a family to drop by more than 2 (down to zero).

A handful of other studies have estimated a fertility response from changes in child tax benefits or other child subsidies since Whittington et al. (1990). Gauthier and Hatzius (1997) find evidence

²¹See the CBO document "Historical Effective Federal Tax Rates: 1979 to 2003" located on the web at: <http://www.cbo.gov/ftpdocs/70xx/doc7000/12-29-FedTaxRates.pdf>. The CBO reports that taxpayers in 2003 paid an average of \$14,200 in federal taxes, 43 percent of which was due to the individual income tax.

of a much smaller total effect in a panel of 22 countries. Huang (2002) also found a much smaller fertility response using times series data from Taiwan. Baughman and Dickert-Conlin (2003) find no fertility response to EITC increases for unmarried women and only a small positive response for married women. For the calculation, I use an estimate from Laroque and Salanié (2005) which uses a structural model of labor supply and fertility to explain the fertility response of families in France. They estimate the uncompensated cost elasticity of the demand for children to be about 0.2. In terms of child tax subsidies, this estimate implies that a child tax subsidy increase of \$1,700 to \$5,500 (using the low or high child cost values) would increase fertility by 20 percent. If we accept this value and apply it to the NLSY sample used in this analysis, it implies that doubling the cost of children would reduce the demand by about 0.392 children. This uncompensated effect is the sum of the substitution effect, S_{NN} , and the income effect. The own-price substitution effect implied by the Laroque and Salanié (2005) estimate is -0.377.

An estimate for the own-price substitution effect for leisure, S_{LL} can be obtained by the same method as was used to estimate of the cross-price substitution effect for leisure and children. Using the same NLSY sample of women, I estimate the effect of wages and non-wage income on labor supply, assuming that labor supply is given by a linear function as in equation (13). The estimation results are reported in Table 6.

The results indicate that a dollar increase in a woman's average hourly wage leads to an increase of approximately 0.48 hours per week of market work. As shown in Table 6, this total effect is decomposed into a negative income effect and a positive substitution effect. The substitution effect reported in the table is normalized so that the interpretation of the effect applies for a doubling of the hourly wage. Since the time endowment is simply the sum of hours of work and leisure time, the own-price substitution effect for leisure demand is the negative of the own-price substitution effect for labor supply.

The female labor supply elasticities implied by these results seem reasonable. Using the column (4) coefficient estimates, the compensated wage elasticity is 0.344 and the uncompensated wage elasticity is 0.224. While they are well within the range of estimated elasticities in the female labor supply literature, they lie in the lower segment of the range (Killingsworth and Heckman, 1986).

Using the high or the low estimate for the cost of raising a child, P_N makes a large difference in

Table 6: Linear Labor Supply Estimation

	(1)	(2)	(3)	(4)	(5)
Wage	0.508 (0.026)**	0.473 (0.027)**	0.482 (0.027)**	0.478 (0.027)**	0.470 (0.027)**
Nonwage Income (thousands)	-0.149 (0.009)**	-0.157 (0.009)**	-0.177 (0.011)**	-0.178 (0.011)**	-0.160 (0.009)**
Hispanic	-1.836 (0.716)*	-0.457 (0.783)	-0.367 (0.783)	-0.552 (0.814)	-0.634 (0.814)
Black	-3.037 (0.508)**	-2.344 (0.527)**	-1.950 (0.548)**	-2.198 (0.572)**	-2.587 (0.551)**
Other race	-0.692 (1.286)	0.189 (1.291)	0.469 (1.292)	0.427 (1.366)	0.164 (1.364)
Married			2.002 (0.702)**	1.879 (0.703)**	
Partner			-0.738 (1.341)	-0.695 (1.343)	
Constant	23.724 (0.602)**	23.324 (1.127)**	22.406 (1.225)**	21.252 (1.443)**	21.964 (1.372)**
Region controls	yes	yes	yes	yes	yes
Family controls	no	yes	yes	yes	yes
Religion controls	no	no	no	yes	yes
Observations	4059	4059	4059	4059	4059
R-squared	0.1328	0.1528	0.1551	0.1627	0.1606
Total Effect	6.325	5.889	6.001	5.951	5.852
Income Effect	-2.736	-2.883	-3.250	-3.268	-2.938
Substitution Effect	9.061	8.772	9.251	9.220	8.789

* significant at 5% ** significant at 1%. The reported values are computed using sample weights. Standard errors in parentheses.

