Teenage labour supply and financial support: Do parents 'tax' their children? *

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Abstract

25% of 13-16 year-olds in England have a job while still in compulsory full-time education. Teenagers usually depend on financial support from their parents in the form of "pocket money", "allowances", "transfers" etc. Parents can shape their child's incentive to get a job, either by setting a fixed transfer level in advance, creating an unearned income effect, or by withdrawing transfers in response to the child's employment, effectively taxing their earnings. This paper models the child's employment and parent's financial support decision as a non-cooperative game, and compares the welfare obtained under different decision-making mechanisms. We test the predictions of the model for a cohort of English teenagers LSYPE data from 2004-2006. Our results are consistent with a situation in which parents 'tax' their children's earnings: they withdraw financial support as the child increases his or her levels of employment. If part-time employment crowds out other productive investment activities and the child's human capital is a household public good, this strategy forces the child to internalise the social cost of his activities.

Keywords: Intra-household transfers; pocket money; child labour supply; noncooperative game; human capital

JEL classifications: C7, D1, I2, J2

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1 Introduction

This paper is about how teenagers living with their parents select into part-time employment while still in compulsory education. Specifically, we identify the mechanism by which parents use their financial resources to shape their child's incentive to get a job.

Around 25% of 13-16 year-olds below the minimum school leaving age in England take some formal paid employment during school term time. This experience may help develop discipline, communicative skills and financial literacy, but by crowding out time and effort devoted to education may impair the child's academic performance and subsequent educational or labour market opportunities. (Department for Children, Schools and Families, 2009). Above a moderate number of hours per week the latter effect has been shown to dominate. This critical threshold becomes lower, the closer to exam time (Ruhm, 1997; Lillydahl, 1990; Payne, 2004).

Given the likely damaging effect of part-time employment on academic performance, it is important to understand the socio-economic gradient along which teenagers are driven into employment by financial necessity. This will occur where parents are unwilling or unable to provide sufficient financial support. Moreover, the progressive extension of compulsory schooling in the UK from age 16 for those reaching that age in the 2011-2012 academic year to 18 for those born two years later will constrain the 18% of teenagers who would otherwise leave school at age 16 from earning a full-time income.[1] Will parents accommodate this situation with continued financial support, or compel their child to take a part-time job (possibly offsetting the benefits of continued education) by imposing a financial burden? This work will tell us.

This paper recognizes that teenagers usually depend on financial support from their parents, referred to as "pocket money", "allowances" or "transfers", etc. In this light, we consider two ways in which parents can use their financial resources to reduce their child's incentive to get a job. They can increase a fixed transfer level, set in advance of the child's decision. This creates an unearned income effect. They may also withdraw transfers in response to the child's employment. This means that parents effectively tax their child's earnings.

We incorporate these stylized facts into a model of a non-cooperative game between an altruistic parent and a selfish child ('rotten kid' - Becker, 1974, 1981).[2] This model and following

[1] OECD publishing (2012), p.19

[2] We assume a non-cooperative model. The literature on intra household allocations between cohabiting partners has adopted the co-operative bargaining model, whereby agents can agree a mutually benefical (Pareto-improving) position. Our empirical setting does not meet the necessary conditions to promote this framework

empirical analysis of interactions between parental transfers and child labour supply follows the work of Dustmann et al. (2009), Wolff (2006), Kalenkoski and Pabilonia (2010) and Gong (2009). These authors all estimate schoolchildren's or college students' labour supply as a function of parental transfers. Wolff (2006) and Gong (2009) implicitly assume a parent-leading Stackelberg framework. Taking into account how the child will respond, the parent fixes his utility-maximising transfer level. Dustmann et al. (2009) and Kalenkoski and Pabilonia (2010) adopt a simultaneous model, also estimating parental transfers as a function of child's labour supply. Implicitly their observed outcomes represent the 'Nash equilibrium', or mutual best response. Taking the action of the other agent as given, both agents are acting optimally.

Dustmann et al. (2009) explicitly compare the Nash and Stackelberg solutions. They show that with a *purely* altruistic parent the same equilibrium is obtained under both frameworks. This paper's first contribution is to demonstrate the implications of *impure* or *paternalistic* altruism by the parent, for the chosen decision-making mechanism. If we assume that the parent discounts the future less heavily than child (Burton et al., 2002), this justifies her weighting the child's human capital more heavily, relative to the child's consumption, than does the child. With this adjustment, we reject the Nash equilibrium as the decision-making mechanism on welfare grounds: both the parent and the child will always be better off at the parent-leading Stackelberg equilibrium. We also show that the parent may prefer to give the first move to the child. This is because the child's human capital is a public good, valued by both agents and damaged by working long hours. Forcing the child to make his labour supply decision based on the net wage, anticipating his parent's withdrawal of transfers, will make the child internalise this social cost and work shorter hours. This contrasts with conventional non-cooperative games, where an agent is better off acting as first mover.

Our second contribution is to identify the true decision-making mechanism by estimating the empirical counterpart to the parent-leading and child-leading Stackelberg models, and testing the prediction of the parent-leading model that parents will reduce transfers or hold them constant in response to factors restricting the child's labour market opportunities. This should apply for two reasons. Firstly, if there is a binding ceiling on the child's working hours, the parent does not need to pay the child to prevent him working longer. Secondly, a Stackelberg leader's action must be credible and time-consistent. The parent may wish to compensate the

(Browning et al. 1994). The bargaining environment is unstable ("constantly changing as the child matures") and communication imperfect ("effective information exchange [is] be hampered by the [child's] still-developing cognitive and communicative abilities", Lundberg et al, 2009).

child if genuinely unable to get a job, but cannot distinguish this situation from a child choosing not to work and holding out for higher transfers, expecting the parent to relent. We reject this prediction: parents increase transfers in response to restricted labour market opportunities. We therefore favour the child-leading model, and show results consistent with the situation in which parents withdraw financial support as the child's labour supply increases.

The previous literature used cross-sectional data on various countries, time periods, and educational institutions: Dustmann et al. (2009) and Wolff (2006) study 16-year olds in the UK in 1974 and teenagers in France in 1992. Kalenkoski and Pabilonia (2010) observe US college students from 1996-2004. Gong (2009) uses data on US children aged 12-16 in 1996. The estimated labour supply and transfer responses vary considerably across these papers: For example, at 1996 exchange rates and prices, it took \$10 (Gong, 2009), \$26.60 (Dustmann et al, 2009) or \$33 (Kalenkoski and Pabilonia, 2010) of additional transfers to reduce employment by one hour per week in three different cases. It is not possible to identify which factor is driving the differences between these results: the greater financial obligations faced by US college students than younger teenagers or their UK counterparts; more restrictive labour market rules for younger teenagers; or a greater weight being given to the perceived human capital benefits of in-school employment when fewer teenagers continued into post-compulsory education. Our third contribution is therefore to analyze the same cohort at different points in time. With these data from the Longitudinal Study of Young People in England (LSYPE), we are able to identify the effect of age (or equivalently, proximity to high-stakes exams at the end of compulsory education) on the parameters of the model, holding constant the relevant institutional arrangements. We find a significant 'tax rate' only for girls in the final year of compulsory schooling, when employment is expected to be most costly in terms of academic performance.

2 Theoretical Model

Our model assumes two agents, a selfish child and an altruistic parent. The child cares about his own consumption (C) and his own human capital (H). The parent cares about her own consumption (P), the child's consumption, and the child's human capital. The utility functions condition on each agent's relative preference for child's human capital over child's consumption, denoted κ_c (child) and κ_p (parent). The parent's altruism is impure or paternalistic, meaning that $\kappa_p > \kappa_c$. Each agent's κ is a predetermined function of exogenous individual and house-

hold preferences and constraints, $\mathbf{X}$, so $\kappa_i = \kappa_i(\mathbf{X})$ for $i = p, c$. We expect a strong positive socio-economic gradient in this relative preference for human capital in both parents and children, as lower-income households are expected to have a higher discount rate (Banerjee and Mullainathan, 2010, and references therein), and highly educated parents will instill in their children an appreciation of the importance of education for future opportunities. The utility functions can be written $U^c = U^c(C, H, \kappa_c(\mathbf{X}))$ (child) and $U^p = U^p(C, P, H, \kappa_p(\mathbf{X}))$ (parent). Both are three times continuously differentiable in C, P and H; strictly increasing in C, P and H at a dimishing rate; and separable in C, P and H, such that the marginal utility from each element is independent of the other elements.[3]

Prior to making his labour supply decision, the child has a baseline endowment of human capital, μ. This is also a predetermined function of $\mathbf{X}$, so $\mu = \mu(\mathbf{X})$. These current and past parental, child and household characteristics are assumed to have determined the parent and child's time and effort devoted to investment activities over the preceding lifecourse. The child's human capital accumulation in a given period is then a function of his time devoted to wage-earning employment L, so $H = H(L, \mu)$. We assume that the marginal human capital product of labour (H_L) can be positive or negative at $L = 0$, but is decreasing in L (so $H_{LL} < 0$). This captures the potential benefit to a small number of hours of work, but also the idea that beyond some level of hours of work, employment must detract from the quality or quantity of time devoted to other human-capital earning pursuits.

Observed transfer and labour supply behaviour is assumed to represent the solution to the one-shot game in which the parent and child each maximise their own utility in the current period subject to their preferences and perceived production function of human capital.

In our model, the parent has exogenous income M, and can choose to transfer the cash amount $t \geq 0$ to the child. Parent consumes the rest of her income, so $P = M - t$. The child chooses his labour supply, L, and earns the constant wage $w > 0$. His consumption is the sum of labour earnings wL, and money received from parents: $C = wL + t$. The following sections will derive the unique equilibrium under the Nash decision-making process, the parent-leading Stackelberg model, and child-leading Stackelberg model. This final model can also be framed as the parent setting a contingent transfer schedule.

[3]Formally, the restrictions on the child's utility function are: $U^c_C > 0$; $U^c_{CC} < 0$; $U^c_H > 0$; $U^c_{HH} < 0$; $U^c_{CH} = 0$. The restrictions on the parent's utility function are: $U^p_C > 0$; $U^p_{CC} < 0$;$U^p_P > 0$; $U^p_{PP} < 0$; $U^p_H > 0$; $U^p_{HH} < 0$; $U^p_{PH} = 0$; $U^p_{PC} = 0$; $U^p_{HC} = 0$.

2.1 Nash and Stackelberg equilibria

In a Nash framework, the parent and child choose their cash transfer and labour supply as their best response to the other's action. At the Nash equilibrium, neither agent can do better, *taking the other's action as given.* Implicitly, this position is reached by an iterative process in which the agents choose starting positions and best-respond in turn to converge on the equilibrium. This implies that the parent does not communicate his strategy or intentions to the child.

In the Stackelberg framework, one party 'leads' by committing to the action that maximises their own utility taking into account that the other agent's 'best response' is a function of the leader's actions. Here, there are two Stackelberg equilibria, one in which the parent leads and one in which the child leads.

In the parent-leading Stackelberg model, the parent fixes the cash transfer in advance. The child follows with his best response in terms of employment, taking the cash transfer as given. A theoretical drawback to this model is that it requires the parent to have perfect information over the child's preferences. (The Nash case does not require either agent to have knowledge of the other's preferences). This is a strong assumption, but parents can communicate with and observe the child, giving them scope to infer their preferences to a close approximation.

