Intra-Household Transfers and the Part-Time Work of Children

Christian Dustmann[†]

John Micklewright[‡]

This version: January 2001

Abstract

We analyze labour supply of 16 year old British children together with the cash transfers made to them by their parents. We develop a theoretical model with an altruistic parent and a selfish child, which serves as a basis for the empirical specification in which labour supply and transfers are jointly determined. We show how parental transfers and the child's labour supply are dependent on each other. Consideration of this is important when assessing the influence of other factors.

[*]We are grateful to the Leverhulme Trust for financial support for this research, which has also benefited from support to the IFS as a Designated Research Centre of the ESRC. We thank Murali Agastya, Richard Blundell, F. Hof, Ian Preston, Arthur van Soest and Frank Windmeijer for useful comments.

[†]University College London, CEPR and IFS, London. Contact: c.dustmann@ucl.ac.uk.

[‡]UNICEF Innocenti Research Centre, Florence. Contact: JMicklewright@unicef-icdc.it

1 Introduction

Labour supply of children, its effects on the process of human capital formation, and how it relates to family wealth and family background has been studied intensively for developing countries (e.g. see the survey by Basu 1999). Here wage income of children often contributes importantly to the family's subsistence income. Children frequently work full time. A well documented and lasting negative consequence of early labour market commitment of children is a reduction in their educational achievements (a classic paper on this subject is Rosenzweig and Evenson 1977).

In contrast, in Western countries labour market participation of children is not in general borne out of subsistence needs of the family (although the impact on educational achievement may be a common concern, e.g. see Dustmann et al (1997)). Rather it helps to finance consumption goods for the child. Teenagers are important customers for sellers of various goods like clothing and specific leisure articles, and specialist industries depend on this consumer group. Labour force participation of teenagers still in full time education is indeed substantial. In the US, the sizeable employment rates among 14-15 year olds in school have long been known, with rates of about 25 percent at the end of the 1970s, rising to 50 percent for 17 year olds (Michael and Tuma 1984). In Britain, rates of between 30 percent and 50 percent for 16-17 year olds in full-time education can be seen for the early 1990s (the level varying with the definition of employment and source of data used) with a marked rise in participation over the previous decades (Sly 1993, Micklewright, Rajah and Smith 1994).

But besides part time earnings from the labour market, the income needed by children to fund personal consumption may come from another source: parental cash transfers. The key point here is that parental transfers and children's labour supply are likely to interact with each other. On the one hand, children may reduce their willingness to participate in the labour market when transfers are increased; on the other, parents may reduce transfers if the child works part-time. Moreover, this interdependency is important for understanding the effect of a range of household factors on child labour supply, such as parental occupation and education, as well as income. Neglect of the possibly interactive nature of transfers and labour supply may lead to wrong assignment of the influence of such variables, since direct and indirect effects are not distinguished.

Little work exists on how cash transfers and child's labour supply are determined within the family in practice. There are some related models in the literature which study the transmission of goods within the family. Becker (1974, 1981, 1993) was the first to analyse intra family transfers between an altruistic parent (or husband), and a selfish child (or wife). Others papers have developed and explored extensions of this model, in particular to consider the case where the beneficiary can determine his or her own income via labour supply (see, among others, Bergstrom 1989 and Juerges 2000). But this literature focuses only on the theory, not least since data on intra-household transfers are seldom recorded in household survey data. We are not aware of any empirical work which analyses transfers of parents to children within the household. We by contrast have access to such data, along with data on children's part-time work, and are therefore able to estimate an empirical model of the joint determination of transfers and labour supply, while still basing the analysis within an appropriate theoretical framework.

We commence by developing a simple theoretical model that is motivated by Becker's work (section 2). In our model, the beneficiary (a selfish child in our case) has the choice over his or her labour supply. Altruistic parents choose the optimal transfers, conditioning on the child's labour supply; the child, in turn, chooses the optimal supply of labour, conditioning on the parents' transfer payment. Guided by our theoretical model, we then develop an econometric model to explain both transfers and labour supply, taking into account interdependencies between the two variables (and various features of the way they are measured in our data) together with a wide range of other factors including parental income (section 3). The model is estimated with data on British teenagers in their last year of compulsory schooling. Results of our analysis are presented in section 4. Section 5 concludes.

2 A model of labour supply and transfers

We consider an altruistic parent, P, and a selfish child, C. In our model, the parent sets the optimal level of transfers, conditional on the child's labour supply, and subject to his or her budget constraint. In turn, the child chooses the optimal supply of labour, conditional on the parent's transfer payments. The Nash equilibrium determines the optimal transfers, as well as the optimal labour supply of the child.

The child's utility function has consumption x^c and leisure L as arguments:

$$U = U(x^c, L; \Gamma_1)\,, \tag{1}$$

where the function U is strictly concave in both arguments, and Γ_1 is a vector of parameters. Normalizing the total time available for leisure and work activities to 1, time for labour market activities equals $H = (1 - L)$, where H are hours worked. The child's budget constraint is given by

$$x^c = T + H\,w\,, \tag{2}$$

where T are transfer payments received from the parent, and w is the wage the child receives per unit of time offered to the labour market.

The parent's utility function is defined over his or her own consumption and the utility of the child:

$$U^p = U^p(V(x^p; \Gamma_2), U(x^c, L; \Gamma_1), \beta))\,, \tag{3}$$

where $\beta \in (0, 1)$ is an altruistic weight, x^p is the parent's consumption and Γ_2 a vector of parameters characterizing the parent's utility function. The utility index V is strictly concave with respect to x^p. The parent's budget constraint is given by

$$x^p = I - T\,, \tag{4}$$

where I is (exogenous) income.

For $T > 0$ (positive transfers), the family budget constraint is given by

$$x^p + x^c = I + H\,w\,. \tag{5}$$

Transfers are determined by maximizing (3) with respect to x^p and T, subject to (5) and conditional on H. The child's labour supply is taken as given by the parent. Labour supply is determined by maximization of (1) with respect to (2), conditional on parent's transfers. The equilibrium is determined by the crossing point of the reaction curves.