Region controls include: northeast, central, and south. Family controls include: number of siblings, youngest child indicator, oldest child indicator, biological parents (14), immigrant parents, mother's education level, rural, moved, and a library indicator. Religion controls include: Catholic, Baptist, Methodist, Lutheran, Presbyterian, Pentecostal, Episcopalian, Jewish, Other Christian Religion, Non-Christian Religion, and a measure of frequency of attendance.

the size of the optimal child tax. Using the low value for P_N of \$3,400 results in an optimal child tax of about \$100 per child. Using the high value for P_N of \$11,000 results in an optimal child tax of about \$800 per child. The reason for the large difference is that if children are quite expensive, then a child tax has the ability to raise a large amount of revenue and thus allow for lower income tax rates while at the same time causing very little distortion in the demand for children. If children are much less expensive, then a large tax would be much more distortive.

The optimal linear income tax rate derived from this method is quite low, 12.7 percent under low child costs and 9.4 percent under high child costs. The linear income tax in this model has

no standard deduction or exemption so this is both the marginal and the average tax rate. For comparison, in order to provide child tax benefits of \$2,000 per child and still raise the \$6,100 revenue, a tax rate of 21.5 percent would be required.

The excess burden of the tax policy is a measure of the loss of welfare greater than would have occurred if the tax revenue had been collected as a lump sum tax:

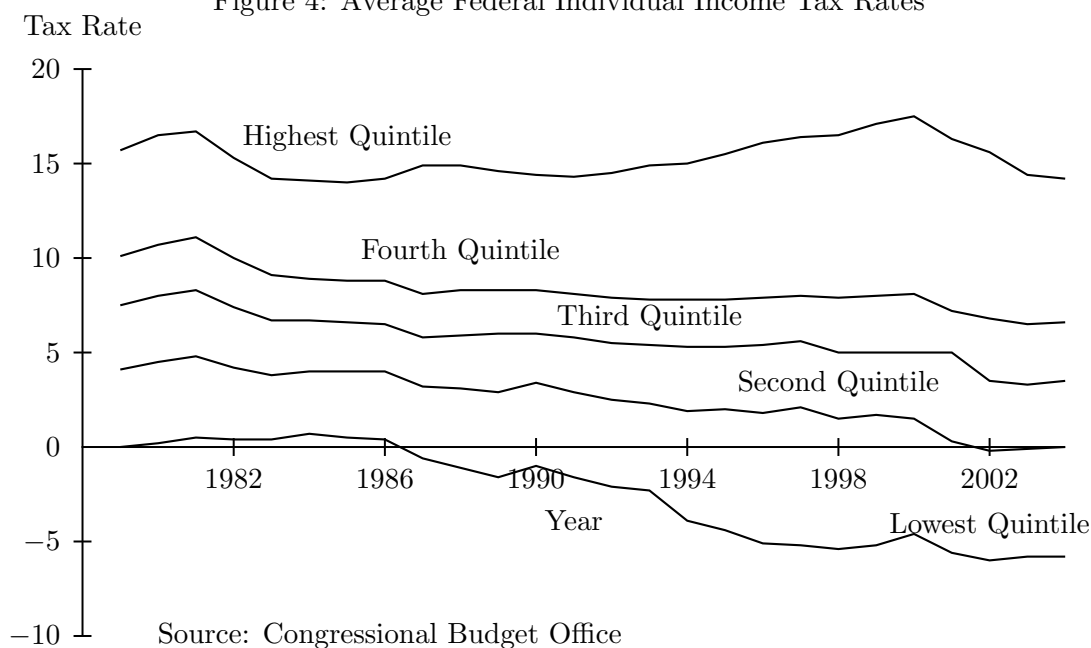
$$EB = -\frac{1}{2} (\tau^2 S_{LL} + \theta^2 S_{NN} - 2\tau\theta S_{LN}). \quad (21)$$

Expressing consumption, leisure, and children in dollar terms means that this excess burden measure is also in dollars. Under a lump sum tax it would have a value of zero. Under the high child cost assumption, the optimal tax policy of a \$800 per child tax and a 9.4 percent flat income tax rate produces an excess burden of \$25. If the government is not able to impose a child tax (θ restricted to be weakly negative) then the flat income tax rate would be 13.2 percent and the excess burden would be \$52. In order for the government to provide a \$2,000 per child subsidy, the excess burden would be \$350. Under the low child cost assumption, the excess burden of providing a \$2,000 per child subsidy is \$496.

