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In-school labour supply, parental transfers, and wages

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Abstract In many industrialised countries, teenagers have a significant spending power, and they are important customers for specialised industries. The income of teenagers still in full time education comes from two major sources: parental pocket money and earnings from part-time jobs. Little is known about the way these sources interact, and how they depend on parental, school and family characteristics. In this paper, we analyse labour supply of 16 year old British teenagers together with the cash transfers made to them by their parents. We first develop a theoretical model, where labour supply and transfers are jointly determined. We then estimate labour supply and transfers jointly, using unique data on labour supply of teenagers, the wages they receive, and the transfers from their parents. We show how these two processes depend on each other, and how transfers and labour supply react to changes in wages.

Keywords Intra-household transfers · Child labour supply

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1 Introduction

This paper analyses teenager labour supply and transfers of parents to teenagers. We first develop a framework that does justice to the potential interactions between these two processes. The theoretical model motivates an econometric model explaining both transfers and labour supply, taking into account interdependencies between the two as well as a wide range of other factors, such as family background and parental income. We estimate the effects of parental transfers on a teenager's labour supply as well as the effect of the teenager's work decision on parental transfers. In addition, we analyse how both labour supply and transfer payments depend on background variables and react to changes in the wage rate.

There are some related models in the literature on 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 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, e.g., Bergstrom 1989; Juerges 2000). In our model, the child chooses his or her labour supply, taking transfers of the parents into account, while altruistic parents choose the optimal transfers, taking the child's labour supply decision into account.

Our data, which stems from the British National Child Development Survey (NCDS), is unusually rich in information for the purpose of our study. It does not only include intra-household transfers and information on children's labour supply as well as weekly wages, but also a large set of family background variables and characteristics of the children, such as the parents' education levels and labour force status and a uniform test measure of the child's reading and math ability. This enables us to estimate a structural empirical model in which transfers and labour supply are jointly determined.

Parental transfers and teenage labour supply are important for several reasons. In Western countries teenagers have become important consumers of items like clothing and specific leisure articles, and they are targeted by specialist industries. Part-time work during full time education may also have effects on the well-being of the child, over and above the direct purpose of obtaining additional resources. One concern may be the impact of part-time work on educational achievement. Tyler (2003) found a negative effect of labor supply of twelfth grade students in the US on math scores. Similarly, Dustmann et al. (1997) found that part-time work during full time education has negative effects on examination results of 16 year old teenagers in the UK, but Dustmann and van Soest (2007) find that this effect is no longer significant when potential endogeneity is controlled for. Ehrenberg and Sherman (1983) investigate the effect of part-time work during full-time education on academic performance and subsequent enrollment, and find a negative effect on enrollment and probabilities of graduating in time. Eckstein and Wolpin (1999) also find that working while in school reduces school performance. On the other side, working part-time during full time education may provide teenagers with a taste of what the real labour market is

like, and allow them to make more informed career choices. Ruhm (1997) and Light (2001) find a positive correlation between job commitment at high school and future economic outcomes, while Hotz et al. (2002) argue that positive effects diminish and are not statistically significant when controlling for dynamic selection.

Either way, parents may want to have some influence on their children's part-time work. One way to do that is to regulate the second source of income which, besides odd jobs, funds teenagers personal consumption: parental cash transfers. Teenagers may reduce their willingness to work part-time when transfers are increased. There are a number of studies that analyse the transfer of parental resources to adult children (see e.g. Altonji et al. 1997; Dunn and Phillips 1997; Hochguertel and Ohlsen 2000), but there is hardly any work that investigates the relationship between parental transfers and part-time work for teenagers still in full time education. The only study we are aware of is Wulff Pabilonia (2001) who studies data from the NLSY 1997. She finds a negative and statistically significant relationship between parental allowances and the probability of employment for 14–16 year olds.

The relationship between part-time work of school children and parental allowances may go either way, however. Parental pocket money may not only influence the child's part-time work, but in a model in which the parent is altruistic and the utility of the child enters the parent's utility function, the child's decision to take up a part-time job may also affect transfers to the child from the parent. As a consequence, any negative correlation between the child's labour supply and transfers may be either due to children reacting to changes in parental allowances, or parents reacting to their child's labour supply decisions, or both. Analysing part-time work of teenagers, or parental transfers, in isolation may therefore result in misleading conclusions.

The structure of the paper is as follows. In the next section, some evidence of children's pocket money allowances and labour supply is presented. A theoretical framework that helps us to understand the interactive nature between parental transfers and children's labour supply is developed in Sect. 3. In Sect. 4, we discuss the data and variables, and present the empirical model. Results of the analysis are presented in Sect. 5. Section 6 concludes.