The parent can costlessly and rapidly alter transfers if the child is seen to be seeking a labour market position that is inconsistent with previous assumptions about the child's preferences. This flexibility threatens the parent's *credibility* or *time-consistency.* A Stackelberg equilibrium requires the follower to believe the leader will not deviate from her initial action. This means that the parent must hold the transfer level fixed in the case of involuntary unemployment, or the child working zero hours and attempting to hold out for higher transfers.

In the child-leading Stackelberg model, the child anticipates the parent's best response and 'leads' by choosing his employment level. The parent then follows with his best response in terms of cash transfers, taking the employment level as given.

The labour supply decision is less reversible than the parent's transfer decision: the child can leave a job (possibly at some psychic cost) but not easily find another job or adjust his hours. We assume the parent has deterministic control over cash transfers. This means the child's first-move commitment will not come under challenge due to the parent deviating from her expected best-response for reasons outside her control. These considerations mean the employment level

is more likely to represent a credible, binding commitment than the transfer level.

The parent's relative financial resources, lower discount rate, and position of authority within the household should all contribute to the parent having most or all of the bargaining power. The idea of a child-leading Stackelberg model, in which the parent 'does the best she can given the action of a dominant child' is therefore not intuitively appealing. The same scenario can be reframed as the parent announcing a contingent schedule of transfers that will be made for every possible level of employment the child can take, and the child choosing the point along it which is best for him. Note also that with a fully contingent strategy, there is no time-consistency problem for the parent. Given that the parent holds the bargaining power, we assume the true decision-making process is that which makes the parent best off. We now evaluate the welfare outcomes of the three possible models.

2.2 Comparing the outcomes of alternative models

2.2.1 Nash versus parent-leading Stackelberg

The parent's maximisation problem is the same under a Nash equilibrium as when she acts as a Stackelberg follower. In either case, she takes the child's action as given:

$$\max_t \; U^p = U^p(P(M-t), C(wL+t), H(L, \mu(\mathbf{X}), \kappa_p(\mathbf{X})) \tag{1}$$

Acting as a Stackelberg leader, the parent must account for the indirect effects of t on the utility from consumption and human capital caused by the child's labour supply response to t:

$$\max_t \; U^p = U^p(P(M-t), C(wL^*(t)+t), H(L^*(t), \mu(\mathbf{X})), \kappa_p(\mathbf{X})) \tag{2}$$

The parent's optimality conditions as a follower and a Stackelberg leader are respectively:

$$U_C^p = U_P^p \tag{3}$$

$$U_C^p + \frac{\partial L^*}{\partial t}[U_C^p.w + U_H^p.H_L] = U_P^p \tag{4}$$

Both expressions state that the parent will make transfers to the point where his marginal utility from (i) her own consumption, and (ii) the child's consumption and human capital, are

equal. In the parent-leading Stackelberg case, this includes the indirect effect through the child's behavioural response. Because transfers must be non-negative, if at $t = 0$ the parent's marginal utility from her own consumption exceeds that from the child's human capital and consumption, she will make zero transfers.

The expression in square brackets is similar to the child's best response optimality condition (equation 8, below): $w.U^c_C = -H_L.U^c_H$, or equivalently $w.U^c_C + H_L.U^c_H = 0$. Both expressions are equal to the net change in the agent's utility caused by simultaneous changes in the child's consumption and human capital. If the parent is *purely* altruistic, placing the same relative weight on the child's human capital and consumption as does the child, then $[U^p_C.w + U^p_H.H_L]$ and $[U^c_C.w + U^c_H.H_L]$ both equal zero at the same level of labour supply and transfers, and the Nash and parent-leading Stackelberg equilibria are coincident, as found by Dustmann et al. (2009). As we assume that the parent's altruism is *paternalistic* however, at the Nash level of transfers it holds that $U^p_C.w + U^p_H.H_L < 0$, and hence:

$$U^p_C + \frac{\partial L^*}{\partial t}[U^p_C.w + U^p_H.H_L] > U^p_P \tag{5}$$

From this position, in the Stackelberg model, the parent's paternalism makes her prepared to pay the child more (increase t) to persuade him to work less (reduce L). It can be shown that the child always withdraws labour earnings at a slower rate than transfers are received (see Appendix A.2.1 for the complete derivation) and both equilibria must lie in the range where the marginal human capital product of labour is negative ($H_L < 0$). (Otherwise, the child and parent would always prefer to increase labour supply at a benefit to both human capital and consumption). Hence, both the child's consumption and human capital must have risen. This means that moving from the Nash to the parent-leading Stackelberg equilibrium makes both the parent and the child better off.

2.2.2 Nash versus child-leading Stackelberg

The child's maximisation problem is the same under a Nash equilibrium as when he acts as a Stackelberg follower. In both cases, he takes the action of the parent as given:

$$\max_L \; U^c = U^c(C(wL + t), H(L, \mu(\mathbf{X})), \kappa_c(\mathbf{X})) \tag{6}$$

Acting as a Stackelberg leader, alternatively stated as choosing a level of labour supply subject to the contingent transfer schedule, the child's optimisation problem is as follows:

$$\max_{L} \; U^c = U^c(C(wL + t^*(L)), H(L), \mu(\mathbf{X}), \kappa_c(\mathbf{X})) \tag{7}$$

The child's optimality conditions as a follower and as a Stackelberg leader are respectively:

$$w.U^c_C = -H_L.U^c_H \tag{8}$$

$$(w + \frac{\partial t^*}{\partial L}).U^c_C = -H_L.U^c_H \tag{9}$$

The parent withdraws transfers in response to increasing labour supply, so $\frac{\partial t^*}{\partial L} < 0$. This means that when acting as a Stackelberg leader, the child bases his labour supply on his net wage $(w + \frac{\partial t^*}{\partial L})$. When taking transfer levels as given, he bases his labour supply on the gross wage, w, which is larger. At the Nash level of labour supply it therefore holds that:

$$(w + \frac{\partial t^*}{\partial L}).U^c_C < -H_L.U^c_H \tag{10}$$

At this position, the net wage is too small to compensate the child for the marginal human cost of employment. He will therefore reduce his labour supply, raising his human capital and reducing consumption, but become better off overall. If the human capital maximising level of labour supply is $L = 0$ and for the first hour of employment the marginal utility lost from human capital is greater than that gained from increased consumption, the child will work zero hours.

At equilibrium, the 'tax rate'; the slope of the best-response correspondence along which cash transfers from parents are observed to be withdrawn in response to the child's earnings, is strictly between zero and one (see Appendix A.2.2 for the complete derivation). Above the human capital maximising labour supply, the child will never work for a negative or zero net wage, and the equilibrium cannot occur at a point where the parent is *subsidizing* the child's employment. The parent only does this where (i) the child's human capital is still increasing in labour supply and (ii) where she would prefer to increase the child's consumption at the cost of reducing her own consumption and her child's human capital. The parent's 'bliss point' will occur at the point where the parent is indifferent between increasing the child's consumption,

reducing the child's human capital, and reducing her own consumption. In this state she will neither tax nor subsidise the child's employment. Hence, the child-leading Stackelberg equilibrium must lie at a point on the parent's best-response correspondence between the Nash equilibrium and the parent's bliss point. This means that both the child and the parent are better off at the child-leading Stackelberg than the Nash equilibrium.[4]

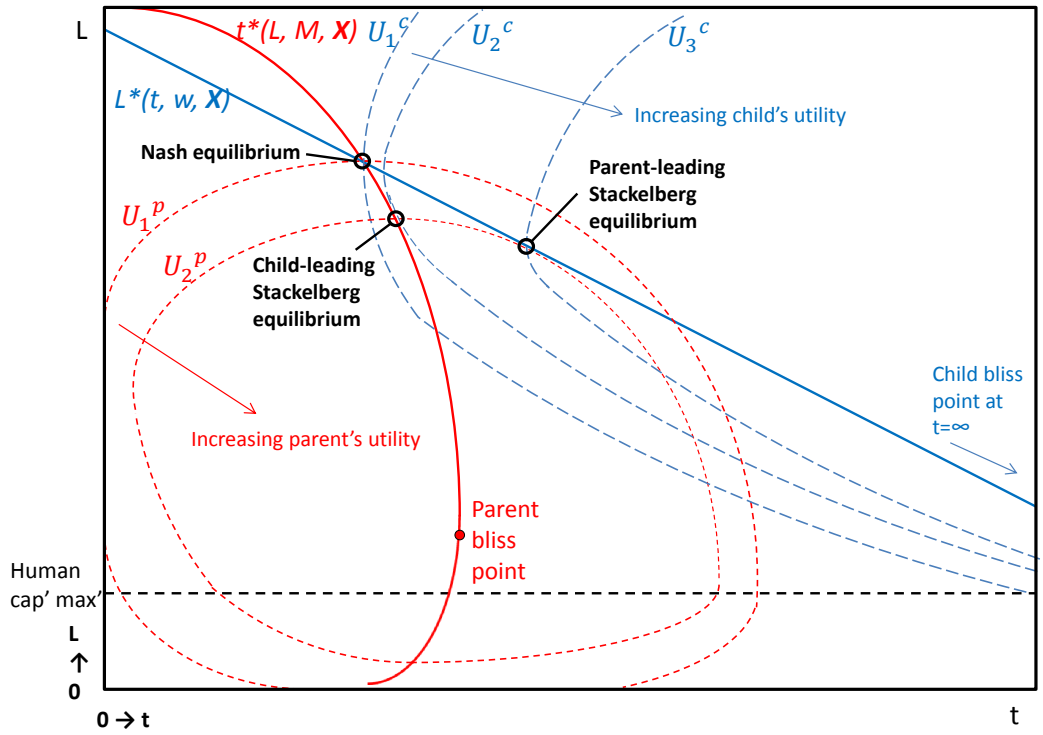
2.3 Graphical representation

Each agent's optimisation problem can be illustrated graphically, as shown for an interior solution case in Figure 1. The parent's best response (BR) correspondence $t^*(L, M, \mathbf{X})$ is the locus of points maximising the parent's utility for each given labour supply. The child's BR $L^*(t, w, \mathbf{X})$ is the locus of points maximising the child's utility for each given transfer level. The Nash equilibrium represents the mutual best response. As the parent cares relatively more about human capital than does the child, the parent's 'bliss point' lies below the child's best-response correspondence. If the parent is very selfish, the high cost in terms of her own consumption, of increasing the child's human capital and consumption, will result in a bliss point below the human-capital maximising level of labour supply. This possibility makes no difference to the fundamental analysis: as shown in equation (8), the equilibrium will always occur at labour supply above the human capital maximising level. The child's bliss point is at infinite transfers and the human capital maximising level of labour supply. The Nash equilibrium is at the intersection of the agents' best-response correspondences. Both Stackelberg equilibria entail the leader choosing the point on the follower's BR correspondence which makes him or her best off.

The strategy for identifying each agent's BR correspondence can be visualised in this representation. In the Nash framework, each agent's BR correspondence is traced out by shifts in the other's BR correspondence, caused by factors having no direct effect on their own. In each Stackelberg model, shifts in the leader's utility map caused by factors having no direct effect on the follower's BR will shift out this BR as the locus of points which are tangent to the leader's highest attainable indifference curve.