I believe it to be unlikely that the United States would adopt a system of explicit child taxes. A child tax would be seen as regressive and fundamentally unfair. A flat tax per child (a child head tax) would be regressive because while it is true that higher income families tend to have more children, they do not have proportionally more children. Of course, there is no need for a child tax to be regressive; it could be designed to increase with taxable income.

Also note that the child tax result hinges on the assumption that the government needs to raise a positive level of revenue from the representative agent. Consider instead that the government is deciding how best to use the income tax to transfer money to the agent. A negative value of R in the optimal tax policy equations results in a child subsidy rather than a child tax. This suggests that optimal transfers should involve both a negative income tax rate and a child subsidy if lump-sum transfers are not feasible. This is an important case to consider because families in the lowest 40 percent of the income distribution in the United States have a negative federal income tax liability on average as shown in Figure 4.

Figure 4: Average Federal Individual Income Tax Rates



5 Some Distributional Considerations

In a representative agent model, no social gains from redistribution through child tax benefits are possible, but in a model with heterogeneous agents, such gains are possible. However, there is a trade-off between the distortionary cost of providing child subsidies and the social gains from a tax policy that provides a more equitable treatment of families.

From a utilitarian perspective, one justification for child subsidies is that they may help a government with limited tax instruments achieve a higher level of socially beneficial redistribution. Consider a model with a government that has the ability to impose a linear income tax and a per-child subsidy or tax. This particular tax structure is equivalent to a flat consumption tax with special child tax treatment or a linear income tax with a dependent exemption. This restriction on the tax instruments available to the government may be applicable to some developing countries that do not have the administrative structure necessary to impose a progressive income tax. Child tax subsidies can make a linear income tax or a flat consumption tax progressive. Low-income families have proportionally more children even if high-income families have more children. This means that increasing the flat tax rate and increasing child subsidies redistributes from the high-

ability type to the low-ability type.

Under an optimal non-linear income tax, can the provision of child tax benefits still improve social welfare? Child tax benefits could be used to improve social welfare in a model in which the government gains new information about an agent's unobserved ability level by observing the number of children. For example, if the number of children is correlated with the ability level and not perfectly correlated with income, then a tax system that uses this additional information can achieve a higher level of social welfare than one that does not. However, it is not clear if such a correlation exists. One could also consider a model in which social welfare depends directly on expenditure on children, and to the extent that child subsidies increase expenditure on children, they could be used to increase social welfare.

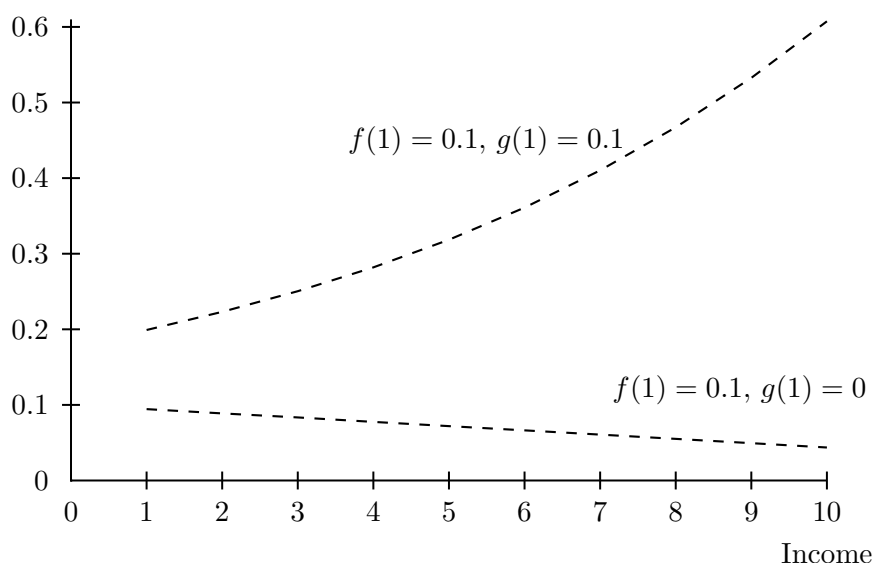
However, rather than considering either of these models, we consider a model in which there is a necessary time or monetary cost associated with children from which the agents do not derive any utility. For example, if agents have Stone-Geary utility where at least one of the basic needs parameters increases in the number of children, providing child tax benefits could increase social welfare. This is represented by the following utility function:

$$U(C, L, N) = \beta \ln(C - f(N)) + (1 - \beta) \ln(L - g(N)) + V(N) \tag{22}$$

where $f(N)$ is some necessary cost of raising a child which the agent does not consider consumption and $g(N)$ is some necessary time cost of raising a child which the agent does not consider leisure. The function $V(N)$ captures the direct utility from children. Expenditure on children, either in time or money, above the necessary levels of $f(N)$ and $g(N)$ is respectively considered consumption or leisure.

With a utilitarian social welfare function, the motivation for child tax benefits is that for $f(1) > 0$ and $f'(N) > 0$ the marginal utility of consumption is greater for those with more children. The same is true for the marginal utility of leisure under equivalent conditions on $g(N)$. Thus, for any function $V(N)$, the optimal tax policy will redistribute to those with more children from those with less children. I show this numerically assuming five ability types $\{1, 2, 3, 4, 5\}$. Figure 5 shows the optimal child tax treatment under two alternative assumptions for $f(1)$ and $g(1)$. In each case,

Figure 5: Optimal Child Tax Treatment for Numerical Example 2



$f(0) = 0$ and $g(0) = 0$.

With monetary costs alone, this exercise shows that the optimal child subsidy should decline as income rises. The intuition is that the difference in marginal utility of income for agents with different number of children declines as income rises and thus so does the social welfare gains from redistribution. There is still redistribution from high-income to low-income agents, but less redistribution from those without children to those with children at higher income levels.

Time costs of children lead to the opposite result. The intuition is that the difference in the marginal utility of income for those with different numbers of children increases in the agents' ability level and thus income level. An agent with a high ability level or wage has a higher opportunity cost of the time spent raising children than an agent with a lower ability level. Because the difference in the marginal utility of income increases in income, the optimal child subsidy increases in income in models with only time costs.

In models with both monetary and time costs of raising children, the shape of the curve depends on the relative importance of the two costs. In Figure 5, the top curve is increasing in income because the time costs dominate the monetary costs. In this example, the time required to raise a child is fixed, representing the amount of supervision, care, and adult interaction that children need. However, in reality, there is no requirement that parents spend all of that time. For high-ability agents, some time costs can be avoided by paying for child care services. Thus, the monetary costs

of raising a child may be more important than the time costs, suggesting that the optimal child subsidy may decrease in income.

6 Conclusion

The budgetary cost of child tax benefits in the U.S. is about \$140 billion per year and continues to grow. However, there has been little work regarding the efficiency costs of providing these child subsidies. In this paper, I use a representative agent model to show that the efficiency costs depend on the cross-price substitution effect for children and leisure (non-market work) time. If children and leisure are complements then child subsidies are not optimal in terms of economic efficiency. Estimation of a child demand function using NLSY data indicated that children and leisure are complements over the life cycle. A back of the envelope style calculation of the optimal child tax implied by the estimates was in the range of \$100 to \$800 per child.

There is a strong need for additional research on the optimal design of child subsidies. The child tax benefits in the United States are large and expensive and have the potential to grow even larger over the next few years. This is a research topic with far too little formal analysis on which to base policy recommendations. Careful thinking about the efficiency costs associated with child subsidies is only the first step. Further analysis of the consequences of child subsidies, especially for different ranges in the income distribution, presents an important area for future research.

References

- AUERBACH, A. J. (1985): “The Theory of Excess Burden and Optimal Taxation,” in *Handbook of Public Economics*, ed. by A. J. Auerbach, and M. Feldstein, vol. 1, pp. 61–127. Elsevier Science Publishers B.V. (North-Holland).
- AUERBACH, A. J., AND H. S. ROSEN (1980): “Will the Real Excess Burden Please Stand Up? (Or, Seven Measures in Search of a Concept),” NBER Working Paper: 0495, National Bureau of Economic Research.
- BAUGHMAN, R., AND S. DICKERT-CONLIN (2003): “Did Expanding the EITC Promote Motherhood?,” *American Economic Review*, 93(2), 247–251.