2 Part-time work of children and parental allowances

Labour force participation of teenagers still in full time education is substantial. In the US, the sizeable employment rates among 14 and 15 year olds in school have long been known, with rates of about 25% at the end of the 1970s, rising to 50% for 17 year olds (Michael and Tuma 1984). Wulff Pabilonia (2001) reports, again for the US, that in 1996, 56% of 16-year olds hold a job. In Britain, rates of between 30 and 50% for 16 and 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 et al. 1994). More recent numbers suggest that in 1999, about 52% of 16 and 17 year olds in full time education were also working part-time (DFEE 1999). However, summarising three case studies for England, Hodgson and Spours (2001) argue that part-time work of full-time pupils may be as high as 70–80%.

The data we use for our study are drawn from the British 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, 33, and 42. 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.[1]

The NCDS3 data provide a rich source of information on the subject under investigation. Data were collected separately from four sources—from the children 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 5,035 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).

The survey provides detailed information on weekly parental cash transfers, and on labour supply of children. It also gives some details on how teenagers spend their money. In addition, we observe teenagers' weekly earnings in banded form, allowing us to construct hourly wages and to estimate their responsiveness to wage changes. In what follows, we report all wage, transfers, and income information in 2003 prices. Tables 1 and 2 provide information on the distributions of the two variables that we seek to explain, weekly hours of work and transfers, separately for girls and for boys. The first column reports the mean of hours worked, evaluated at the midpoints of the banded hours information. Teenage boys work slightly more hours on average than teenage girls—4.09, as compared to 3.61. There is a stark difference in labour supply for those who do and do not receive transfer payments, with those who receive transfers working less than half as many hours than those who do not receive any payments.

The next columns trace the distribution of hours worked, for all individuals, and those who do and do not receive transfer payments. Almost half of the individuals in our sample report a regular term-time job. This percentage is much higher for those who do not receive any transfers, where 85% participate. These numbers are nearly the same for boys and girls. The distribution of working hours is shifted to the right for those who do not receive transfers, and boys tend to be in the upper range of labour supply relative to girls.

The first column in Table 2 reports mean transfers for all individuals, and for those who do and do not work. Girls receive on average slightly higher transfers than boys—which could be related to their lower labour supply. There is a sizeable difference between transfer payments to individuals who work and those who do not work—for boys, labour market participants receive on average 6.81 pounds weekly transfers, while non-participants receive 9.15 pounds. The numbers for girls are 7.21

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

Table 1 Hours worked per week by transfer receipt

Hours	Mean[a]	None	< 3	3–6	6–9	9–12	12–15	15+	Total
Girls									
All	3.61	49.52	2.94	16.72	20.53	5.16	2.46	2.66	100
Transfers = 0	6.33	15.53	4.97	23.60	36.02	8.70	6.21	4.97	100
Transfers > 0	3.42	51.85	2.80	16.25	19.47	4.92	2.21	2.50	100
Boys									
All	4.09	48.30	6.47	13.09	13.69	6.92	4.84	6.69	100
Transfers = 0	7.95	15.23	6.17	16.46	17.70	15.23	12.76	16.46	100
Transfers > 0	3.70	51.65	6.50	12.74	13.29	6.08	4.04	5.71	100

[a] Evaluated at midpoints

Table 2 Transfer payments by employment status

Transfers	Mean[a]	None	[0, 3.50)	[3.50, 5.25)	[5.25, 7)	[7, 10.50)	[10.50, 14)	[14, 21)	21+	Total
Girls										
All	8.33	6.43	8.99	22.42	12.03	24.90	12.07	7.99	5.16	100
Hours = 0	9.47	2.02	6.63	20.53	12.37	26.60	15.04	10.59	6.22	100
Hours > 0	7.21	10.75	11.30	24.27	11.70	23.24	9.17	5.45	4.11	100
Boys										
All	7.94	9.30	8.76	23.96	12.02	21.97	11.02	8.19	4.78	100
Hours = 0	9.15	2.93	6.74	22.50	12.28	25.83	13.95	9.67	6.10	100
Hours > 0	6.81	15.25	10.66	25.31	11.77	18.36	8.29	6.81	3.55	100

Transfer brackets are in pounds per week in 2003 prices
[a] Evaluated at midpoints

and 9.47 pounds. The following columns trace the distribution of transfer payments for the three groups. The great majority of teenagers receive some cash transfers from their parents, with the percentage of boys receiving no payments being slightly higher than that of girls. Also, among those who work, the percentage of boys receiving no transfers is higher than the percentage of girls. The amounts of transfers vary considerably, but the overall distributions are roughly similar for boys and girls. About 1 in 11 receive positive amounts of less than 3.50 pounds per week, while 1 in 8 receives 14 pounds or more.

The numbers in Tables 1 and 2 suggest that transfer payments and hours of work are two processes which interact strongly, with those receiving transfers having lower participation probabilities, and those working receiving less transfers. However, these numbers are unconditional, and allow no conclusions to be drawn about the possible causality, or the way transfers and labour supply relate to common observable and unobservable factors. Below we specify and estimate an empirical model for these processes. Our model takes also account of responsiveness of both processes to wages teenagers receive. Our empirical specification is motivated by a theoretical framework

for modelling the two processes within a family unit, which we set out in the next section.