For convenience, assume that the parent's and the child's utility functions are of Cobb-Douglas type, with

$$U^c(x^c, L) \;=\; (x^c)^{\lambda_1}\,(1 - H - \zeta)^{\lambda_2}$$

and

$$U^p(x^p, U^c) \;=\; (x^p - \xi)^{\eta}\,(U^c)^{\beta}\,,$$

where ζ and ξ are "committed leisure" and "committed consumption" of the child and the parent respectively. In our simple formulation, child's committed leisure may include any demands on his or her time other than working, like school duties etc. Parent's committed consumption may include financial obligations, including transfers to other children.

The first order conditions can be derived in a straightforward manner.[1] The optimal labour supply rule of the child, given parental transfers T, is given by

[1] There are other possibilities for strategic behaviour within the household. It turns out that for our model, the Nash solution is observationally equivalent to the cooperative solution, and a solution where the parent decides on both transfers and child's leisure.

$$H = \begin{cases} \frac{\lambda_1}{(\lambda_1+\lambda_2)}(1-\zeta) - \frac{\lambda_2}{(\lambda_1+\lambda_2)w} T & \text{for} \quad 0 \leq T < \frac{\lambda_1 w}{\lambda_2}(1-\zeta) \\ 0 & \text{for} \quad T > \frac{\lambda_1 w}{\lambda_2}(1-\zeta)\,. \end{cases} \tag{6}$$

The optimal parental allocation rule for transfers, given the child's labour supply H, is given by

$$T = \begin{cases} \frac{\lambda_1 \beta}{\eta+\lambda_1 \beta} I - \frac{\lambda_1 \beta}{\eta+\lambda_1 \beta} \xi - \frac{\eta}{\eta+\lambda_1 \beta} wH & \text{for} \quad 0 \leq H < \frac{\lambda_1 \beta}{\eta}(I-\xi) \\ 0 & \text{for} \quad H > \frac{\lambda_1 \beta}{\eta}(I-\xi)\,. \end{cases} \tag{7}$$

Relation (6) says that the child will supply labour only if transfers are below a certain threshold. Above that threshold, labour supply equals zero. The critical level depends on the child's preference for consumption and leisure time. The higher the child's preference for consumption, relative to leisure, the higher the level of transfers necessary to induce the child not to work. Commitment of time to other activities (ζ) reduces participation propensity and labour supply, as do transfer payments.

Relation (7) says that transfers are positive as long as the child's labour supply is below a certain threshold, which depends positively on parental income, and on the parent's altruistic preference; furthermore, it depends negatively on the parental preference for own consumption, as well as other consumption commitments ξ of the parent. Transfers are reduced by the child's hours of work and consumption commitments, and increase in parental income.

Since the scales of the parent's and the child's utility functions are not separately identified, some normalisation is necessary. A convenient choice is $\lambda_1 + \lambda_2 = 1$ and $\beta = 1 - \eta$.

There are a number of key features in this simple model. First, parental income does not affect labour supply, other than through transfer payments. Second, the child's time commitment ζ, as well as wages w, only enter the child's labour supply equation. Third, other consumption commitments of the parent ξ only enter the transfer equation. These restrictions imply some identifying assumptions for our empirical model, and we will discuss them below.

3 Empirical Analysis

3.1 The Empirical Model

Our empirical specification is guided by this model, although we do not attempt to estimate its structural parameters. We do not observe teenagers' wages in the data set, but only their weekly earnings, as categorical data. To construct a wage measure is in principle possible, but necessitates further identification assumptions. However, in another paper (Dustmann, Rajah, Smith, 1997), we show that wages of 16 year old school children are hardly related in a systematic way to background variables. We hence simplify our empirical model by assuming that differences in wages across teenagers are random, conditional on the regressors in the labour supply equation.

We parameterise ζ and ξ as follows:

$$\zeta = X' a_h + Z' b_h + u \,, \tag{8}$$

and

$$\xi = X' a_t + Y' b_t + v \,. \tag{9}$$

The transfer and labour supply equations in (6) and (7) suggest then the following empirical model:

$$h^* = X' a_h + Z' b_h + \gamma \, g(t^*) + u \,, \tag{10-a}$$

$$t^* = X' a_t + Y' b_t + c_t \, I + \delta \, f(h^*) + v \,, \tag{10-b}$$

where t^* and h^* are latent variables for transfers and hours worked. The set of common regressors which affects labour supply as well as transfer payments is given by X, with associated parameter vectors a_h and a_t. The vectors Z and Y are observable characteristics affecting only labour supply, or only transfers respectively, with associated parameter vectors b_h and b_t, and I is family income, with associated parameter c_t. The functions $g(t^*)$ and $f(h^*)$ describe the way transfers and labours supply affect each other. According to our theoretical model, the associated parameters γ and δ are both negative. The random variables u and v are assumed to be joint normal. Equations (10-a) and (10-b) constitute a simultaneous equation system, where the dependent variables are observable down to a limit of zero.

There are various possibilities to specify the functions $g(t^*)$ and $f(h^*)$. Our theoretical model suggests that labour supply has an impact on the parent's optimal transfer rule only if the child participates. Likewise, transfers affect labour supply only if they are positive. This implies for the empirical model that $g(t^*) = \mathbf{1}(t^* > 0)\, t^*$ and $f(h^*) = \mathbf{1}(h^* > 0)\, h^*$: parent and child condition their transfers and labour supply respectively on the underlying latent index of the respective counterpart, if this index is larger than zero.