[4]It is a sufficient condition for this welfare improvement that the parent is impurely altruistic. One may also consider that if the child-leading Stackelberg equilibrium lay below the parent's bliss point, it would imply that while the child is happy with the trade-off between human capital and consumption, the parent would prefer to reduce the child's consumption and raise his human capital. This would violate our assumption that the parent cares relatively more about human capital than does the child.

Figure 1: Agents' optimisation problem and the three equilibria

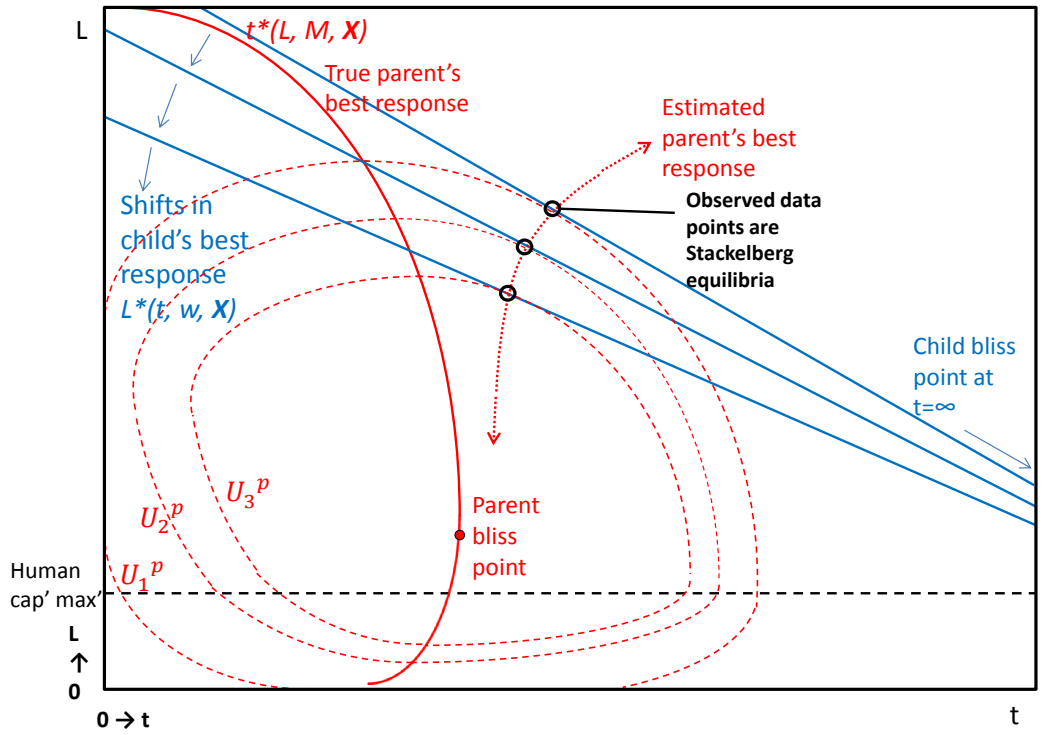


2.4 The identification problem

The 'true' decision-making process cannot be inferred from the parameters of a single estimated model. The identification problem can be illustrated by considering that if the parent-leading Stackelberg process is true but the assumptions of the Nash framework are imposed in the econometric specification, shifting the child's BR correspondence will trace out a locus of points which are tangent to the parent's indifference curves. This will incorrectly be interpreted as representing the parent's BR correspondence. The case shown in Figure 2 would lead us to conclude that at the equilibrium margin parents are choosing to subsidise, rather than tax, their child's earnings.

We can rule out the observed outcomes ever representing the Nash equilibrium on welfare grounds. We showed in sections 2.2.1 and 2.2.2, and it is apparent in Figure 1, that both the parent and the child are better off at both the parent-leading and the child-leading Stackelberg equilibria. The former applies because the parent's paternalism makes him prepared to pay the child more to work less. The latter applies because the positive marginal tax rate faced by the child means he internalises the social cost (in terms of human capital) of his employment. This makes him reduce his labour supply, which pleases the parent.

Figure 2: Erroneous identification of the parent's best response.



We assume the parent chooses the strategy which gives her the highest utility. The model does not specify whether this will be the parent-leading or child-leading Stackelberg model. Figure 1 is drawn such that the parent is indifferent between these decision-making processes, receiving utility level U_2^P in both cases. The more paternalistic are the parent's preferences (characterised by a steeper subsidy and tax on employment below and above the parent's bliss point respectively), the greater scope there is to favour the child-leading model. In addition, the more selfish is the parent overall (characteristed by shifting her BR correspondence to the left and her bliss point to a lower level of labour supply, and reducing the tax and subsidy rates over the relevant ranges), the more scope there is to favour the parent-leading model.

Since we cannot reject either Stackelberg model on theoretical grounds, we must do so on empirical grounds. In the next section, we discuss testable predictions of the parent-leading Stackelberg model that allow us to validate or reject this model.

2.5 Labour market rationing and the Stackelberg model

The parent-leading Stackelberg model requires that the parent will hold transfers constant in response to factors expected to restrict the child's probability of obtaining a job. These labour

market factors should not affect either agent's preferences or directly affect their utility, except via the child's labour supply. Therefore, a time-consistent parent should ignore these factors in setting his transfer decision.

In addition, if a binding ceiling is placed on the child's hours of employment, then the parent should reduce the transfers made to the child: she no longer needs to 'pay the child not to work' and at this ceiling can reduce transfers without trading his rise in consumption off against a reduction in human capital. Such a ceiling may result either from legal restrictions on the number and timing of hours of employment a child may do, or from limited labour demand.

If the parent-leading Stackelberg model is true, therefore, we will find zero or negative coefficients on labour market characteristics expected to restrict the child's employment opportunities. If this prediction is rejected empirically, we propose that the parent is acting as a Stackelberg follower, by announcing a contingent transfer schedule.

3 Data and institutional background

3.1 LSYPE data

We test the predictions of our model using data from the first three waves of the Longitudinal Study of Young People in England (LSYPE). This sample is drawn from a single academic cohort of teenagers in England, interviewed mainly in the spring at age 13-14 (wave 1, school year 9, 2004), 14-15 (wave 2, school year 10, 2005), and 15-16 (wave 3, school year 11, 2006), the last three years of compulsory schooling. The data contain a rich set of individual and household variables and information on the child's prior educational performance, for which we control in the analysis. The key questions we use to represent the decisions of parents and children are described next.

The parental cash transfers question is "Do you receive any pocket money, allowances, or other support towards your living costs from parents or relatives?". The emphasis on "allowances" or "support towards your living costs" but without reference to specific items means that this does not refer to hypothecated transfers. The present tense makes clear that this unearned income refers to a current, ongoing, and regular arrangement, that represents a close substitute for labour income.

This binary indicator gives no information on the size or frequency of transfers. We observe

reductions in parental transfers only at the extensive margin i.e. switching from positive to zero transfers. We assume that this variable reflects parents' latent desired transfer level, and that this changes monotonically with parental income, child labour supply, and child's labour market restrictions. Under this assumption, the sign of marginal effects on the probability of positive transfer will indicate the sign of the relationship to the amount of positive transfers. Although our statistical power to detect parents' behavioural responses is limited, this is sufficient to test the key predictions of both Stackelberg models.

Youth respondents are also asked "Do you ever do any work in a spare-time paid job, even if it is only for an hour or two now and then? (Please don't include jobs you only do during the school holidays or voluntary work)". Those answering 'yes' are asked 'How many hours on average do you usually work in this job (or jobs) during a term time week? Please include any hours you work at the weekend during term-time". These questions explicitly exclude unpaid or voluntary work, ensuring that a positive response is unambiguously associated with labour income. The term-time focus makes the crowding out of study time or other extra-curricular activities a salient concern. The present tense means that a teenager who is 'working' according to this measure considers himself currently to be engaged in the labour market: they have been in employment in the very recent past and expect to again in the near future.

3.2 Employment of children in England

The rules governing the employment of children in England are set by the Department for Education (see guidelines in DCSF, 2009). Children aged at least 13 but less than the school leaving age may undertake 'light' work, deemed as not being harmful to their health, safety or development.[5] There are age-specific restrictions to the types and hours of work children may do. Those under 16 cannot work 'mainly or solely' for the sale of alcohol, for example. All those in compulsory education may work only 12 hours per week in term time. These can include a maximum of 2 hours on a weekday or Sunday; 8 hours on a Saturday (5 hours for those under 15 years); one hour before school on a weekday; and none during school hours or after 7pm on a school night. Those employing children below the school leaving age must obtain the signature of a parent and a permit from the Local Education Authority, which must be satisfied that the child's education will not be damaged. Howieson et al. (2006) estimate that in Scotland

[5]Full-time education is compulsory until the last Friday in June of the academic year when the child turns 16.

only 11% of children covered by this legislation had the required permit, so this effective veto is poorly enforced.

3.3 Descriptive statistics

Table 1: Descriptive statistics by gender.

	Wave 1		Wave 2		Wave 3	
	Boys	Girls	Boys	Girls	Boys	Girls
Employed (%)	24.9%	18.9%	28.3%	27.1%	29.0%	31.2%
Receive cash transfer (%)	80.9%	81.7%	77.8%	79.4%	76.7%	78.4%
Mean age 16 exam score[1]	281.13 (3.04)	308.25 (2.67)	283.62 (3.11)	309.51 (2.82)	281.85 (3.23)	311.39 (2.85)
Observations	7116	7250	6258	6303	5815	5839

By employment status

	Wave 1				Wave 2				Wave 3			
	Boys		Girls		Boys		Girls		Boys		Girls	
Employed:	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Mean hours employment[2]	4.14 (0.10)	.	4.24 (0.11)	.	5.16 (0.13)	.	5.38 (0.10)	.	6.44 (0.15)	.	6.72 (0.13)	.
Mean earnings[2]	£14.52 (0.41)	.	£14.24 (0.39)	.	£20.58 (0.52)	.	£18.90 (0.33)	.	£27.96 (0.63)	.	£27.31 (0.55)	.
Receive cash transfer (%)	71.5%	83.9%	73.3%	83.6%	66.3%	82.4%	71.1%	82.6%	63.2%	82.0%	67.5%	83.3%
Standardized age 14 exam score[3]	0.097 (0.032)	-0.101 (0.034)	0.293 (0.034)	0.019 (0.030)	0.096 (0.033)	-0.090 (0.036)	0.302 (0.031)	-0.009 (0.018)	0.114 (0.031)	-0.094 (0.037)	0.302 (0.034)	-0.015 (0.034)
Mean age 16 exam score[1]	294.31 (3.35)	276.75 (3.50)	328.06 (3.42)	303.62 (2.89)	295.07 (3.47)	277.41 (3.57)	331.37 (2.83)	301.36 (1.92)	299.44 (2.83)	276.39 (3.69)	334.50 (2.96)	300.91 (3.30)

By receipt of cash transfer

	Wave 1				Wave 2				Wave 3			
	Boys		Girls		Boys		Girls		Boys		Girls	
Receive transfer:	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Employed (%)	22.0%	37.1%	17.0%	27.6%	24.2%	43.1%	24.3%	38.2%	23.1%	44.4%	26.8%	46.9%
Standardized age 14 exam score	-0.044 (0.032)	-0.086 (0.043)	0.069 (0.029)	0.078 (0.042)	-0.039 (0.033)	-0.029 (0.043)	0.079 (0.032)	0.061 (0.042)	-0.040 (0.034)	-0.024 (0.042)	0.092 (0.032)	0.063 (0.047)
Mean age 16 exam score	282.3 (3.07)	276.05 (4.64)	307.64 (2.81)	310.94 (34.14)	282.4 (3.25)	282.48 (4.37)	309.72.8 (2.96)	308.71 (4.05)	282.6 (3.44)	283.54 (4.47)	312.69 (2.97)	306.67 (4.48)

Notes: All figures for hours and earnings are weekly. Standard errors in parentheses. Population means and proportions calculated using final probability weights. Standard errors clustered by school. [1] GCSE capped point score (calculated over best eight subjects). [2] Hours of employment and earnings are per week. [3]: Key Stage 3 Average Point Score, standardized by subtracting mean and dividing by standard deviation.