3 A model of labour supply and transfers

3.1 The general framework

We develop a simple theoretical framework for the relationship between parental allowances towards the child and the child's part-time work decision. We consider an altruistic parent (p) and a selfish child (c). In our model, the parent sets the optimal level of transfers subject to his or her own budget constraint, taking account of the child's labour supply decision. In turn, the child chooses the optimal supply of labour, conditional on the parent's transfer payments. We first present the model without taking account of non-negativity constraints on transfers or hours. Formally, the child solves the utility maximisation problem:

$$\text{Maximize}_H \quad U^c(x^c, L) \quad \text{subject to}\, x^c = wH + T \quad \text{and} \quad L = 1 - H\,, \tag{1}$$

where x^c is the child's consumption paid from transfers and own earnings, L is leisure time, and H is hours worked. We have normalised the total time available for leisure and work activities to 1. The child's net hourly wage rate w is assumed not to depend on hours worked; non-proportional earnings taxes are irrelevant for the small amounts that teenagers typically earn. Finally, T denotes transfers from the parent to the child. We will focus on the case of a Nash equilibrium or a Stackelberg equilibrium with the parent as leader, in both of which the child takes T as given. The utility function U^c is assumed to be quasi-concave and increasing in its first argument.

The altruistic parent is assumed to solve the following problem:

$$\text{Maximize}_T \quad U^p(x^p, u^c) \text{ subject to } x^p = \delta I - T \quad \text{and} \quad u^c = U^c(wH + T, 1 - H) \tag{2}$$

Here I denotes family income excluding the child's earnings and δI is the non-committed part of income that can be allocated for either family consumption (of a composite commodity x^p) or can be transferred to the child. The standard model with $\delta = 1$ is a special case. In case of a Nash equilibrium, the parent takes H as given. In a Stackelberg equilibrium with the parent as leader, H is a function of T (depending on the specification of U^c and the wage rate w). Both strategies lead to observationally equivalent first order conditions and to estimation equations where parental income affects labour supply only through transfers and not through parental income I. In a linear model without non-negativity constraints on hours and transfers, the "exclusion restriction" that I has no direct effect on H is needed for identification. In the current model with binding non-negativity constraints (see below), the econometric model is still identified if I is added to the labour supply equation, so that the exclusion restriction can be tested.

We consider here the Nash equilibrium, determined by the first order conditions for child and parent:[2]

$$\frac{\partial U^c}{\partial L} = w \frac{\partial U^c}{\partial x^c} \tag{4}$$

and

$$\frac{\partial U^p}{\partial x^p} = \frac{\partial U^p}{\partial U^c} \frac{\partial U^c}{\partial x^c} \tag{5}$$

In (2), we have assumed that parent and child use the same child utility function. With the data we have, relaxing this assumption would lead to an unidentified model. The assumption would not be valid if, for example, children are less forward looking than their parents or have higher discount rates, and working more leads to less investment in schooling. As discussed in the introduction, the existing literature is not unanimous on whether intertemporal considerations play a role. We do not incorporate them in our model.

Another assumption in (2) is that parents can only influence their child's labour supply through financial transfers and cannot directly control H. This assumption is not necessary, however, given the previous one—which implies that the labour supply outcome will be the same irrespective who decides.

3.2 Deriving estimation equations

The first order conditions in (4) and (5) provide the structure for empirical estimation. To derive the estimation equations, we choose particular functional forms. For the parent's utility function, we choose the following generalised Cobb–Douglas specification:

$$U^p(x^p, u^c) = (x^p + \gamma_0)^{\gamma_1} (u^c)^{\gamma_2} \tag{6}$$

For the child's preferences we choose the specification of Hausman (1985), giving rise to a linear labour supply function:

$$U^c(x^c, L) = (\alpha_2(1 - L) - \alpha_1) \exp\left(\frac{\alpha_2(\alpha_0 + \alpha_2 x^c - (1 - L))}{\alpha_2(1 - L) - \alpha_1}\right) \tag{7}$$

[2] For the Stackelberg equilibrium with the parent as leader, the first order conditions are given by (4) and

$$\frac{\partial U^p}{\partial x^p} = \frac{\partial U^p}{\partial U^c}\left(\frac{\partial U^c}{\partial x^c} + \frac{dL}{dT}\left[\frac{\partial U^c}{\partial L} - w\frac{\partial U^c}{\partial x^c}\right]\right). \tag{3}$$

where dL/dT is the slope of the child's reaction curve. Since (4) implies that the term in square brackets is zero, this gives the same solution as the Nash equilibrium. Similarly, the "equilibrium" in which the parent acts as an altruistic dictator and determines both H and T gives the same solution, since H enters U^p only through U^c. Only the Stackelberg equilibrium with the child as leader would give a different solution.

with $\alpha_1 > 0$ and $\alpha_2 < 0$ (to guarantee that the utility function is quasi-concave and increasing in its first argument). The labour supply function is given by:

$$H = \alpha_0 + \alpha_1 w + \alpha_2 T \tag{8}$$

This specification has been used quite often in the labour supply literature (see Blundell and MaCurdy 1999).[3]

Combining (8) with parental preferences in (6) gives the following first order condition for transfers:

$$T = \pi_0 + \pi_1 I + \pi_2 H \tag{9}$$

where $\pi_0 = \gamma_0 - \gamma_1\alpha_1/(\gamma_2\alpha_2^2)$, $\pi_1 = \delta$, and $\pi_2 = \gamma_1/(\gamma_2\alpha_2)$.