- BOSKIN, M. J., AND E. SHESHINSKI (1983): "Optimal Tax Treatment of the Family: Married Couples," *Journal of Public Economics*, 20(3), 281–297.
- BUTZ, W. P., AND M. P. WARD (1979): "The Emergence of Countercyclical U.S. Fertility," *The American Economic Review*, 69(3), 318–328.
- CORLETT, W. J., AND D. C. HAGUE (1954): "Complementarity and the Excess Burden of Taxation," *The Review of Economic Studies*, 21(1), 21–30.
- DIAMOND, P. A., AND D. L. MCFADDEN (1974): "Some Uses of the Expenditure Function in Public Finance," *Journal of Public Economics*, 3(1), 3–21.
- GAUTHIER, A. H., AND J. HATZIUS (1997): "Family Benefits and Fertility: An Economic Analysis.," *Population Studies*, 51(3), 295–306.
- GREEN, J. R., AND E. SHESHINSKI (1979): "Approximating the Efficiency Gain of Tax Reforms," *Journal of Public Economics*, 11(2), 179–195.
- HARBERGER, A. C. (1964): "The Measurement of Waste," *The American Economic Review*, 54(3), 58–76.
- HECKMAN, J. J., AND J. R. WALKER (1990): "The Relationship Between Wages and Income and the Timing and Spacing of Births: Evidence from Swedish Longitudinal Data," *Econometrica*, 58(6), 1411–1441.
- HICKS, J. R. (1939): *Value and Capital*. Oxford: Oxford University Press.
- HOTELLING, H. (1938): "The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates," *Econometrica*, 6(3), 242–269.
- HUANG, J.-T. (2002): "Personal Tax Exemption: The Effect on Fertility in Taiwan," *The Developing Economies*, XL(1), 32–48.
- JONES, L. E., A. SCHOONBROODT, AND M. TERTILT (2008): "Fertility and Income in the Cross Section: Theories and Evidence," Mimeo.
- KILLINGSWORTH, M. R., AND J. J. HECKMAN (1986): "Female Labor Supply: A Survey," in *Handbook of Labor Economics Volume 1*, ed. by O. Ashenfelter, and R. Layard, pp. 103–204. Amsterdam: North-Holland.
- LAROQUE, G., AND B. SALANIÉ (2005): *Does Fertility Respond to Financial Incentives?* CEPR Discussion Paper no. 5007. (<http://www.cepr.org/pubs/dps/DP5007.asp>).
- LINO, M. (2007): "Expenditures on Children by Families, 2006," *U.S. Department of Agriculture, Center for Nutrition Policy and Promotion*, Miscellaneous Publication No. 1528-2006.

- MACURDY, T., D. GREEN, AND H. PAARSCH (1990): "Assessing Empirical Approaches for Analyzing Taxes and Labor Supply," *Journal of Human Resources*, 25(3), 415–490.
- MARTIN, J. A., B. E. HAMILTON, P. D. SUTTON, S. J. VENTURA, F. MENACKER, AND M. L. MUNSON (2005): "Births: Final Data for 2003," *National Vital Statistics Reports*, 54(2).
- MILLER, A. R. (2006): "The Effects of Motherhood Timing on Career Path," Mimeo, University of Virginia.
- PENCAVEL, J. (1986): "Labor Supply of Men: A Survey," in *Handbook of Labor Economics Volume 1*, ed. by O. Ashenfelter, and R. Layard, pp. 3–102. Amsterdam: North-Holland.
- ROSEN, H. S. (1978): "The Measurement of Excess Burden with Explicit Utility Functions," *Journal of Political Economy*, 86(2), S121–S135.
- SCHULTZ, T. P. (1985): "Changing World Prices, Women's Wages, and the Fertility Transition: Sweden, 1860-1910," *The Journal of Political Economy*, 93(6), 1126–1154.
- WHITTINGTON, L. A., J. ALM, AND H. E. PETERS (1990): "Fertility and the Personal Exemption: Implicit Pronatalist Policy in the United States," *The American Economic Review*, 80(3), 545–556.