Table 1 shows descriptive statistics relating to employment, earnings, cash transfers from parents, and educational performance at age 14 and 16. At every stage, those in employment are positively selected on age 14 educational performance, and go on to perform better at age 16, by a sufficient margin to widen future educational opportunities substantially.[6] This relationship

[6]The difference in performance is equivalent to one GCSE grade in four of the student's best eight subjects. The threshold for continuation in full-time education is five A*-C grades. This is achieved by around 60% of students. Students typically take around 10 GCSE courses.

is driven by the positive correlation between factors determining employability and academic performance, such as individual motivation; relative age (Crawford et al., 2013); and school quality, parental investments, and local labour market conditions.

Employment and financial support are always negatively correlated. Parents are always more likely to make cash transfers to children who do not work, and children are always more likely to work if they do not receive cash transfers. This is consistent with children's working decision being financially motivated and with parents' ability to make financial transfers enabling them to disincentivise employment.

The propensity to work and hours of work both rise as the children age. This is driven predominantly by increasing employment among girls. This starts from a lower base and overtakes employment among boys in the final year of compulsory schooling. Conditional on working, girls always on average work longer hours than boys, but receive lower earnings and hourly wages. This is not driven by selection on educational performance: Girls have superior prior educational performance and are more positively selected into employment by performance than boys. Nor can the different trajectories of employment be driven by changes or systematic differences in parents' characteristics. Both of these should be orthogonal to the sex of their child. Instead, these observations are consistent with boys and girls being active in distinct labour markets with different factors restricting employment. For this reason we estimate our models separately for males and females.[7]

4 Estimation

We estimate separate cross-sectional models of the observed counterparts to the parent-leading and child-leading Stackelberg models. The econometric specification for the transfer and labour supply decisions are shown in equations (11-12) and (13-14). The decision to estimate separately by wave rather than exploiting the panel nature of this dataset is made because the teenage years are a time of transition. Teenagers have very different labour market opportunities at age 16 than 13. Time away from studying may be increasingly costly in terms of educational performance. Children will desire higher consumption and increasing independence over what they

[7]These differentiated labour markets are driven by (i) social norms about the types of jobs to be taken by boys and girls and (ii) rigid gender roles within certain ethnic groups which make employment among girls exceptionally rare, both in comparison to other ethnic groups and to boys of the same ethnic group. Appendix A.1 presents some descriptive statistics on both these topics.

consume. For these reasons, we do not expect a stable relationship over time that conventional panel data methods are appropriate for.

Equations (11-12) show the parent-leading Stackelberg model. The parent's transfer decision (equation 11) is a reduced form, accounting for the parent anticipating the child's best-response. Equation (12) represents the child's effective best correspondence. Transfers and labour supply are subject to correlated random shocks due to unobservable heterogeneity in preferences, resources, and constraints such as discrete job offers and variation in travel time to school or work, such that:[8]

$$\begin{pmatrix} \epsilon_t^S \\ \epsilon_L^N \end{pmatrix} \sim \mathcal{N} \begin{pmatrix} \sigma_t^S & \rho_1 \\ \rho_1 & \sigma_L^N \end{pmatrix}$$

This recursive system of a simultaneous probit and tobit is estimated using Full Information Maximum Likelihood. This system is identified through the exclusion of parental income, M from the second stage (child's labour supply) equation. Variables expected to restrict the child's labour market opportunities, $\mathbf{Z}$ are included in both equations to test that (i) these variables have the predicted effect on child labour supply, and (ii) that the parent holds constant or reduces transfers in response to these restrictions.

$$\begin{aligned} t = 1 \quad if \quad t^S(M, \mathbf{Z}, \mathbf{X}) + \epsilon_t^S > 0 \\ t = 0 \quad if \quad t^S(M, \mathbf{Z}, \mathbf{X}) + \epsilon_t^S \leq 0 \end{aligned} \tag{11}$$

$$\begin{aligned} L = L^N(t, \mathbf{Z}, \mathbf{X}) + \epsilon_L \quad if \quad L^N(t, \mathbf{Z}, \mathbf{X}) + \epsilon_L^N > 0 \\ L = 0 \quad if \quad L^N(t, \mathbf{Z}, \mathbf{X}) + \epsilon_L^N \leq 0 \end{aligned} \tag{12}$$

Equations (13-14) show the child-leading Stackelberg model. Equation (14) is the reduced form for the child's labour supply, consistent with the child accounting for the parent's transfer schedule, yet still being constrained by labour market restrictions and involuntary unemployment. Equation (13) represents the parent's best response, or contingent transfer schedule. We again

[8]The superscript S refers to an agent acting as a Stackelberg leader. The superscript N refers to an agent taking the actions of the other as given, as in a Nash equilibrium or acting as a Stackelberg follower.

assume the presence of correlated random shocks such that:

$$\begin{pmatrix} \epsilon_t^N \\ \epsilon_L^S \end{pmatrix} \sim \mathcal{N} \begin{pmatrix} \sigma_t^N & \rho_2 \\ \rho_2 & \sigma_L^S \end{pmatrix}$$

The recursive system to be estimated is then as follows. This system is identified through the exclusion of labour market factors $\mathbf{Z}$ from the second-stage (parental transfer) equation.

$$\begin{aligned} t = 1 \quad if \quad t^N(L, M, \mathbf{X}) + \epsilon_t^N > 0 \\ t = 0 \quad if \quad t^N(L, M, \mathbf{X}) + \epsilon_t^N \leq 0 \end{aligned} \tag{13}$$

$$\begin{aligned} L = L^S(M, \mathbf{Z}, \mathbf{X}) + \epsilon_L \quad if \quad L^S(M, \mathbf{Z}, \mathbf{X}) + \epsilon_L^S > 0 \\ L = 0 \quad if \quad L^S(M, \mathbf{Z}, \mathbf{X}) + \epsilon_L^S \leq 0 \end{aligned} \tag{14}$$

4.1 Identification restrictions

Two conditions must be met for the use of instrumental variables to be valid. The *relevance* condition requires that conditional on other explanatory variables, the instruments have a sufficiently strong direct effect on the endogenous explanatory variable, conditional on the other covariates. The *exogeneity* condition requires that the instruments are (conditionally) mean independent from the second-stage dependent variable. In other words, the instruments (parental income in the parent-leading model, labour market restrictions in the child-leading model) must have no direct effect on the second-stage dependent variable, except through the endogenous explanatory variable.

As it is explicit in the theoretical model and consistent with previous literature (Dustmann et al., 2009; Wolff, 2006; Kalenkoski and Pabilonia, 2010; and Gong, 2009), it is assumed that parental income meets these conditions for the parent-leading Stackelberg model. The identifying assumption for estimation with this dataset is that the probability of transfer is strictly increasing in parental income. This will be true provided that the parents' latent desired transfer level is strictly increasing in income.[9]

[9]The LSYPE uses a different measure of income in each sampling wave. In waves 1 and 3 the variable "Total income from work, benefits and anything else for [Main Parent] (and partner)" is elicited in 92 bands and 12 bands respectively. In wave 2, the "gross annual salary" of both parents and the "total annual amount of benefits

We consider three determinants of the child's labour market opportunities. Firstly, relative age within the academic cohort is included as a linear term, equal to 1 for September birthdays (the oldest in the cohort) and up to 12 for those born the following August. Children born earlier in the academic year will be allowed to work longer hours or in specific job types earlier than their younger peers. This means they are better placed to fill suitable vacancies which arise in the autumn as older cohorts leave for university. The parent's attitude to financial support may change when the child turns a year older, so we also control for the child being interviewed after their birthday within the academic year.

Secondly, we use the 2004 index of multiple deprivation (IMD) of the teenagers' area of residence as a very localised proxy for area characteristics determining a teenager's employment opportunities. The IMD measures the prevalence of deprivation within geographical areas containing 400-1200 households (Office of the Deputy Prime Minister, 2004). The index is calculated from aggregated individual-level deprivation indicators and area characteristics in seven domains: income; employment; health; education, skills and training; barriers to housing and services; crime; and the living environment. All these elements are expected to be correlated with youth labour market opportunities. Of greatest relevance in driving this relationship are (i) the localized unemployment rate, and (ii) the average road distance to a post office and supermarket or convenience store. The latter are suitable potential employers and may also be clustered with other shops and businesses.[10]

Thirdly, we use the adult (aged 16-64) unemployment rate in the youth's local authority district (LAD) of residence at time of interview. There are 325 LADs in England, with an average population of 164,000. This variable therefore represents labour market opportunities over a wider geographic area. Conditional on the parents' *own* income and employment status we assume this has no direct effect on parent's transfer decision, except via the child's employment opportunities.

received" are elicited separately, and other sources of income are omitted. Because these measures are not directly comparable, we define our income measure as "relative permanent income": the percentile (zero being the lowest, one being the highest) of the household's mean gross income percentile across the three waves, using imputed household income where necessary. Details of the imputation procedure can be found in James et al. (2010).

[10]The IMD is functionally dependent on the characteristics of the individual households observed in the LSYPE. We explicitly control in estimation for household-level counterparts to the aggregated deprivation indicators recorded in the IMD. We assume that conditional on household circumstances (including parental employment and income and the child's prior educational performance) the local area characteristics captured by the IMD have no direct effect on the parent's transfer decision except via the child's employment opportunities.

4.2 Additional controls

The vector of additional controls, $\mathbf{X}$ includes further variables expected to affect the parent's resource constraints, either agent's relative preference for human capital (κ_i) or the child's labour market opportunities or endowment of human capital (μ). These can be grouped as follows: (i) Socio-economic characteristics, including parent's employment status and education; (ii) the child's prior educational performance and special educational needs (SEN) status; (iii) ethnicity dummies, to account for differing preferences and also labour market discrimination; and (iv) household structure, since this determines members' material and time resources as well as preferences. We account for seasonal and geographical variation in labour market opportunities with dummies for month of interview, residence outside Greater London, and the urban-rural classification.

5 Results

In this section, we first present the estimates obtained under the parent-leading Stackelberg framework. We show these are contrary to the predictions of the model in two ways, so empirically reject this model and infer that the child-leading Stackelberg mechanism is used instead. We then show results consistent with this hypothesis. The complete maximum likelihood estimation output for both sexes and all waves is presented is Appendix A.3. In this section, we focus on a few key variables, and for ease of exposition, refer to plots of marginal effects of key variables in Figures 3-14. All coefficients in the transfer equation are presented as the average marginal effect on probability of transfer.[11]

5.1 Parent leading: Setting a 'fixed' transfer level

The coefficients and standard errors for key variables for the parent's transfer decision and the child's best-response correspondence estimated assuming both exogeneity ("tobit") and endogeneity ("FIML 2nd stage") of labour supply are presented Table 2. The identification assumption that the probability of positive transfers is increasing in parental income clearly

[11] Any comparison between sexes is not 'other things equal', because of systematic differences in characteristics between these groups. Girls have higher prior educational performance and a lower incidence of special educational needs than boys, for example. The results should be interpreted as comparing average marginal effects based on a sample representative of the population of the group and time of interest.

holds. However, these results are contrary to the predictions of the parent-leading Stackelberg model in two ways.