Note that this model implies $\pi_2 < 0$. The same equation with $\pi_2 = 0$ is obtained if parents simply choose transfers on the basis of their income and other characteristics (such as number of children), not accounting for the utility level of the child. This model is less attractive from a micro-economic theory point of view.

Both transfers and labour supply are censored at zero. For hours the need for this is obvious. For transfers, censoring implies that we do not allow for negative transfers, that is, transfers from child to parent. For the teenagers we consider this seems plausible, as they all go to school and only work part-time (at most). The survey question on transfers also imposes non-negativity.

The non-negativity constraints on H and T result in the following system:

$$H = \max(0, \alpha_0 + \alpha_1 w + \alpha_2 T) \tag{10}$$

$$T = \max(0, \pi_0 + \pi_1 I + \pi_2 H) \tag{11}$$

This system will have exactly one solution if $\alpha_2\pi_2 < 1$, i.e., if $(0 <)\gamma_1 < \gamma_2$.

Since $\alpha_2 < 0$, (10) 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 preferences for consumption and leisure time and on the wage rate. Transfer payments induce a negative income effect and reduce the participation propensity.

With $\pi_2 < 0$, (11) says that transfers are positive as long as the child's labour supply falls below a certain threshold, which depends positively on parental income, and on the parent's degree of altruism.

To identify the parent's utility function, a normalisation has to be imposed. Without loss of generality, we assume $\gamma_1 + \gamma_2 = 1$. With this normalisation, there is a one-to-one correspondence between the parameters in (10) and (11) and the structural parameters in the parent's and child's utility functions.

[3] We also estimated a generalized Cobb–Douglas similar to the utility function for the parents. This gave similar results but a lower goodness of fit.

4 Empirical model and estimation

The nature of our data, with labour supply and transfers censored at zero and observed as categorical variables only, makes estimation non-standard. We now discuss our empirical model and the way to estimate it, building on (10) and (11).

We allow for observed and unobserved heterogeneity in preferences of parents and children by specifying the parameters γ_0 (or π_0) in the parent's utility function and α_0 in the child's utility function as linear functions of observed background characteristics (denoted by X_T and X_H, respectively) and error terms (ϵ_T and ϵ_H, respectively).[4] The other preference parameters are assumed to be the same for all observations in the sample. This gives the following model:

$$H = \max(0, X_H\,\alpha + \alpha_1 w + \alpha_2 T + \epsilon_H) \tag{12}$$

$$T = \max(0, X_T\pi + \pi_1 I + \pi_2 H + \epsilon_T)\,, \tag{13}$$

where α and π are vectors of parameters. The error terms are assumed to have normal distributions with mean zero and unknown variances, independent of the background characteristics, income, and wage rates, and independent of each other.[5]

The model can be estimated by maximum likelihood. As explained above, only categorical information on the variables H and T is available, including whether they are zero or not. The likelihood contributions are the probabilities of these categorical outcomes, jointly for both dependent variables. These are bivariate normal probabilities for ϵ_T and ϵ_H. Suppose, for example, a given observation has H in the hours category 9 – 12 and T in the transfers category 7.5 – 14. Since we observe that both H and T are positive, (12) and (13) for this observation imply that

$$H = X_H\,\alpha + \alpha_1 w + \alpha_2 T + \epsilon_H\,, \tag{14}$$

$$T = X_T\pi + \pi_1 I + \pi_2 H + \epsilon_T\,. \tag{15}$$

Solving for H and T gives

$$H = \frac{X_T\,\alpha + \alpha_1 w + \alpha_2(X_T + \pi_1\,I + \epsilon_T) + \epsilon_H}{(1 - \alpha_2\pi_2)}\,, \tag{16}$$

$$T = \frac{X_T\pi + \pi_1 I + \pi_2(X_H\alpha + \alpha_1 w + \epsilon_H) + \epsilon_T}{1 - \alpha_2\pi_2}\,. \tag{17}$$

For this observation, the likelihood contribution is the bivariate probability that H is between 9 and 12 and that T is between 7.5 and 14 given the regressors, which we have rewritten as the bivariate normal probability that two linear combinations of ϵ_H

[4] The index indicating the observation is suppressed.