If we estimate the model in (10-a) and (10-b) simultaneously, coherency conditions have to be fulfilled to ensure that a unique and identifiable reduced form for the endogenous variables exists (see Blundell and Smith (1989), van Soest et al (1993) and Maddala (1983)). The above system of equations can be shown to be coherent under the condition that $(1 - \gamma\,\delta) > 0$. This condition correspond directly to the restrictions implied by our theoretical model, with $\gamma = -(\lambda_2)/(\lambda_1 + \lambda_2) < 0$, $\delta = -(\eta)/(\eta + \lambda_1\beta)$, and $\gamma\,\delta = (\eta\,\lambda_1)/((\eta + \lambda_1\beta)(\lambda_1 + \lambda_2)) < 1$.[2]

There are 4 different regimes in this model: (I) both labour supply and transfers are positive; (II) labour supply is positive, but transfers are zero; (III), transfers are positive, but labour supply is zero; and (IV) both transfers and labour supply are zero. Any pair of observations may fall into one of the four regimes, which are characterised as follows:

[2]Notice that the system is logically incoherent if we condition on observed labour supply and transfers, instead of the underlying indices h^* and t^*.

$$\begin{aligned}
\text{Regime } I: \quad & h^* > 0 && \Rightarrow (1-\gamma\,\delta)^{-1}(m_1 + \gamma\, m_2) > 0\,, \\
& t^* > 0 && \Rightarrow (1-\gamma\,\delta)^{-1}(m_2 + \delta\, m_1) > 0\,, \\
\text{Regime } II: \quad & h^* > 0 && \Rightarrow m_1 > 0\,. \\
& t^* < 0 && \Rightarrow m_2 + \delta\, m_1 > 0\,. \\
\text{Regime } III: \quad & h^* < 0 && \Rightarrow (m_1 + \gamma\, m_2) < 0\,, \\
& t^* > 0 && \Rightarrow m_2 > 0\,. \\
\text{Regime } IV: \quad & h^* < 0 && \Rightarrow m_2 < 0\,, \\
& t^* < 0 && \Rightarrow m_1 < 0\,,
\end{aligned} \tag{11}$$

where $m_1 = X'a_h + Z'b_h$ and $m_2 = X'a_t + Y'b_t + c_t I$. In this model, the parameters γ and δ are identified (although the model is interdependent in the linear index), due to the regime structure, without imposing exclusion restrictions. Non-random selection into the regimes would imply that the error terms u and v are correlated. We allow for this correlation by estimating the correlation parameter ρ. In principle this parameter is also identified by the model structure and the distributional assumptions we have made. Parametric identification of ρ turns out to be very weak for our application, and the likelihood function does not converge, so we do impose some exclusion restrictions, which we discuss below.

One shortcoming in our data is that we do not observe the variables h^* and t^* as continuous variables over their positive ranges, but only as categorical variables. This complicates things considerably, implying (given our distributional assumptions) a simultaneous ordered probit system with known thresholds. We derive the model likelihood in the Appendix. To simplify computation, in the case of labour supply, we only exploit information on whether the child works or not.

So far, we have not specified the type of transfers parents make to their children. Transfers may be in kind or in cash, and in our data we observe only those in cash.

The data may therefore lead us to overestimate the size of transfers for those who do have to buy goods that are provided to others as an in-kind transfer. However, we do have qualitative information on whether or not the cash transfer the child receives is meant to cover expenses like travel, clothes or meals, and we use this information to adjust the empirical model. We allow the thresholds between the ranges of the data to vary between the two types of receiver (expenses covered and uncovered).

Denote the observed thresholds category j for cash transfers by θ_j, and define an indicator variable D_i, being equal to one if some of the cash transfers are supposed to cover other expenses for individual i. Then we re-define the thresholds as

$$\tilde{\theta}_{ij} = \theta_j \, e^{\kappa \, D_{\mathrm{i}}} \, . \tag{12}$$

If the parameter κ is negative, then transfers to those who have to pay for goods provided in-kind to others are higher and hence the thresholds can be thought of as being shifted to the left.[3]

3.2 Data Description

The data we use are drawn from the British National Child Development Study (NCDS), which follows all children born in one week in March 1958. Information has been collected on these individuals and their families at various points in their lives - at birth and at ages 7, 11, 16, 23 and 33. We draw mainly on the data collected in Spring 1974, known as "NCDS3", when the individuals were aged 16 and in their last year of compulsory schooling.[4]

The NCDS3 data provide an unusually rich source of information on the subject under investigation. Data were collected separately from four sources - from the chil-

[3]See Pradham and van Soest (1995) for a not dissimilar parameterisation of thresholds in an ordered probit model.

[4]The NCDS children were in the first birth cohort required to stay at school until 16.

dren themselves, from parents, from schools, and from family doctors. Interviews with the children include questions on labour supply, earnings, and pocket money. Information on a range of household characteristics, including income, were collected from parents. The schools conducted standardised tests of the children's ability that were added to the survey data base. Moreover, the survey provides a reasonably large sample - our analysis is of 4,491 children. Nevertheless, attrition and missing data mean that this sample is considerably smaller than it might have been. We lose a lot of information due to missing questionnaires which cover some of the variables we use, or from incomplete information necessary to construct some of the regressors (like family income).

In table 1 we provide summary statistics of the variables used in our analysis (we discuss these variables later). To check whether attrition affects the randomness of our sample, we report in column 3 the variable means calculated across all available observations in NCDS, irrespective of whether the individual is in our estimation sample or not (the sample sizes in each case are reported in column 4). Comparing columns 1 and 3 shows that the means are typically very similar. This is reassuring, and indicates that attrition is not selective on (these) observables.

Tables (2) and (3) provide information on the distributions of the two variables that we seek to explain, weekly hours of work and transfers. Almost half of the individuals in our sample report a regular term-time job - 48 percent. However, this percentage is much higher for those who do not receive any transfers, where 87 percent participate. Among those with a job, median hours is in the range 6-9 hours, broadly equivalent to one day's full-time work. The distribution of working hours is shifted to the right for those who do not receive transfers.

Table (3) shows that the great majority of children do receive cash transfers from parents, but the amounts vary considerably. 1 in 11 receive positive amounts of less than 50 pence per week (about 2.85 pounds in 2000 terms while 1 in 8 get 2 pounds or more. The median is just under 1 pound, or about 5.70 pounds in current day terms.