Firstly, Figure 3 shows that while for all other groups, labour supply is decreasing in transfer receipt, for girls in wave 1 receiving a cash transfer invokes a statistically significant positive labour supply response.[12]

Table 2: Estimation results: Stackelberg model with parent leading (setting 'fixed' transfer level in advance).

Boys

	Wave 1 (age 13-14)			Wave 2 (age 14-15)			Wave 3 (age 15-16)		
	Transfer (FIML 1st stage)	Work Hours (tobit)	Work Hours (FIML 2nd stage)	Transfer (FIML 1st stage)	Work Hours (tobit)	Work Hours (FIML 2nd stage)	Transfer (FIML 1st stage)	Work Hours (tobit)	Work Hours (FIML 2nd stage)
Transfer		-2.890***	-0.540		-3.752***	-7.658**		-5.074***	-15.168***
		(0.353)	(2.418)		(0.362)	(3.462)		(0.408)	(1.869)
'Permanent' income percentile	0.119***			0.133***			0.069*		
	(0.035)			(0.039)			(0.040)		
IMD (standardized)	0.008	-0.845***	-0.845***	0.014	-0.987***	-0.931***	0.027**	-1.111***	-0.895***
	(0.011)	(0.209)	(0.211)	(0.010)	(0.262)	(0.271)	(0.010)	(0.303)	(0.327)
Birth month	-0.000	-0.076	-0.062	0.004*	-0.032	-0.014	0.003	-0.317***	-0.287***
	(0.002)	(0.052)	(0.052)	(0.002)	(0.054)	(0.054)	(0.003)	(0.086)	(0.091)
LEA age 16-64 unemployment rate	0.019**	-0.117	-0.167	0.025**	-0.440**	-0.341*	0.028***	-0.778***	-0.502**
	(0.008)	(0.183)	(0.185)	(0.008)	(0.193)	(0.200)	(0.008)	(0.206)	(0.224)
Prior educational performance									
KS3 (age 14) point score (standardized)				-0.003	-0.015	-0.007	-0.001	-0.130	-0.107
				(0.007)	(0.232)	(0.235)	(0.008)	(0.268)	(0.280)
KS2 (age 11) point score (standardized)	0.003	0.276	0.261						
	(0.028)	(0.186)	(0.185)						
Joint significance of labour market variables: χ^2_3	14.16	8.64	26.33	24.17	11.28	22.53	38.73	18.47	29.67
(p-value)	(0.0027)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)
Observations		4868			4868			4868	

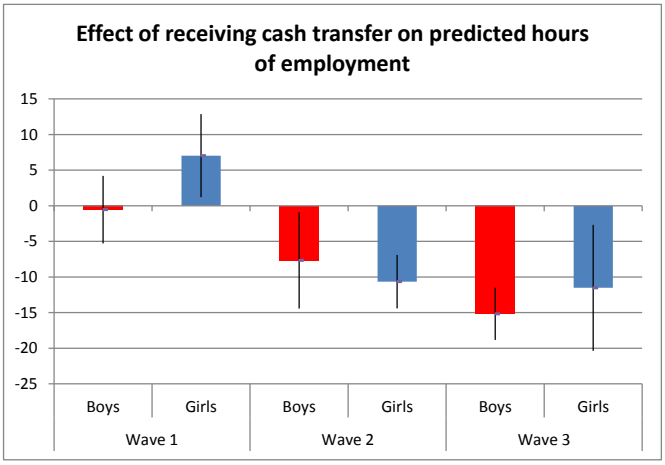
Girls

	Wave 1 (age 13-14)			Wave 2 (age 14-15)			Wave 3 (age 15-16)		
	Transfer (FIML 1st stage)	Work Hours (tobit)	Work Hours (FIML 2nd stage)	Transfer (FIML 1st stage)	Work Hours (tobit)	Work Hours (FIML 2nd stage)	Transfer (FIML 1st stage)	Work Hours (tobit)	Work Hours (FIML 2nd stage)
Transfer		-0.238***	7.034**		-2.796***	-10.649***		-4.549***	-11.521**
		(0.377)	(2.974)		(0.346)	(1.915)		(0.393)	(4.514)
'Permanent' income percentile	0.082**			0.118***			0.109**		
	(0.037)			(0.038)			(0.047)		
IMD (standardized)	0.016*	-0.785***	-0.981***	0.008	-0.337	-0.345	0.027**	-0.477*	-0.360
	(0.009)	(0.235)	(0.280)	(0.010)	(0.252)	(0.267)	(0.0011)	(0.304)	(0.320)
Birth month	0.002	-0.118**	-0.146**	-0.002	-0.082	-0.103*	0.008***	-0.351***	-0.298***
	(0.002)	(0.063)	(0.070)	(0.002)	(0.051)	(0.054)	(0.003)	(0.080)	(0.084)
LEA age 16-64 unemployment rate	0.005	-0.487**	-0.549**	0.021**	-0.798***	-0.714***	0.027***	-0.902***	-0.761***
	(0.007)	(0.203)	(0.234)	(0.009)	(0.212)	(0.232)	(0.008)	(0.220)	(0.252)
Prior educational performance									
KS3 (age 14) point score (standardized)				0.000	0.711***	0.706***	0.004	0.499*8	0.543**
				(0.0308)	(0.214)	(0.226)	(0.009)	(0.250)	(0.255)
KS2 (age 11) point score (standardized)	-0.006	0.534***	0.606***						
	(0.009)	(0.199)	(0.220)						
Joint significance of labour market variables: χ^2_3	6.81	12.13	29.12	10.48	10.24	22.80	39.57	18.29	24.10
(p-value)	(0.0782)	(0.0000)	(0.0000)	(0.0149)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations		4857			4857			4857	

Notes: Joint significance statistics and p-values are Wald test statistics. Coefficients in transfer column presented as average marginal effects on the probability of a positive transfer being made presented in accompanying graphs). Standard errors, clustered by school, in parentheses. Longitudinal weights applied. *: $p \leq 0.1$; **: $p \leq 0.05$ ***: $p \leq 0.01$. Index of multiple deprivation is standardized by substracting the mean and dividing by standard deviation. Month-of-birth within academic year: Sept (oldest in year) = 1, Aug (youngest in year) = 12. Prior educational performance is standardized average point score at age 11 (Key Stage 2) in wave 1, and age 14 (Key Stage 3) in waves 2 and 3. **Additional controls**: Parent's socio-economic status, education and employment, child's prior educational performance, resident and non-resident siblings, lone parent family, child's special educational needs (SEN) classification, urban-rural classification, child's ethnicity, timing of interview.

[12]We considered that as girls' employment in this age-group significantly comprises babysitting of younger siblings, the payment for this work may be conflated with transfers received from parents. By re-estimating the model for children with no younger siblings and finding the same result, we find no evidence for this hypothesis.

Figure 3: Parent-leading Stackelberg



Secondly, parents are shown to increase their probability of making cash transfers in response to the factors which restrict the child's labour market opportunities. The parent-leading Stackelberg model requires that transfers are held constant or reduced in response to such factors.

Figure 4 shows that being born later in the academic year produces a significant employment penalty for both boys and girls only in wave 3. This is consistent with 'turning 16' being more of an advantage for the types of jobs systematically vacated by students departing for university than lesser birthdays. Figure 7 shows that parents never significantly reduce their probability of transfer for offspring who are younger within their cohort, and for girls in the year they turn 16, significantly increase the probability of transfer. We cannot infer whether the absence of a corresponding effect for boys, for whom the employment penalty is equally large, is due to systematically different treatment - parents acting more altruistically, in terms of insuring their consumption, towards their daughters than sons - or statistical imprecision.

Figures 5 and 6 show that the IMD and adult unemployment always have a negative effect on predicted working hours. At least one of these coefficients is statistically signficant at the 5% level in all six specifications. Figures 8 and 9 show that both these indicators always have a positive effect effect on the probability of transfer. Both are statistically significant for wave 3, and the coefficient on unemployment is statistically significant at the 5% level in all cases except for girls in wave 1, for whom we have already rejected this model. [13]

[13]These finding show that the IMD is not acting as a proxy for unobserved household level characteristics with which it is correlated. If this were the case, one would expect a negative sign, because generally the more affluent the household, and hence the greater the probability of the transfer, the lower the IMD. As such, we are