[5] The latter is assumed mainly for computational convenience; without this assumption, analytical expressions for the likelihood contributions are still straightforward to derive but maximization of the likelihood will be more involved. Independence of errors is not needed for identification.

and ϵ_T are in some rectangle. Thus the likelihood contribution of this observation is a bivariate normal probability which is straightforward to compute.

For other types of observations, likelihood contributions can be derived in a similar way (if $H > 0$ and $T > 0$) or in an easier way (if $H = 0$ or $T = 0$). For example, if $H = 0$ and $T = 0$ the likelihood contribution is the bivariate normal probability $Pr(\epsilon_H < -X_H\alpha - \alpha_1 w; \epsilon_T < -X_T\pi - \pi_1 I | X_H, w, X_T, I)$. Thus the likelihoods are similar to those of a bivariate ordered probit model, but the censoring at zero adds another complication.[6]

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, however, also has 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 in the empirical model. We multiply transfer amounts that are reported to include amounts to be spent on travel, clothes, etc., by a correction factor τ, to transform them into corresponding transfer amounts that do not include these expenditures. The parameter τ will be estimated jointly with the other parameters; we expect it to be smaller than one.[7]

The model is identified without exclusion restrictions on X_H or X_T, as w enters the equation for H but not the equation for T, while family income I enters the equation for T but not the equation for H. These exclusion restrictions are implied by the economic framework in Sect. 3. Second, additional identification comes from the particular regime structure of the model, implying that the model is still identified without these exclusion restrictions. Intuitively, this can be seen from the reduced form for the various regimes. Consider the case without w or I in the equations. H depends on $X\alpha$ if $T = 0$ but on $X(\alpha + \alpha_2\pi)$ if $T > 0$. As a consequence, both α and $\alpha + \alpha_2\pi$ are identified. A similar argument for T shows that both π and $\pi + \pi_2\alpha$ are identified. This implies that all structural parameters are identified without exclusion restrictions.[8] Because of this, the exclusion restrictions can be tested simply by estimating the model not imposing the exclusion restrictions and performing a Wald test.

5 Description of variables

The variables included in the vectors X_T and X_H are described in Table 3. In addition, we also condition on regional dummy variables in all estimations. The table presents means and standard deviations of the variables, separately for boys and girls.

Skill level and labour market status of the parents (indicators of whether the father works, is self employed, or works on a farm, and whether the mother works), as well as educational background of father and mother (their school leaving age) are likely to

[6] The model is well-defined (or coherent, see Gourieroux et al. 1980) if $\alpha_2\pi_2 < 1$. All our estimates satisfy this inequality without imposing it, implying that coherency is not a concern here (cf. Van Soest et al. 1993).

[7] In the likelihood, this is incorporated by multiplying the threshold values with $1/\tau$ for observations where expenditures on travel, clothes, etc. are included.

[8] This is the same as identification of a simultaneous Tobit model (cf. Gourieroux et al. 1980).

Table 3 Descriptive statistics explanatory variables

Variable	Girls		Boys	
	Mean/%	SD	Mean/%	SD
Father works	88.9		89.6	
Father self employed	4.1		3.9	
Father farmer	2.4		2.3	
Mother works	67.7		68.6	
Number of younger siblings	1.24	1.29	1.27	1.28
Number of Older siblings	1.10	1.31	1.09	1.34
Age father left school[a]	4.02	1.75	4.02	1.80
Age mother left school[a]	4.00	1.41	3.97	1.39
Ability test score age 11	45.13	20.09	45.76	21.17
Household income	350.58	134.41	346.22	124.71
Comprehensive school	53.2		55.6	
Grammar school	14.9		11.5	
Modern school	25.2		24.8	
Technical school	0.5		0.7	
Independent school	4.3		4.4	
Special needs school	1.6		2.3	
Wage rate	2.69	1.95	3.18	2.45

Means and standard deviations for continuous variables; the percentage with value 1 for dummy variables
Number of Observations in sample: 5035
Household income is 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
[a] Mothers' and Father's age when leaving full time education, minus 12

be related to the child's work preferences and opportunities, as well as to the parents' judgment about the optimal transfers. For example, married women are often working in sectors with opportunities for part-time work for teenagers. And a farmer or self employed father may have a demand for the child's work inside the family business.

The type of school the teenager attends may be related to both parental preferences and to the child's "committed leisure", which includes all other demands on the child's time. We include a vector of school type variables (see Dustmann et al. 2003 for details on the UK school system).

Conditional on household income, transfer payments are likely to be related to other transfer commitments of the parents. Such commitments depend on the number of the child's siblings. Our data allows us to distinguish older and younger siblings. We expect the number of siblings to reduce transfers, with the effect of younger siblings being stronger than the effect of older siblings (who are at least 16 years old), since the latter are more likely to be financially independent. Furthermore, older siblings may have experiences with part-time jobs, thus helping the younger teenager to find work, while younger siblings may impose constraints on the teenager's allocation of time, as they may have to be looked after in the parents' absence.