Table 1: Descriptive Statistics and Attrition

Variable	Mean sample	StdD sample	Mean overall sample	N.Obs. overall sample
Father Works	0.898	0.302	0.867	10320
Father Self Employed	0.043	0.203	0.056	9479
Father Farmer	0.026	0.161	0.028	9479
Mother Works	0.691	0.461	0.659	10178
N. Younger Siblings	1.230	1.261	1.251	10160
N. Older Siblings	1.077	1.319	1.188	10175
Age Father left school*	4.019	1.753	4.055	9988
Age Father left school*	4.022	1.420	3.966	10160
Ability Test Score Age 11	45.542	15.677	43.041	12948
Physical handicap	0.010	0.101	0.020	10210
Female	0.490	0.499	0.481	17214
Log Household Income	3.830	0.394	3.798	8037
height	166.125	8.651	165.853	10006
Comprehensive School	0.553	0.497	0.588	10718
Grammar School	0.149	0.356	0.124	10718
Modern School	0.268	0.443	0.253	10718
Technical School	0.008	0.090	0.006	10718
Independent School	0.044	0.206	0.062	11487
East	0.353	0.478	0.356	10352
North West	0.333	0.471	0.338	10352
North	0.169	0.375	0.171	10352
Wales	0.061	0.241	0.059	10352
South West	0.081	0.272	0.073	10352

**: Mothers' and Father's age when leaving full time education, minus 12.*
Number of Observations in sample: 4291.
Log household income is the logarithm of total weekly income from earned and unearned sources (including state benefits). This variable is obtained from summing mid-points of banded variables (with 12 categories) for father's earnings, mother's earnings and other income of either parent. See Micklewright (1986) for further details.

Table 2: Weekly Hours Worked

Hours	None	<3	3-6	6-9	9-12	12-15	15+	Total
All	47.81	4.52	15.94	17.64	5.95	3.67	4.48	100.00
Transfers=0	13.29	4.62	19.36	25.72	13.29	12.43	11.27	100.00
Transfers>0	50.69	4.51	15.66	16.96	5.33	2.94	3.91	100.00

There are some notable differences in transfers between those with and without a job, as we would expect. Nearly a quarter of children with a job receive no transfers or less than 50p, compared to less than 1 in 10 of those not working. The median is not much more than 75p for workers but is well over 1 pound where there is no job.

Table 3: Transfer Payments

Transfers	None	0-0.49	0.50-0.74	0.75-0.99	1.00-1.49	1.50-1.99	2.00-2.99	3.00+	Total
All	7.77	9.05	23.20	11.83	23.96	11.59	7.95	4.65	100.00
Hours=0	2.16	7.20	21.51	11.86	27.11	14.59	9.98	5.60	100.00
Hours>0	12.89	10.74	24.74	11.81	21.09	8.85	6.10	3.78	100.00

The tables indicate that those who receive transfers have lower participation probabilities, and that those who work receive less transfers. However, these raw numbers do not reveal the nature of this process. They do not allow us to distinguish between a situation where labour supply and transfers do affect each other, a situation where there is no interaction, but only selection on unobservables, or a situation where, for instance, only labour supply affects transfers. The latter is a classic simultaneity bias problem.

3.3 Estimation and Identification

The variables we use as regressors are described in table 1. We include in X (the vector of regressors which enters both the transfer equation and the labour supply equation) variables which refer to skill level and labour market status of the parents. These include indicator variables on whether the father works, is self employed, works on a farm, and whether the mother works. We also include variables on educational background of father and mother (which measure their school leaving age, see table 1). These variables are likely to be related, on the one side, to preferences and opportunities of the child regarding part time work. On the other side, they may be related to parental judgements about the amount of transfers which should be allocated to children. For instance, parental education may be related to the child's preferences for academic activities, thus reducing his/her propensity to work during school attendance. At the same time, better educated parents may have different opinions about the amount of pocket money beneficial for the child. Also, labour force status of the parents may pick up several effects on child's labour force participation: married women are often working in sectors which provide more easily part-time work for children. A self employed father, or a father who works on a farm may reflect a higher demand for the child's work inside the family business. We also include in X the type of school the child attends. Again, the school choice may be related to both parental preferences and to the child's "committed leisure", which includes all other demands on the child's time. Finally, we include in X regional indicators and a gender dummy.

One implication of our theoretical model is that family income enters the transfer equation, but not the hours worked equation, i.e. family income affects hours only through transfers. We implement this restriction by excluding parental income from the latter equation; we test this implication of our theoretical model below. Conditional on household income, transfer payments are likely to be related to other transfer commitments of the parent. Something which captures these commitments is the number of the child's siblings. We distinguish older and younger siblings since we expect the number of younger siblings to reduce transfers, whilst the number of older siblings (who are at least 16 years old) should have less effect on transfers, since these children are more likely to be financially independent. As an additional identification restriction, we therefore exclude the number of younger siblings from the labour supply equation. However, older siblings may create labour market opportunities for the teenager, and we include this variable in both transfer and labour supply equation.

To identify the effect of labour supply on parental transfers, we use scores from ability tests taken at the age of 11.[5] It is unlikely that scores at this age affect parental

[5]The ability index measures general maths and English skills at age 11.

transfers when the child is 16 years old (other than through labour supply); on the other hand, children with higher achievements in these tests are likely to learn more efficiently and, therefore, have more time available for other activities, like labour market participation. This variable reduces therefore the child's individual commitment to other activities. Alternatively, more able children may recognise their comparative advantage in studying and may hence supply less time to the labour market. Either way it seems an appropriate variable for the labour supply equation.

We have also some information about physical features of the child in our data. We have information about the height of the child, as well as to whether the child suffers from any physical handicap. Both features are likely to affect child's labour supply. Since much of the work done by children is manual, height could affect the employer's opinion about the employability of the child, as well as the teenager's capacity to do manual work. Both the height and physical handicaps are likely to affect the child's cost of accepting a job besides school. These variables are, furthermore, unlikely to affect transfer payments of the parent, conditional on the child's labour supply decision.

Our basic specification therefore includes in the transfer equation, but not the labour supply equation family income, and the number of younger siblings; it includes in the labour supply equation, but not the transfer equation ability scores at age 11, height, and an indicator variable whether the child suffers from any physical handicap. Below we investigate the robustness of our results if we relax these assumptions.

4 Results

We present results of the full model in table 4. The first two pairs of columns present results for the transfer equation. We report both the effect of the regressors while conditioning on labour supply (columns 1), and the total effect (columns 2), which in addition includes their impact coming through the labour supply equation and transmitted to transfers via the interaction parameter δ. The total effect thus combines both the direct and indirect effects. The last three sets of columns report the regressors' effects in the labour supply equation. Again, columns 3 are the conditional effects; columns 4 are the total effects on labour supply, including those coming through transfers via γ; columns 5 are the total effects on the labour force participation probability. We report coefficient estimates and t-ratios. Computation of the total effects and their standard errors is documented in the Appendix.