Figure 4: Parent-leading Stackelberg

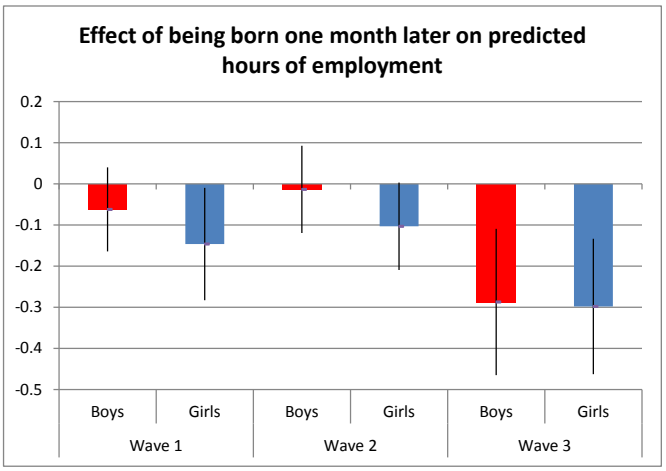


Figure 5: Parent-leading Stackelberg

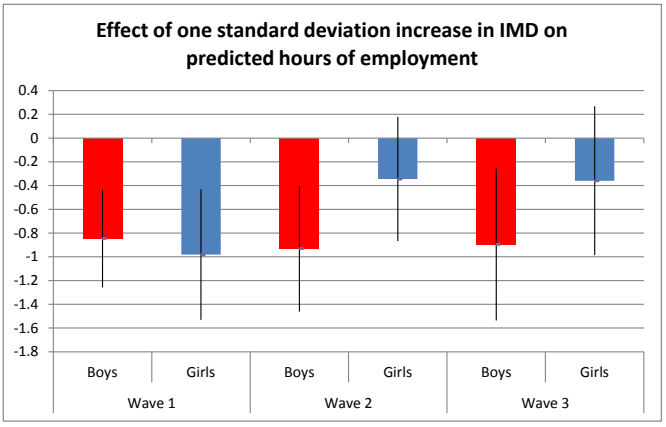


Figure 6: Parent-leading Stackelberg

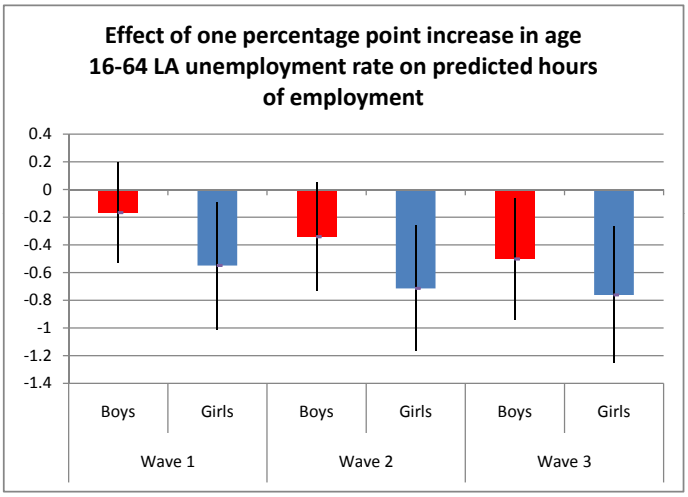


Figure 7: Parent-leading Stackelberg

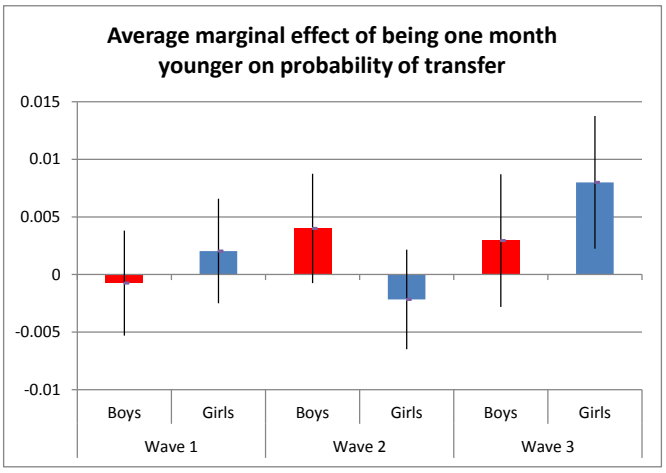


Figure 8: Parent-leading Stackelberg

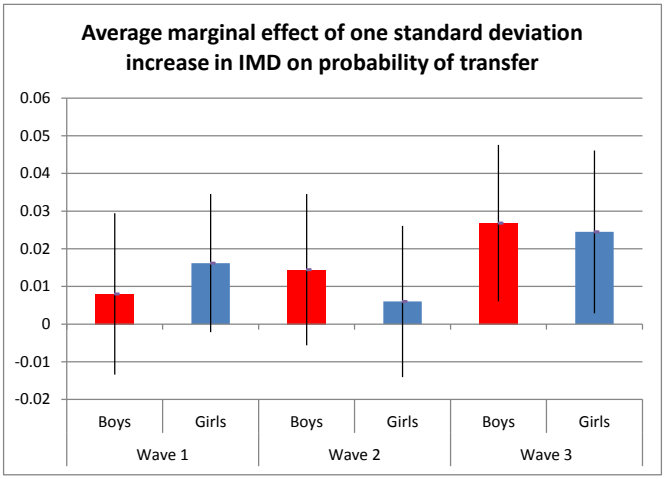
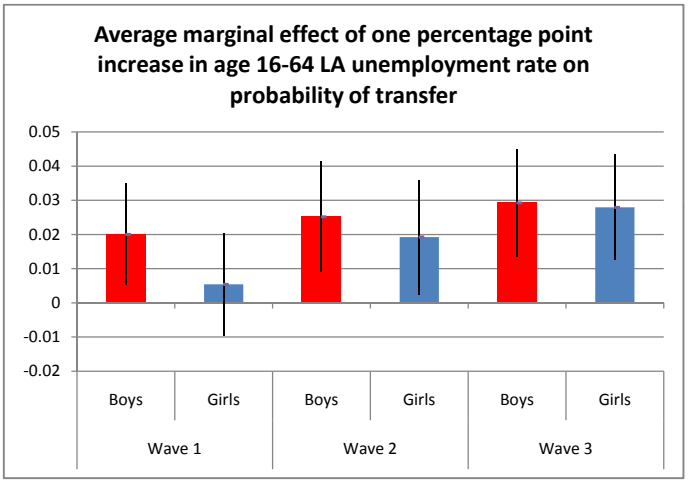


Figure 9: Parent-leading Stackelberg



These findings relating to parental transfers show that parents' behaviour is not time-consistent and not opportunistic in relation to a ceiling on the child's hours of employment. We therefore reject a parent-leading Stackelberg model for the determination of child's labour supply. This may mean that the difficulty for a child to obtain and keep a job presents too often and heavy a challenge to time-consistent behaviour by the parent. Alternatively, the parent may give too low a weight to his own consumption relative to elements of the child's utility, and to child's consumption relative to human capital, for this decision-making process to make him best off: The parent is not selfish or present-orientated enough. Either way, it seems parents prefer to 'insure' their child's consumption against labour market difficulties outside their control.

5.2 Child leading, *or* parent setting a contingent transfer schedule

We now present results for the child-leading Stackelberg framework, in which shifts in the child's labour supply decision identify the parent's best-response correspondence. The coefficients and standard errors for key variables for the child's work hours decision, and the parent's transfer decision assuming both exogeneity ("probit") and endogeneity ("FIML 2nd stage") of transfers, are presented in Table 3.

5.2.1 First stage: Labour supply equation

Figures 10-12 show that the magnitude and significance of the unemployment rate, IMD and month of birth do not change substantially when we estimate a reduced form for the child's labour supply, rather than making labour supply dependent on endogenous transfers. These instrumental variables pass the *relevance* condition: they are always jointly significant at the the 5% level or less. By assumption they have no direct effect on the parent's transfer decision, except via the child's labour supply.

These results support the decision to estimate seperately by wave and sex. Both boys and girls become progressively more responsive to the adult unemployment rate as they get older. While the difference in coefficients is not statistically significant, boys appear better insulated from this wider adult labour market, instead (at least at ages 14-15 and 15-16) being dependent on very localized determinants of opportunities, proxied by the IMD.

confident that by including household level counterparts to the deprivation indicators captured by the IMD, the coefficients here represent the contextual effect of local labour market conditions.

Figure 10: Child-leading Stackelberg

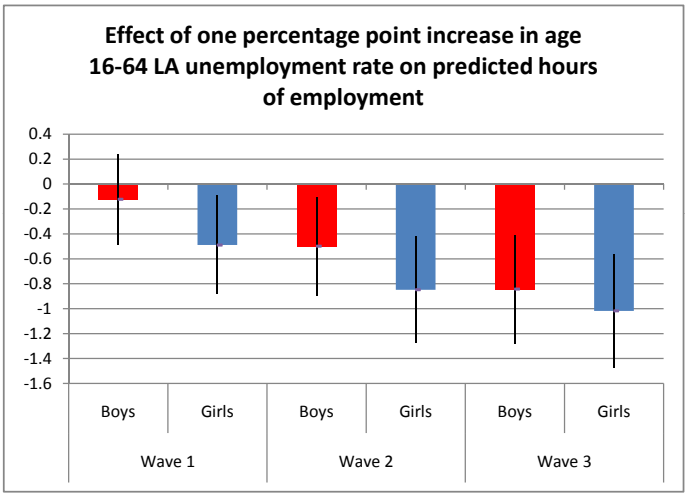


Figure 11: Child-leading Stackelberg

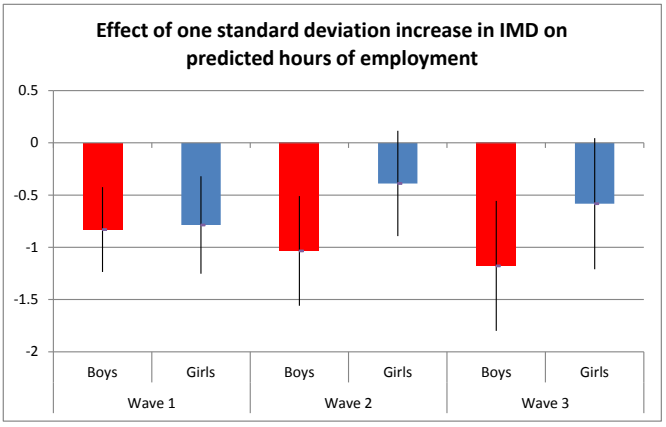


Figure 12: Child-leading Stackelberg

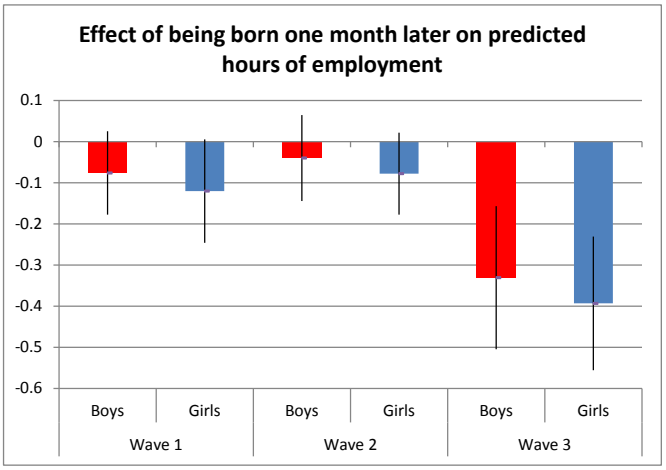


Table 3: Estimation results: Stackelberg model with child leading, or parent setting contingent transfer schedule.

Boys

	Wave 1 (age 13-14)			Wave 2 (age 14-15)			Wave 3 (age 15-16)		
	Work Hours (FIML 1st stage)	Transfer (probit)	Transfer (FIML 2nd stage)	Work Hours (FIML 1st stage)	Transfer (probit)	Transfer (FIML 2nd stage)	Work Hours (FIML 1st stage)	Transfer (probit)	Transfer (FIML 2nd stage)
Work Hours		-0.019***	-0.005		-0.020***	-0.010*		-0.019***	-0.007
		(0.002)	(0.006)		(0.002)	(0.005)		(0.002)	(0.004)
'Permanant' income	0.391	0.103***	0.101***	-1.389	0.096**	0.101**	-0.319	0.059	0.055
percentile	(0.909)	(0.036)	(0.036)	(1.014)	(0.039)	(0.040)	(1.277)	(0.038)	(0.039)
IMD (standardized)	-0.817***			-1.017***			-1.158***		
	(0.207)			(0.267)			(0.317)		
Birth month	-0.064			-0.037			-0.326***		
	(0.052)			(0.053)			(0.088)		
LEA age 16-64	-0.125			-0.489**			-0.818***		
unemployment rate	(0.184)			(0.202)			(0.222)		
Prior educational performance:									
KS3 (age 14) point score				0.023	-0.006	-0.006	-0.102	-0.007	-0.006
(standardized)				(0.234)	(0.008)	(0.008)	(0.274)	(0.009)	(0.009)
KS2 (age 11) point score	0.251	0.005	0.004						
(standardized)	(0.186)	(0.008)	(0.008)						
Joint significance of labour market variables: χ^2_3	24.49	.	.	34.85	.	.	47.94	.	.
(p-value)	(0.0000)	.	.	(0.0000)	.	.	(0.0000)	.	.
Observations		4868			4868			4868	