Our data has test score results from ability tests the teenager took at age 11, scaled between 0 and 100.[9] The academic potential of teenagers may affect their labour supply in various ways. High ability teenagers are more efficient in solving academic tasks and may need less time on studying, leaving more time for work. On the other hand, teenagers with a high academic potential may attach more importance to an academic education and refrain from activities that jeopardize their academic success. The effect of ability on labour supply is therefore ambiguous. Ability scores may also affect transfer payments—for example, parents may want to prevent children with weak academic performance from working part-time by increasing transfers.

The last row of Table 3 reports wage rates of teenagers. We have computed these from the midpoints of weekly earnings, divided by the midpoints of weekly hours worked.[10] The numbers suggest that wage rates of female teenagers are slightly lower than those of male teenagers: 2.7 pounds, as compared to 3.2 pounds.[11]

As we only observe earnings for individuals who work, we predict hourly wages of non-workers using a standard Heckman selection model for the log wage rate. Results for this model are presented in Table 5 in the appendix, separately for boys and girls. The model is identified by excluding parental education and household income from the wage equation. These variables are jointly significant in the participation equation for females (p-value 0.0005) but not quite for males (p-value 0.1189). The correlation between the errors in the two equations is significantly positive for both boys and girls, and of roughly similar magnitude, implying that those with higher propensity to participate can earn a higher wage, given their observed characteristics.

6 Results

We have estimated all models for the pooled sample, as well as for boys and girls separately. Since Likelihood Ratio tests strongly reject the pooled models, we only discuss separate models for boys and girls.

6.1 Labour supply and transfers

In Table 4, we present our estimation results of the labour supply equation (columns 1 and 3) and the transfer equation (columns 2 and 4). We report parameter estimates and their standard errors.

The effect of transfers on labour supply is significantly negative, in line with the theoretical model. Transfers induce an income effect, which reduces the child's labour

[9] The ability index measures general mathematics and English skills.

[10] The banded information on hours worked is described in Table 2; the bands for weekly earnings are 0, $(0, 7), \ldots, (35, 42), (42, \infty)$.

[11] Taking the mid point is admittedly an *ad hoc* solution and introduces a measurement error in wage rates. Given the narrow earnings bands we do not expect that this is important. In principle, this can be avoided by simultaneously estimating a wage equation, but this complicates model estimation substantially.

Table 4 Estimation results: hours worked and transfers, boys and girls

	Boys				Girls			
	Hours		Transfers		Hours		Transfers	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	1.565	1.632	7.188	0.729	1.817	1.324	6.654	0.696
Father works	0.437	0.658	−0.930	0.322	0.889	0.570	0.019	0.345
Father farmer	5.891	1.248	−0.461	0.672	−1.596	1.120	−0.229	0.641
Father self employed	2.626	1.073	0.068	0.468	0.718	0.895	1.092	0.538
Mother works	1.153	0.464	−0.079	0.233	1.084	0.374	0.252	0.240
East	0.675	0.824	0.991	0.431	−0.369	0.630	−0.482	0.404
North west	−0.115	0.843	1.965	0.438	−1.902	0.648	0.644	0.412
North	−1.632	0.925	2.188	0.469	−3.064	0.733	0.673	0.461
South west	−0.401	1.122	1.650	0.557	−3.433	0.901	1.803	0.504
Independent school	−5.877	1.217	0.872	0.613	−3.960	0.944	0.749	0.539
Special needs school	−3.627	1.349	−1.995	0.571	−3.463	1.381	−0.690	0.647
Modern school	0.714	0.496	−0.414	0.238	0.549	0.403	−0.244	0.245
Technical school	3.398	2.285	−0.013	1.069	−2.096	2.130	−1.521	2.752
Grammar school	−0.328	0.754	−0.180	0.437	−1.464	0.565	−0.183	0.382
Age father left school[a]	−0.253	0.141	−0.122	0.071	−0.302	0.115	0.009	0.067
Age mother left school[a]	−0.091	0.184	−0.239	0.096	−0.304	0.145	−0.237	0.081
Number of older siblings	0.020	0.158	−0.066	0.070	−0.337	0.141	0.031	0.070
Number of younger siblings	0.411	0.169	−0.432	0.076	0.040	0.137	−0.486	0.078
Ability test score age 11	−2.425	1.239	−1.269	0.615	3.866	1.049	−1.266	0.626
Household income/100	–	–	0.476	0.095	–	–	0.538	0.085
Adjustment parameter τ	–	–	0.676	0.012	–	–	0.725	0.013
Transfers	−0.302	0.131	–	–	−0.312	0.105	–	–
Hours worked	–	–	−0.078	0.050	–	–	−0.041	0.066
Wage rate	0.755	0.088	–	–	1.067	0.057	–	–
Error Variance	9.159	0.225	4.855	0.075	7.205	0.183	4.787	0.081
Log likelihood	−9108.41				−8564.86			
Number of observations	2563				2472			

[a] Mothers' and Father's age when leaving full time education, minus 12

supply. The estimates for boys and girls are very similar: −0.302 and −0.312 respectively. An increase in cash transfers by five pounds thus leads to a reduction in labour supply of about 1.5 hours per week. This is a sizeable effect, given that mean hours worked per week are 3.9 hours. It implies an income elasticity of teenagers' labour supply of about −0.6 at the mean, which is large compared to income elasticities of adult labour supply in the literature. This result is in line, however, with Wulff Pabilonia (2001) who, using US data, finds that parental allowances reduce employment for teenagers in the age range between 14 and 16 years of age.