Our estimates of the effects of transfers on labour supply, and labour supply on transfers show that both affect each other, and the estimates of γ and δ are significant at the 5% level. Three additional pounds of cash transfer lead to a reduction in weekly labour supply by about 1 hour; on the other hand, each additional hour of work reduces cash transfers by about 36 pence, a larger impact given the means of the two variables. Conditional on transfers and labour supply, the correlation in the error term is positive, indicating that unobservables which lead to higher transfer payments imply also a higher labour supply propensity. However, the estimate of this parameter is hardly significant at the 10 percent level.

The threshold parameter D is highly significant and negative, as expected. It captures the effect of the child having to cover certain expenses from cash transfers (which is the case for about 40 percent of the sample). This in effect scales the transfer thresholds down to 69% of the original thresholds (which are, in pence per week, [0, 50, 100, 200, 300]).[6] Accordingly, a teenager with, for example, reported transfers in the range 100-200p who has to cover expenses from this can be viewed as if he had no expenses to cover and received transfers in the range 69-138p.

The estimates in columns 1 indicate that, among the occupational characteristics of the parents, and conditional on the child's labour supply, only the fact that the father is self employed has a significant and positive effect on transfers. In families where the father is self employed, transfer payments are by about 19 pence higher per week,

[6]Since the estimate for κ equals -0.369, $\tilde{\theta} = \theta\, e^{-0.369} = 0.691\,\theta$ for those who cover no expenses from their cash transfers.

Table 4: **Full model, transfers and labour supply**

	Transfer Payments				Labour Supply					
	1		2		3		4		5	
	Coeff	t-ratio	Coeff	t-ratio	Coeff	t-ratio	Coeff	t-ratio	Coeff	t-ratio
Constant	0.366	2.489	0.401	1.787	-0.092	-0.187	-0.224	-0.455	-0.086	-0.454
Father Works	-0.041	-0.914	-0.082	-1.774	0.107	1.543	0.122	1.851	0.047	1.855
Father Farmer	-0.043	-0.529	-0.095	-1.283	0.137	1.007	0.152	1.219	0.059	1.215
Father Self Employed	0.193	3.012	0.045	0.482	0.385	3.497	0.316	2.872	0.122	2.796
Mother Works	0.033	1.061	-0.030	-0.713	0.165	3.541	0.153	3.410	0.059	3.374
East	0.085	1.550	0.043	0.723	0.111	1.410	0.080	1.048	0.031	1.044
North West	0.187	3.384	0.254	4.464	-0.175	-2.028	-0.242	-2.847	-0.093	-2.826
Wales	0.231	3.368	0.343	4.732	-0.292	-2.485	-0.375	-3.278	-0.144	-3.239
North	0.163	2.630	0.313	4.099	-0.391	-4.164	-0.450	-4.909	-0.173	-4.743
Independent School	0.144	1.970	0.362	3.370	-0.569	-4.714	-0.621	-5.199	-0.239	-5.011
Comprehensive School	0.114	2.845	0.038	0.709	0.199	3.249	0.158	2.616	0.061	2.563
Modern School	0.048	1.084	-0.034	-0.626	0.214	3.140	0.197	3.012	0.076	2.947
Technical School	0.039	0.274	-0.051	-0.322	0.234	1.039	0.220	0.988	0.085	0.985
Age Father left school*	-0.130	-1.444	-0.004	-0.035	-0.330	-2.435	-0.283	-2.155	-0.109	-2.127
Age Mother left school*	-0.414	-3.720	-0.286	-2.090	-0.335	-1.863	-0.186	-1.036	-0.072	-1.031
Female	0.043	1.700	0.041	1.497	0.006	0.126	-0.009	-0.194	-0.004	-0.194
N. Older Siblings/10	-0.146	-0.757	-0.160	-0.836	0.035	0.114	0.088	0.298	0.034	0.298
Abil. Test Score A. 11/100	–	–	-0.092	-1.604	0.241	2.186	0.241	2.186	0.093	2.180
Height/100	–	–	-0.106	-0.923	0.276	1.013	0.276	1.013	0.106	1.011
Physical handicap	–	–	0.089	1.984	-0.232	-2.978	-0.232	-2.978	-0.089	-2.923
N. Younger Siblings/10	-0.799	-8.185	-0.799	-8.185	–	–	0.287	3.419	0.110	3.776
Log Household Income	0.231	6.445	0.231	6.445	–	–	-0.083	-3.433	-0.032	-3.761
Labour Supply (δ)	-0.383	-3.889	–	–	–	–	–	–	–	–
Transfers (γ)	–	–	–	–	-0.359	-2.235	–	–	–	–
Other Model	Correlation u, v: 0.267; t-value: 1.631. Var(v): 0.730; t-value: 69.288.									
Parameters	Threshold Parameter D: -0.369; t-value:-26.076. Model Likelihood: -8762.76.									

Note: South West is the base category. Columns 1: Parameter Estimates, Transfer Equation; Columns 2: Total Effects; Columns 3: Parameter Estimates, Labour Supply Equation; Columns 4: Total Effects, Labour Supply; Columns 5: Total Effects, Participation Probability.

conditional on labour supply of the child. This effect can be interpreted as an indication of self employed parents having a higher preference for transfers, which could be due, for instance, to larger altruistic commitments to the offspring. Various explanations for this are possible - for instance, families with self employed family members may have developed a stronger sense for family integrity and mutual support.

However, the combined effect of this variable is zero, as indicated by the estimates in columns 2.[7] The reason is that children of self employed fathers have a higher propensity to work (see columns 3); since working reduces transfers, the direct and indirect effects cancel out. Therefore, while our structural estimates indicate a higher propensity of parents to give cash transfers in families where the father is self employed, simple estimations which do not take account of the interdependent nature of transfers and labour supply would not be able to detect this effect, since estimates would be not dissimilar to the total effects reported. This underlines the importance of structural estimation when identifying the effect of family background characteristics on these two outcomes. Similar observations can be made with respect to other regressors.