Girls

	Wave 1 (age 13-14)			Wave 2 (age 14-15)			Wave 3 (age 15-16)		
	Work Hours (FIML 1st stage)	Transfer (probit)	Transfer (FIML 2nd stage)	Work Hours (FIML 1st stage)	Transfer (probit)	Transfer (FIML 2nd stage)	Work Hours (FIML 1st stage)	Transfer (probit)	Transfer (FIML 2nd stage)
Work Hours		-0.016***	-0.002		-0.016***	-0.009		-0.019***	-0.015***
		(0.003)	(0.007)		(0.002)	(0.006)		(0.001)	(0.004)
'Permanant' income	-0.094	0.087**	0.086**	-1.726*	0.095**	0.098**	-0.572	0.087**	0.089**
percentile	(0.986)	(0.038)	(0.039)	(1.010)	(0.038)	(0.039)	(1.190)	(0.040)	(0.040)
IMD (standardized)	-0.808***			-0.399			-0.577*		
	(0.238)			(0.258)			(0.320)		
Birth month	-0.121*			-0.085*			-0.393***		
	(0.064)			(0.051)			(0.083)		
LEA age 16-64	-0.482**			-0.869***			-1.031***		
unemployment rate	(0.202)			(0.221)			(0.233)		
Prior educational performance:									
KS3 (age 14) point score				0.720***	0.002	0.002	0.486*	0.001	0.001
(standardized)				(0.214)	(0.009)	(0.009)	(0.258)	(0.008)	(0.009)
KS2 (age 11) point score	0.550***	-0.006	-0.007						
(standardized)	(0.201)	(0.009)	(0.009)						
Joint significance of labour market variables: χ^2_3	35.26	.	.	32.72	.	.	57.88	.	.
(p-value)	(0.0000)	.	.	(0.0000)	.	.	(0.0000)	.	.
Observations		4857			4857			4857	

Notes: Joint significance statistics and p-values are Wald test statistics. Estimating all six specifications jointly obtains Wald test statistic of χ^2_6 =23.64 (p =0.0006) for joint significance of children's Work Hours on parents' probability of transfer. Coefficients in transfer column presented as average marginal effects on the probability of a positive transfer being made presented in accompanying graphs). Standard errors, clustered by school, in parentheses. Longitudinal weights applied. *: $p \leq 0.1$; **: $p \leq 0.05$ ***: $p \leq 0.01$. Index of multiple deprivation is standardized by substracting the mean and dividing by standard deviation. Month-of-birth within academic year: Sept (oldest in year) = 1, Aug (youngest in year) = 12. Prior educational performance is standardized average point score at age 11 (Key Stage 2) in wave 1, and age 14 (Key Stage 3) in waves 2 and 3. **Additional controls**: Parent's education, socio-economic status and employment, child's prior educational performance, resident and non-resident siblings, lone parent family, child's special educational needs (SEN) classification, urban-rural classification, child's ethnicity, timing of interview.

Turning 16 (in wave 3) earlier than one's peers is the only birthday that matters significantly for employment opportunities. Jobs this birthday opens up; involving alcohol or catering; are clearly more common among vacancies created by 18 year-olds leaving for university than those for which the lifting of the 5-hour Saturday restriction (on one's 15th birthday) would be the employer's binding concern. Hence, month of birth can be used as an instrument in this context,

but not indiscriminately without understanding institutional arrangements. The instruments are collectively more relevant in wave 3, resulting in marginally more precisely estimated second stage second stage coefficients on labour supply in that wave.

5.2.2 Second stage: Parent's transfer or tax schedule

Figure 13 shows that parent's transfer probability is always increasing in household income. The effect is small, akin to a 10 percentage point movement up the income distribution increasing the probability of transfers by approximately 1 percentage point. We expected a small magnitude for the income gradient. Earlier work by Dustmann et al. (2009) and Dustmann and Micklewright (2001) identified a marginal propensity for parents to transfer income to their children of just 0.005 on average, for example. With transfers somewhat inelastic with respect to parental income, this is consistent with Dustmann et al's (1996) argument that youths from lower-income households do not face "disproportionately high financial pressure" to work.

Figure 13: Child-leading Stackelberg

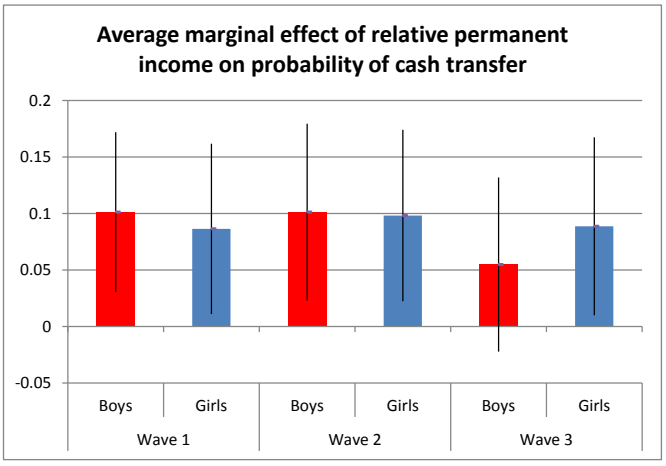
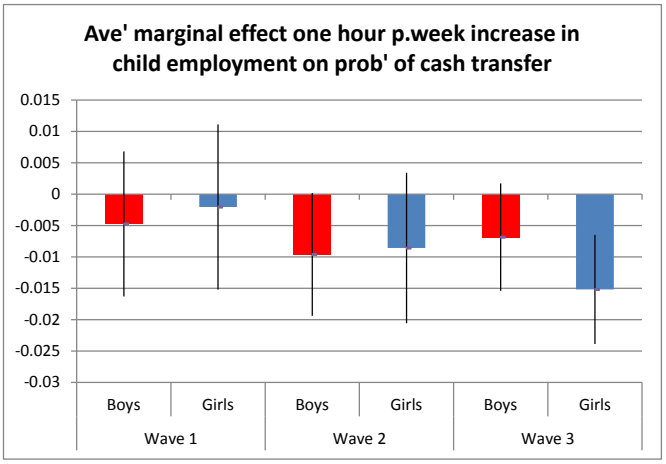


Figure 14 shows that transfer probability is always decreasing in hours of employment, but that this observed withdrawal of transfers is statistically significant only for girls in wave 3, which is the final year of compulsory education. As such, apart from this final group, we cannot reject the null hypothesis that parents do not tax their children. This shows the limitation of the data, that we observe reductions in parental transfers only at the extensive margin i.e. switching from positive to zero transfers. These results are consistent with reductions occuring in the intensive margin (the *amount*), but as these changes are not observable our statistical power to detect

parents' behavioural responses is limited.[14]

Figure 14: Child-leading Stackelberg



Our estimates here tell us simply that the 'tax rate' at the intensive margin is sufficiently shallow to mean that increasing labour supply results in very few cases of parents switching from positive to zero transfers. Parents are sufficiently altruistic and paternalistic to adopt this decision-making mechanism in preference to setting a 'fixed' transfer level, but these results imply they do not perceive having a job to be particularly damaging to the child's human capital or educational performance. Clearly, they do not feel compelled to discourage employment through an especially heavy 'tax rate'. Nevertheless, if the academic cost of in-school employment is greatest nearest to exam time, we would expect to detect such a tax schedule in the final year of compulsory education, if ever, and the results in Figure 14 are consistent with this prediction.

6 Conclusion

Employment experience for teenagers in compulsory education has a potentially major impact on educational performance and subsequent academic and labour market opportunities. This paper has focused on the principle that parents can use financial incentives to alter their child's decision to work, and developed a theoretical model for the interaction determining financial support provided by parents and part-time employment taken by children. We motivate two alternative Stackelberg frameworks. In the first (parent-leading), parents set their transfer level in advance, anticipating the child's best-response. In the second (child leading) parents set

[14] An potential line to pursue was to identify the effect of income changes *over time* on the transfer schedule. This is not feasible due to the measurement differences between waves.

a contingent transfer schedule for each level of labour supply, thereby effectively taxing their children's earnings.

We test our model using data for a cohort of English teenagers between 2004 and 2006, estimating repeated cross-sectional models for an identical sample of individuals at ages 13-14, 14-15, and 15-16. Holding constant the institutional arrangements, educational system and time-invariant unobserved characteristics, we identify significant differences in the determinants of selection into employment as the children age, though we do not detect significant differences in the propensity of parents to 'tax' their children's earnings over this time.

Estimating the empirical counterpart to the parent-leading framework, we show that parents use their relative financial power to 'insure' their child's consumption against factors beyond their control. This means that rather than holding transfers constant in response to factors affecting the child's labour market opportunities, or reducing them in response to a ceiling being placed on their hours of employment, parents raise transfers instead. This suggests that the dominant attitude for parents is that they would like their children to facilitate their own consumption, but will not penalize them if this proves difficult. We also demonstrate a very shallow income gradient in parent's willingness to make cash transfers to the child. Between these results we infer that parents of children who otherwise would leave education at 16 - from low income households as well as high - can and will accommodate the two additional compulsory years of schooling from 2013-2014 as an 'extension to childhood', rather than impose a financial burden on an 'independent adult'. This should ensure participation in post-compulsory education will not substantially be hindered by financial pressures to take employment.

These results show that a parent setting a 'fixed' transfer level cannot be credible in doing so. We therefore reject the parent-leading Stackelberg framework. We infer that parents instead set a contingent schedule transfer schedule for each level of labour supply undertaken by the child. In the language of game theory, this can be interpreted as the parent - whose financial resources afford the choice between the two decision-mechanisms - becoming better off by ceding the Stackelberg first-move advantage to the child. The child's human capital is a public good, valued by both the parent and the child, and which is eroded by long hours of employment. In this framework, by taxing the child's earnings the parent forces the child to internalise this social cost. This cannot be achieved with a fixed lump-sum transfer. In this regard, interventions such as the UK's Education Maintenance Allowance (EMA); through which the government paid 16-

18 year-olds from low income households up to £30 a week to attend post-compulsory education; fall short as an incentive mechanism for a secondary goal of raising educational performance by reducing their labour supply.

In this framework, we find that the probability of receiving transfers is always decreasing in the child's hours of employment, though this is only significant for girls in the final year of compulsory schooling. Although the magnitude of the observed effect is small, it demonstrates that, at least for girls at the time when employment is likely to be most costly in terms of academic performance, parents do tax their children.

At face value, our results might suggest there is no role for more restrictive regulation of in-school employment. There is strong positive selection into employment by prior educational performance, which disappears for boys but persists for girls when controlling for a host of further individual and household characteristics. We acknowledge the limitations imposed by the definition of our transfer variable. However, the shallow income gradient in parental transfers reveals no evidence that consumption pressures drive low socio-economic status children into employment. This also implies relatively little socio-economic differentiation in the *ability* of parents to tax their children and so force them to account for the human capital cost of their employment. Nevertheless, from the perspective of a social planner, it may be the case that parents underestimate the human capital cost of employment, leading to sub-optimal outcomes.

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A Appendix

A.1 Differentiated labour markets by gender

A.1.1 Job types

The LSYPE does not provide any information on the nature of work undertaken. Howieson et al. (2006) indicate the extent to which boys' and girls' labour markets are differentiated in Scotland, where the education system, labour market conditions and legislation are very similar to England. The largest categories of employment among those aged 14 and under are newspaper delivery (32% of workers, among which boys outnumber girls by a factor of five) and babysitting (11% of workers, among which girls outnumber boys by a factor of six). In both cases, the gender bias will partly be driven by genuine differences in physical and mental attributes affecting individuals' ability to do the job well, but also by social norms for gender roles. This suggests that the size and male dominance of the market for newspaper deliverers is responsible for the higher male employment at age 13-14, when few other jobs are available.