The effect of hours worked on parental transfers is also negative, in line with the theory, but for both sexes, it is small and insignificant. Thus the hypothesis that parents simply choose the transfer level on the basis of their income and other characteristics rather than on the basis of altruistic utility maximization cannot be rejected.

Wage rates have the expected positive direct effect on labour supply. We first discuss the direct structural effect. Evaluated at the average level of transfers and wages, an increase in the wage rate by one pound increases labour supply by about 0.75 hours. The effect on girls' labour supply is considerably larger—an increase by one pound leads to an increase in the supply of labour by about 1.07 hours. This gives wage elasticities at the mean of about 0.56 for boys and 0.78 for girls, well within the broad range of labour supply elasticities found for adults in the labour supply literature.

As we discussed above, some teenagers receive transfers in kind, which we do not observe in our data. However, we have qualitative information on whether children are supposed to use received cash transfers for covering expenses like clothing, travel, etc. We have implemented this information in the model by multiplying transfer thresholds by a correction factor (see details in Sect. 4). The estimate of the threshold parameter is significantly smaller than one, as expected. It can be interpreted as capturing the difference between the utility of transfers for teenagers who do not (60% of the sample) and do (40%) have to pay certain expenses from their cash transfers. According to this estimate, a boy who obtains, for example, 10 pounds per week and has to cover other expenses is equally well off as if he had no expenses to cover and received 6.76 pounds per week. For girls, the corresponding number is slightly larger, at 7.25 pounds per week.

6.2 Parental income

An important variable is parental income. Parental income has a significant positive impact on transfer payments. An additional 100 pounds of weekly household income increases transfer payments by about 0.5 pounds, with similar effects for boys and girls.

Our theoretical model implies that parental income should not be included in the labour supply equation and affects labour supply only via transfer payments. We test for this exclusion restriction by estimating the model including income in both labour supply and transfer equations. Family income is insignificant in the labour supply equation, with a t-value for boys of 1.14, and for girls of 0.13.

Our model allows us to compute the marginal indirect effects of parental income on labour supply via the transfer equation. We consider the case where the non-negativity constraints are not binding, so that the reduced forms are given by (16) and (17). Standard errors are computed by simulating from the estimated asymptotic distribution of the parameter estimates (using 500 draws). These indirect effects are precisely estimated (absolute t-values above 2), and similar in size for both groups. On average, an increase of weekly parental income by 100 pounds reduces hours of work by about 0.14 for boys and 0.17 for girls.

6.3 Family and individual characteristics

We discuss some of the other coefficient estimates, starting with the labour supply equation. There are some interesting differences in parameter estimates between boys and girls. Most notable is the large and positive effect of fathers being self employed or farmers on the labour supply of boys. Teenage boys whose father is a farmer work about 6 hours more than other boys, and boys whose father is self employed work 2.6 hours more. This most likely reflects an early involvement of the child in the parental business or on the parental farm and may also be related to the teenager's plan to work in the family business after leaving school. Both variables have no impact on transfer payments. For girls the effects of these variables on labour supply are insignificant, but, other than for boys, the fact that the father is self employed increases transfer payments significantly, by about one pound per week.

Another notable difference between boys and girls is the effect of ability test scores on transfer payments and labour supply. While higher test scores significantly reduce labour supply for boys (the variable is scaled between 0 and 1), they have an opposite (and larger) effect on labour supply of girls. As we discussed above, both effects have an interpretation. On the one hand, high achievers may be more efficient in learning and understanding academic material, and therefore have more time for other activities like part-time work. The estimates suggest that this is the case for teenage girls. On the other side, those with high test scores may have higher returns from investments into academic education, and spend more time in learning activities. This interpretation seems to be supported by the data for teenage boys. An alternative interpretation for the difference is that girls work in different types of jobs, where part-time work gives a larger investment in skills that pay off in future earnings. For both boys and girls, higher test scores are associated with lower transfer payments. Although significant, these effects are very small.

Parental education is associated with lower labour supply for girls, while the effect is insignificant for boys. The effects of mother's and father's education on girls' labour supply are of roughly equal size and suggest that better educated parents consider part-time work of their daughters as less appropriate. They may have greater concern about educational achievements, which they may perceive as being detrimentally affected by part-time work. These concerns seem to be less prevalent for sons.