Notable is the negative relationship between parental education and transfer payments. Both father's and mother's education reduce transfers, with mother's education having a more pronounced effect. Thus, conditional on family income, better educated parents seem to find it preferable to be less generous with cash transfers towards their offsprings. Again, the total effects are less pronounced, due to the negative effect of parental education on labour supply.

The effect of younger siblings on transfers is negative, as expected. Its coefficient is very precisely estimated, but the effect is modest, with each additional sibling reducing transfers by about 8 pence per week. Parental income has a positive impact on transfer payments, and the estimate on the log income variable is rather well determined. Evaluated at the mean of transfers, the elasticity estimate is about 0.19: A 10 percent increase in household income increases transfer payments by about 1.9 percent. This

[7] The combined effects refer to regime I, where $h^* > 0$ and $t^* > 0$.

effect translates approximately into an increase in transfers of 50p per 100 pounds of additional family income.

An important implication of our theoretical model is that parental income should affect child's labour supply only indirectly, via the transfer equation. We test this assumption by including the log income measure in both labour supply and transfer equation. We maintain the exclusion restriction on the number of younger siblings from the labour supply equation. The estimated coefficient of log income on labour supply is small and negative, and not significant (coefficient estimate -0.044; t-value 0.55). Estimates of other model parameters, in particular δ, γ and ρ, are very similar to those reported in the table. This result is in accordance with our theoretical model, where income should relate only indirectly to the child's labour supply.

The ability score variable, the individual's height, and whether the individual is suffering from physical disabilities affect transfers only via their effect on labour supply. Accordingly, their direct effects are zero. Through its negative effect on the child's participation propensity, physical handicap increases transfer payments by about 9p per week - a modest effect. Similarly, through its effect on labour supply, higher ability scores at age 11 they decrease transfer payments slightly. Height has no significant effect on labour supply.

The last three columns present results for the labour supply equation. Noteworthy are the positive effects of the father being self employed on the labour supply of his offspring, and of the mother participating in the labour market. Both, conditional and total effects, are of similar magnitude. As the last column indicates, children of fathers who are self employed have a 12 percent higher probability to work part time. This most likely reflects an early involvement of the child in the parental business. The positive effect of the mother working may reflect better access of children to appropriate part time jobs, since female jobs may quite often be appropriate for teenagers.

The effects of the different school types are all relative to grammar school. The strongest effect is for attendance of an independent (fee-paying) school, with similar magnitudes of direct and total effects. Attendance at an independent school reduces participation probabilities by some 24 percentage points. This may reflect a stronger time commitment of the child to this type of school. On the other side, children who attend modern or comprehensive schools tend to work more, relative to grammar schools.

As for transfers, education of the parents reduces labour supply. This may suggest that better educated parents are more concerned about educational achievements of their offspring, which they may perceive as being detrimentally affected by part time work. As mentioned above, physical appearance seems not to be related to labour supply, as the positive, but insignificant coefficient on the variable for height indicates. However, those with higher ability scores tend to have a higher supply propensity. Also, being physically handicapped leads to a reduction in labour supply.

Parental income and the number of younger siblings affect labour supply only indirectly, via transfer payments. These indirect effects are precisely estimated, and significant at the 5 percent level. By reducing transfers, younger siblings increase labour supply; similarly, an increase of family income decreases labour supply. Evaluated at the mean of family income, an increase by 100 pounds of weekly income decreases the probability that the child participates by about 6.4 percentage points. This may seem to be a modest effect; however, it has quite strong implications for labour supply decisions (and the possibly detrimental effects on school performance) of children who belong to families at the top and bottom percentiles of the income distribution. Also, considering that the way parental income affects labour supply is through transfer payments for teenager's consumption, the effects are quite sizable.

4.1 Robustness Checks

We provide some robustness checks for our results. As we discussed above, the parameters δ and γ are identified by the regime structure of the model. In table 5, we report results of the model which imposes the same exclusion restrictions as the model in table 4 (upper panel), and a model where identification relies only on the regime structure with no exclusion restrictions imposed (lower panel) - we refer to the former specification as model 1 and to the latter as model 2. The first three pairs of columns report results for specifications where $\rho = \gamma = 0$, $\rho = \delta = 0$, $\rho = 0$; the last column reports results with no restrictions imposed on these parameters. For model 2, the estimation of this last specification relies heavily on parametric identification, and the likelihood did not converge.

Table 5: **Robustness Checks**

	1		2		3		4	
	Coeff	t-ratio	Coeff	t-ratio	Coeff	t-ratio	Coeff	t-ratio
Labour Supply	-0.403	-11.910	–	–	-0.274	-2.898	-0.383	-3.884
Transfers	–	–	-0.395	-13.309	-0.131	-1.497	-0.357	-2.223
Corr(u,v)	–	–	–	–	–	–	0.266	1.628
Model Likelihood	-8767.17		-8770.90		-8765.71		-8764.80	
Labour Supply	-0.4019	-11.931	–	–	-0.435	-2.890	–	–
Transfers	–	–	-0.385	-12.851	0.031	0.255	–	–
Corr(u,v)	–	–	–	–	–	–	–	–
Model Likelihood	-8751.67		-8763.68		-8751.64		–	

When estimating γ and δ in isolation, and without imposing exclusion restrictions (results in columns 1 and 2), estimates are nearly identical for models 1 and 2. This may be interpreted as an indication that estimates of these parameters are not very sensitive to the exclusion restrictions. When we estimate both parameters jointly (columns 3), we obtain a slightly larger estimate of δ in model 2. Furthermore, the estimate of γ is close to zero in this model, but it is also insignificant in model 1. This suggests that estimation of this parameter is sensitive to regime selection. Furthermore, in model 2, the likelihoods of specifications 1 and 3 are almost identical, while the likelihood of specification 2 is significantly smaller. Therefore the contribution to the likelihood of including transfers as a regressor in the labour supply equation is small.