Notable is also the negative relationship between mother's education and transfer payments for both boys and girls, implying that, conditional on family income, better educated mothers consider generous transfer payments as less appropriate.

The effects of siblings on teenagers' labour supply are not in line with our expectations. We find a significantly positive effect of younger siblings on hours worked by boys, where we expected a negative effect if boys have to look after their younger siblings. The results suggest that this is not important for boys' labour supply. We also find a negative and significant effect of older siblings on hours worked by girls, whereas we expected a negative effect since older siblings may help the teenagers to become familiar with the labour market. Again, this suggests that this mechanism is

not important for girls. We find a negative effects of (older) siblings on transfers, in line with the notion that siblings are competing for scarce family resources.

7 Conclusions

In this paper, we investigated 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 parents. Both cash transfers and part-time work are means for the child to acquire resources for consumption. Descriptive statistics suggest that there is a strong association between parental transfer payments and labour supply of teenagers. They show that the two processes are likely to interact with each other, and appropriate modelling should take this into account. We first developed 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 used 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 and the wages teenagers receive.

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. The effect of teenagers' labour force participation on parental transfers is negative, but very small, and not significantly different from zero. Therefore, our data cannot reject a simple model where parents determine transfers without explicitly taking into account the child's utility against the model where the parent maximizes an altruistic utility function and teenagers' labour supply affects transfers. It should be interesting to see whether this finding is confirmed in future work based on different data. On the other side, the effect of transfers on teenagers' labour supply is quite substantial, and precisely estimated. Elasticities are of the magnitude of about -0.6 at the mean - quite large if compared with the range of estimates for adult income elasticities.

A further interesting finding is that teenagers seem to react sensitively to changes in wages, where labour supply elasticities evaluated at the mean are 0.56 for boys and 0.78 for girls. This is in the range found in the labour supply literature for adults.

Overall, our analysis suggests that teenagers react sensitively to parental transfers when making labour supply decisions. As we discussed above, there is a growing literature that investigates the effect of labour supply of teenagers while in full time education on later outcomes. Our results suggests cash allowances as one possibility for parents to take influence on their childrens' labour supply. Our analysis also suggests that parental transfers are not responsive to teenagers' labour supply. In addition, we find substantial heterogeneity in payments of transfers according to family background and school type attended.

Consumption of teenagers is substantial, and investigation of their consumption choices will almost certainly be a subject of future research. Key pre-requisite for consumption of those teenagers still in full time education is availability of financial resources. Our study is an attempt to shed light on the two key sources of financial means for consumption, and how the processes that describe their acquisition interact within the household.

Appendix

Table 5 Heckman selection model for log hourly wage rate

	Boys				Girls			
	Wage		Selection		Wage		Selection	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	−1.359	0.126	−0.018	0.164	−1.421	0.102	0.225	0.165
Father works	0.017	0.064	0.215	0.090	−0.003	0.054	0.123	0.091
Father farmer	−0.155	0.107	0.506	0.175	−0.069	0.107	−0.203	0.171
Father self employed	0.124	0.083	0.416	0.134	0.070	0.073	0.221	0.131
Mother works	0.182	0.041	0.217	0.058	0.063	0.035	0.178	0.058
East	0.061	0.066	0.044	0.098	0.105	0.056	0.025	0.098
North west	−0.121	0.068	−0.164	0.099	−0.075	0.058	−0.338	0.098
North	−0.180	0.077	−0.333	0.107	−0.231	0.070	−0.603	0.110
South west	−0.134	0.092	−0.089	0.133	−0.126	0.089	−0.695	0.133
Grammar school	0.095	0.063	0.017	0.089	−0.062	0.052	−0.246	0.084
Special needs school	−0.421	0.135	−0.432	0.167	−0.281	0.153	−0.502	0.211
Technical school	−0.075	0.183	0.238	0.288	−0.192	0.226	−0.319	0.348
Modern school	0.049	0.042	0.132	0.061	−0.017	0.037	0.036	0.063
Independent school	−0.259	0.130	−0.649	0.142	−0.215	0.105	−0.717	0.141
Number of older siblings	0.009	0.013	0.009	0.019	−0.005	0.013	−0.052	0.020
Number of younger siblings	0.013	0.014	0.062	0.020	0.038	0.013	0.045	0.020
Ability test score age 11	−0.300	0.105	−0.182	0.146	−0.141	0.100	0.618	0.160
Family income			−0.022	0.015			−0.003	0.001
Age father left school			−0.004	0.019			−0.031	0.015
Age mother left school			−0.002	0.001			−0.028	0.020
ρ			0.668	0.075			0.686	0.061
σ			0.687	0.032			0.599	0.025
Log likelihood	−2879.63				−2545.13			
Number of observations	2563				2472			
Number working	1326				1254			

Wage equations. Participation equation is identified by excluding parental education and family income; these variables are jointly significant in the participation equation. The correlation between the unobservables in participation- and wage equation is given by ρ, and σ is the standard deviation of the error term in the log wage equation

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