Moreover, the difference in the likelihood between specifications in columns 3 and

4 for model 1 are also very small, and specification 3 cannot be rejected. The same is true when comparing specifications 1 and 4 of model 2, where specification 1 is rejected at the 10 percent level of significance, but not at the 5 percent level. We may conclude from these tests that the estimation of the effect of labour supply on transfers is robust to various specifications, but the effect of transfers on labour supply is sensitive to the model specification.

The models we have estimated impose some overidentifying restrictions. We have estimated a wide range of specifications to investigate the robustness of results to these exclusions. The model without exclusions imposed, discussed above, may be seen as one extreme benchmark. When we exclude the indicator variable for the child's physical handicap, and the height of the child from the model (and, therefore, impose only one exclusion on the transfer equation: ability scores), coefficient estimates are very similar to those in table 4, with parameters δ and γ being equal to -0.41 and -0.37, and both being well determined. Furthermore, $\rho = 0.30$, with a t-value of 1.78. When excluding the number of younger siblings, in addition, from the transfer equation (so that only income is excluded from the labour supply equation, and only ability scores from the transfer equation), the likelihood does not converge for the full model. When restricting ρ to zero, estimates are similar to those in table 5, with the effect of labour supply on transfers being negative and well determined, and the effect of transfers on labour supply, though being negative, not being significantly different from zero.

5 Conclusions

In this paper, we investigate the labour supply of children still living in the parental household and attending school full time together with the cash transfers they receive from their from parents. Both cash transfers and part time work are means for the child to acquire resources for consumption. They are likely to interact with each other, and appropriate modelling should take this into account. We first develop a simple theoretical model, where children condition their labour supply decision on transfers received, and where parents condition their transfer decisions on the child's labour supply. We use the insights provided by this model to specify an econometric model, which exploits direct observation on parental transfers to their children as well as information on the child's labour supply. Such data are rarely available, and our analysis is a first attempt at an empirical assessment of the determinants of the different income flows for teenagers still in full time education. In doing so it also contributes to the literature on intra-household allocation, including the interactive nature of this process.

We explicitly allow for the possibility that the teenagers' behaviour feeds back to affect that of the parents in their decision of what transfers to give, and vice versa. Our findings suggest that teenagers' labour force participation does indeed reduce parental transfers. Furthermore, we find some evidence that in turn the transfers reduce the hours worked and participation probabilities of the children. However, while the effect of hours worked on transfers is very robust, the effect of transfers on hours worked is less well determined, and sensitive to the specification of the model. As regards the effect of other model regressors on the two decisions, our analysis emphasises the importance of modelling processes within the household in a fully structural model. We demonstrate that estimation in a reduced from model may lead to misleading conclusions about the effect of other variables on any of the two decisions.

One important result on family factors is that family income has no significant direct effect on labour supply, but a positive effect on transfers. By way of increasing transfers, it may reduce labour force participation of teenagers. Bigger effects on both participation and transfers were found from some of the variables capturing parental labour force status and occupation. Use of a structural model to disentangle direct and indirect effects proved important here, especially as these were sometimes opposite in sign. Interesting is also the effect of parental education, which reduces both labour supply of children (conditional and unconditional on transfers), and transfer payments (conditional and unconditional on labour supply).

References

- Basu, K. (1999): "Child Labour, Cause, Consequence and Cure, with remarks on International Labour Standards", Journal of Economic Literature, 37, 1083-119.
- Becker, G.S. (1974): "A Theory of Social Interaction", Journal of Political Economy, 1063-94.
- Becker, G.S. (1981): "Altruism in the Family and Selfishness in the Market", Economica, 48, 1-15.
- Becker, G.S. (1993): A Treatise on the Family, enlarged edition, Cambridge, Mass.: Harvard University Press.
- Becker, G.S. (1981b): "Altruism in the Family and Selfishness in the Market", Economica, 48, 1-15.
- Bergstrom, T.C. (1989): "A Fresh Look at the Rotten Kid Theorem-And Other Household Mysteries", Journal of Political Economy, 97, 1138-1159.
- Blundell, R. and Smith, R. (1989): "Estimation in a Class of Simultaneous Equation Limited Dependent Variable Models", Review of Economic Studies, 56, 37-58.
- Dustmann, C., Micklewright, J., Rajah, N. and S. Smith (1996), "Earnings and Learning: Educational Policy and The Growth of Part-Time Work by Full-time Pupils" Fiscal Studies, pp. 79–103, 1996.
- Dustmann, C., Rajah, N. and S. Smith (1997), "Teenage Truancy, Working Habits and Wages", Journal of Population Economics, 10, 425-442.
- Juerges, H. (2000): "Of Rotten Kids and Rawlsian Parents: The Optimal Timing of Intergenerational Transfers" Journal of Population Economics, 13, 147-157.
- Maddala G.S. (1983): Limited-Dependent and Qualitative Variables in Econometrics, Cambridge University Press.
- Michael R.T. and Tuma N.B. (1984): "Youth Employment: Does Life Begin at 16?", Journal of Labor Economics, 2(4), 464-476.
- Micklewright, J. (1986): "A Note on Household Income data in NCDS3", NCDS User Support Group Working Paper 18, City University.

- Micklewright, J., Rajah, N. and Smith, S. (1994): "Labouring and Learning: Part-Time Work and Full-Time Education", National Institute Review, 148, 73-85.

- Pradham, M. and A. van Soest (1995): "Formal and Informal Sector Employment in Urban Areas in Bolivia", Labour Economics, 2(3), 275-298.

- Rosenzweig, M.R. and R. Evenson (1977): "Fertility, Schooling, and the Economic Contribution of Children in Rural India: An Econometric Analysis", Econometrica, 45, 1065-1079.

- Sly, F. (1993): "Economic Activity of 16 and 17 year olds", Employment Gazette, July, 307-12.

- van Soest, A., A. Kapteyn and P. Kooreman (1993): "Coherency and Regularity of Demand Systems and Inequality Constraints", Journal of Econometrics, 57, 161-188.

Appendix

Derivation of Likelihood Function

To derive the likelihood, define j and k as indices which denote the category in which t^* and h^* fall for some observation. Furthermore, denote by μ_j and θ_k the (known) thresholds of the respective range of categories. The categorical variables are defined as

$$j = \begin{cases} 0 & : \quad \mu_{-1} < h^* \leq \mu_0 \\ 1 & : \quad 0 < h^* \leq \mu_1 \end{cases} \tag{13}$$

$$k = \begin{cases} 0 & : \quad \theta_{-1} < t^* \leq \theta_0 \\ 1 & : \quad \theta_0 < t^* \leq \theta_1 \\ 2 & : \quad \theta_1 < t^* \leq \theta_2 \\ & \quad . \; . \\ & \quad . \; . \\ K & : \quad \theta_{K-1} < t^* \leq \theta_K \end{cases} , \tag{14}$$

where μ_{-1} and θ_{-1} are equal to $-\infty$, μ_1 and θ_K are equal to ∞ and μ_0 and θ_0 are equal to zero.[8]

As indicated by (11), any pair of observations may fall in one of four regimes. The contribution to the likelihood of a pair of observations $[k, j]$ is then given by

$$Prob(j,k) = Prob(\mu_{j-1} < h^* \leq \mu_j, \, \theta_{k-1} < t^* \leq \theta_k) \, , \tag{15}$$

where pairs of observations with $j = 1 \, ; \, k \in [1, K]$ fall in regime (I), with $j = 1 \, ; \, k = 0$ in regime (II), with $j = 0 \, ; \, k \in [1, K]$ in regime (III) and pairs with $j = 1 \, ; k = 0$ in regime (IV).

For illustration, we derive the contribution to the likelihood of a pair which falls in regime (I), i.e. a person who both participates and has positive transfers. For u and v being jointly normally distributed with variances σ_u^2 and σ_v^2 and covariance σ_{uv}, Prob(j, k) can be written as

$$\begin{aligned} \text{Prob}(j,k) = & \; F(\epsilon_1/\sigma_{z_1} < -[\mu_0(1-\gamma\delta) - Z'\alpha - \gamma\, X'\beta]/\sigma_{z_1}, \epsilon_2/\sigma_{z_2} < [\theta_k(1-\gamma\delta) - \delta\, Z'\alpha - X'\beta]/\sigma_{z_2}, -\rho) \\ & -F(\epsilon_1/\sigma_{z_1} < -[\mu_0(1-\gamma\delta) - Z'\alpha - \gamma\, X'\beta]/\sigma_{z_1}, \epsilon_2/\sigma_{z_2} < [\theta_{k-1}(1-\gamma\delta) - \delta\, Z'\alpha - X'\beta]/\sigma_{z_2}, -\rho) \, , \end{aligned} \tag{16}$$

[8] In order to reduce the estimation problem to a reasonable level we reduce the transfer categories from 8 to 6, combining ranges (a) 50-74p and 75-99p, and (b) 100-149p and 150-199p.

where $\epsilon_1 = u + \gamma\, v$ and $\epsilon_2 = v + \delta\, u$ are jointly normally distributed with variances $\mathrm{Var}(\epsilon_1) = \sigma^2_{\epsilon_1} = \sigma^2_u + \gamma^2\, \sigma^2_v + 2\,\gamma\, \sigma_{vu}$ and $\mathrm{Var}(\epsilon_2) = \sigma^2_{\epsilon_2} = \delta^2\, \sigma^2_u + \sigma^2_v + 2\,\delta\, \sigma_{vu}$, covariance $\mathrm{Cov}(\epsilon_1, \epsilon_2) = \sigma_{\epsilon_1 \epsilon_2} = \sigma_{uv}\,(1 + \gamma\,\delta) + \delta\, \sigma^2_u + \gamma\, \sigma^2_v$, and error correlation $\rho = \sigma_{\epsilon_1\epsilon_2}/(\sigma_{\epsilon_1}\sigma_{\epsilon_2})$. $F(.,.,.)$ denotes the standard bivariate normal distribution function.

The contributions to the likelihood of observations which fall into any of the other regimes are derived in a similar way. Notice that the composite error terms differ in each of the four regimes. This requires a different normalization for each regime. The log likelihood function is then given by the following expression:

$$ln\, L = \sum_{j=1\,,\,k \in [1,K]} ln\, Pr(j,k) + \sum_{j=1\,,\,k=0} ln\, Pr(j,k) + \sum_{j=0,\,k \in [1,K]} ln\, Pr(j,k) + \sum_{j=0,\,k=0} ln\, Pr(j,k)\,. \tag{17}$$

Marginal Effects

For regime I ($h^* > 0$, $t^* > 0$), the transfer equation and the hours worked equation can be written as

$$h^* = Z'\alpha + \gamma\, X'\beta + u + \gamma\, v\,, \tag{18}$$

and

$$t^* = X'\alpha + \delta\, Z'\alpha + v\, + \delta\, v\,. \tag{19}$$

The marginal effect of a variable y on the participation probability, given that $t^* > 0$, is given by

$$\kappa = \phi[(Z'\alpha + \gamma\, X'\beta)\frac{1}{\sigma_{\epsilon_1}}]\, \frac{1}{\sigma_{\epsilon_1}}\, [\tilde{\alpha} + \gamma\, \tilde{\beta}]\,, \tag{20}$$

where $\sigma^2_{\epsilon_1} = \sigma^2_u + \gamma^2\, \sigma^2_v + 2\,\gamma\, \sigma_{uv}$ is the composite variance term for regime I and ϕ denotes the density of the standard normal distribution. Furthermore, $\tilde{\alpha}$ and $\tilde{\beta}$ are the estimated parameter vectors α and β which contain zero elements at the places where variables are excluded from the respective equation. Both have therefore the same dimension.

Standard errors are derived by the Delta-method. The covariance matrix is given by

$$\left[\frac{d\,\kappa}{\delta\,\tau'}\right]\, \Sigma\, \left[\frac{d\,\kappa}{\delta\,\tau'}\right]'\,, \tag{21}$$

where τ is a parameter vector $[\alpha|\beta|\sigma_u|\rho|\gamma]'$ and Σ is the corresponding covariance matrix. The derivation of the score vector $\frac{d\kappa}{\delta\tau^\theta}$ is tedious, but straightforward.

Marginal effects and standard errors for (19) are derived in a similar way.