The largest categories of employment among 15 and 16 year olds are "cafes and restaurants" (17.5%), "other shops" (14%) and "chain stores" (12%), with female employment more heavily concentrated in these industries than male employment. Jobs in these categories are also likely to be subject to age restrictions at 16 in law (due to health and safety requirements in food preparation or the presence of alcohol) or at 15 in practice (because this enables a single, eight hour shift to be supplied on a weekend).

A.1.2 Gender roles and ethnicity

Table A.1.2 shows that the overall trends in employment are driven by the majority white ethnic group, who also have the highest employment levels for both sexes at every wave. There is considerable variation in employment rates and trajectories among the other ethnic groups. This will reflect a combination of socio-cultural norms, prior educational performance, poorer labour market opportunities and active labour market discrimination, but also rigid gender roles within certain ethnic groups which make employment among girls exceptionally rare. In particular, Pakistani and Bangladeshi girls are almost completely excluded from the labour

market. This makes it sensible to estimate our models separately for boys and girls.[15]

Table A1: Employment rates by wave, sex and ethnicity

	Wave 1			Wave 2			Wave 3		
	Boys	Girls		Boys	Girls		Boys	Girls	
White	25.7%	21.3%	***	31.4%	30.3%		30.8%	34.8%	###
Mixed	15.7 %	16.0%		15.6%	19.9%		24.5%	20.5%	
Indian	9.4%	4.4%	***	12.1%	5.0%	***	10.1%	3.4%	***
Pakistani	7.0%	<1.5%	***	6.4%	<1.5%	***	8.0%	<1.5%	***
Bangladeshi	4.5%	<1.5%	***	5.8%	<1.5%	***	7.2%	3.1%	*
Black Caribbean	11.2%	9.6%		11.5%	10.7%		12.1%	14.7%	
Black African	7.8%	4.7%		10.1%	5.2%		6.0%	8.7%	
Other	15.3%	9.8%		16.7%	8.1%		12.8%	11.1%	

Symbols: *, **, ***: Boys' employment higher than girls' at 5%, 1% and 0.1% levels respectively. #, ##, ###: Girls' employment higher than boys' at 5%, 1% and 0.1% levels respectively. Standard errors clustered by school. Population proportions calculated using final probability weights.

[15] In both specifications several ethnicity dummies are statistically significant in both transfer and labour supply equations. Ethnicity therefore makes a difference in levels. However, by re-estimating on white students only and obtaining very similar results, we find no evidence for significant ethnicity interactions with the parameters of interest.

A.2 Observed social interactions

This section derives the child's labour supply response to unearned income and the parent's transfer response to child labour supply. These parameters are derived from the implicit functions which are the first-order conditions in equations 3 and 8.

A.2.1 The labour supply response to unearned income

The child's first-order condition is:

$$[.] = w.U^c_C + H_L.U^c_H = 0 \tag{A1}$$

Using implicit differentiation, the parameter of interest is equal to:

$$\begin{aligned} \frac{\partial L}{\partial t} &= -\frac{[\frac{\partial [.]}{\partial t}]}{[\frac{\partial [.]}{\partial L}]} \\ &= -\frac{\frac{\partial [wU^c_C]}{\partial t} + \frac{\partial [U^c_H H_L]}{\partial t}}{\frac{\partial [wU^c_C]}{\partial L} + \frac{\partial [U^c_H H_L]}{\partial L}} \end{aligned} \tag{A2}$$

The elements of this expression are as follows:

- . $\frac{\partial [w.U^c_C]}{\partial t} = wU^c_{CC}$: w is constant, and increasing t by 1 increases consumption by 1.
- . $\frac{\partial [U^c_H H_L]}{\partial t} = 0$: Human capital production function is invariant to transfers, and marginal utility from human capital and consumption are separable.
- . $\frac{\partial [wU^c_C]}{\partial L} = w^2 U^c_{CC}$: w is constant, and increasing L by 1 changes marginal utility of consumption as though consumption increased by w;
- . $\frac{\partial [U^c_H H_L]}{\partial L} = U^c_{HH}(H_L)^2 + U^c_H.H_{LL}$: Using the product rule, bearing in mind that U^c_H is itself a function of H.

Multiplying and dividing the whole expression by w, the parameter of interest is:

$$\frac{\partial L}{\partial t} = -\frac{1}{w}.\frac{w^2.U^c_{CC}}{w^2.U^c_{CC} + (H_L)^2.U^c_{HH} + U^c_H H_{LL}} \tag{A3}$$

This means that $\frac{\partial L}{\partial t}$ is less negative than $-\frac{1}{w}$, so the child always withdraws labour earnings at a slower rate than transfers are received. Hence, child's consumption is strictly increasing in

cash transfers.

A.2.2 The 'tax' rate

The parent's first-order condition is:

$$[.] = -U_P^p + U_C^p = 0 \tag{A4}$$

The parameter of interest is therefore equal to:

$$\begin{aligned} \frac{\partial t}{\partial L} &= -\frac{[\frac{\partial [.]}{\partial L}]}{[\frac{\partial [.]}{\partial t}]} \\ &= -\frac{-\frac{\partial U_P^p}{\partial L} + \frac{\partial U_C^p}{\partial L}}{-\frac{\partial U_P^p}{\partial t} + \frac{\partial U_C^p}{\partial t}} \end{aligned} \tag{A5}$$

The elements of this expression are as follows:

- . $\frac{\partial U_P^p}{\partial L} = 0$: Child's labour supply has no effect on parent's consumption.
- . $\frac{\partial U_C^p}{\partial L} = w.U_{CC}^p$: Increasing consumption by 1 means U_C^p changes by U_{CC}^p, so at the margin, increasing consumption by w means U_C^p changes by $w.U_{CC}^p$.
- . $\frac{\partial U_P^p}{\partial t} = -U_{PP}^p$: Increasing t by 1 has same effect as reducing own consumption by 1.
- . $\frac{\partial U_C^p}{\partial t} = U_{CC}^p$: Increasing t by 1 has same effect as increasing child's consumption by 1.

This means the parameter of interest is:

$$\frac{\partial t}{\partial L} = -w.\frac{U_{CC}^p}{U_{PP}^p + U_{CC}^p} \tag{A6}$$

Expressing this as the 'tax' rate (in response to earnings rather than labour supply), this becomes:

$$\frac{\partial t}{\partial L}.\frac{1}{w} = -\frac{U_{CC}^p}{U_{PP}^p + U_{CC}^p} \tag{A7}$$

The denominator here is more negative than numerator, so the expression is strictly between zero and minus 1 (the 'tax rate' is strictly between 0 and 100%). This means that the parent

always withdraws transfers in response to labour at a rate slower than the wage earned. This means the child's consumption is strictly increasing in his labour supply.

A.3 Complete estimation output

The complete maximum likelihood estimation output for the parent-leading Stackelberg model is shown in Tables A2-A3, and the child-leading Stackelberg model in Tables A4-A5, starting overleaf. Tables 2 and 3 in the main body presented average marginal effects on the probability of transfer for a set of key variables. Here we show the probit linear latent regression coefficients for both dependent and all explanatory variables. We omit the output for the baseline specifications assuming that transfers and labour supply are exogenous in the second stage of the parent-leading and child-leading specifications respectively.

Table A2: Complete maximum likelihood estimation results: Stackelberg system with parent as leader, setting 'fixed' transfer level in advance.

	Boys						Girls					
	Wave 1		Wave 2		Wave 3		Wave 1		Wave 2		Wave 3	
	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours
Transfer		-0.852		-7.299**		-15.146***		6.950**		-10.233***		-11.126**
		(2.213)		(3.676)		(1.877)		(2.984)		(2.043)		(5.293)
'Permanent' income	0.446***		0.454***		0.228*		0.314**		0.424***		0.387**	
percentile	(0.132)		(0.134)		(0.133)		(0.144)		(0.137)		(0.169)	
IMD (standardized)	0.030	-0.854***	0.049	-0.952***	0.088**	-0.917***	0.061*	-0.952***	0.029	-0.330	0.094**	-0.356
	(0.041)	(0.211)	(0.035)	(0.271)	(0.035)	(0.327)	(0.036)	(0.279)	(0.037)	(0.265)	(0.039)	(0.322)
Birth month	-0.002	-0.075	0.015*	-0.016	0.011	-0.290***	0.009	-0.146**	-0.007	-0.097*	0.029***	-0.300***
	(0.009)	(0.052)	(0.008)	(0.054)	(0.010)	(0.091)	(0.009)	(0.070)	(0.008)	(0.054)	(0.010)	(0.085)
LEA age 16-64	0.073**	-0.155	0.087***	-0.357*	0.095***	-0.523**	0.021	-0.552**	0.075**	-0.690***	0.096***	-0.742***
unemployment rate	(0.029)	(0.185)	(0.028)	(0.201)	(0.026)	(0.225)	(0.029)	(0.234)	(0.031)	(0.229)	(0.029)	(0.263)
Prior educational performance												
KS3 (age 14) point score			-0.011	-0.021	-0.004	-0.131			0.000	0.720***	0.014	0.529**
(standardized)			(0.027)	(0.236)	(0.029)	(0.281)			(0.030)	(0.225)	(0.032)	(0.254)
KS2 (age 11) point score	0.010	0.266					-0.025	0.604***				
(standardized)	(0.031)	(0.186)					(0.033)	(0.218)				
Parents' employment:												
Two FT	-0.028	1.101	-0.226**	1.850**	0.078	1.761	-0.106	1.807**	-0.070	1.794**	0.056	3.500**
	(0.126)	(0.785)	(0.112)	(0.849)	(0.178)	(1.584)	(0.120)	(0.835)	(0.112)	(0.809)	(0.191)	(1.653)
one FT, one PT	-0.019	1.234	-0.102	2.350***	0.086	1.042	-0.060	1.227	-0.069	1.653**	0.114	3.135*
	(0.121)	(0.762)	(0.108)	(0.781)	(0.178)	(1.604)	(0.116)	(0.868)	(0.105)	(0.781)	(0.186)	(1.657)
One FT only	-0.012	0.745	-0.101	1.356*	0.063	0.706	0.014	0.811	-0.081	0.326	0.078	1.352
	(0.104)	(0.684)	(0.099)	(0.755)	(0.158)	(1.426)	(0.099)	(0.772)	(0.097)	(0.764)	(0.172)	(1.521)
One/two PT, no FT	0.147	1.124	0.037	0.965	0.210	1.574	0.045	0.541	-0.055	0.530	0.095	0.602
	(0.117)	(0.760)	(0.109)	(0.835)	(0.157)	(1.464)	(0.107)	(0.872)	(0.104)	(0.774)	(0.172)	(1.485)
Non-resident	-0.015	-0.012	-0.004	0.201	-0.020	0.227	-0.017	0.318	-0.024	0.438**	-0.044	-0.297
siblings	(0.031)	(0.166)	(0.022)	(0.162)	(0.023)	(0.217)	(0.033)	(0.238)	(0.023)	(0.183)	(0.027)	(0.218)
Resident siblings	-0.055**	0.555***	-0.031	0.325**	-0.064***	0.424**	-0.115***	1.038***	-0.098***	0.581***	-0.075***	0.318
	(0.024)	(0.138)	(0.023)	(0.159)	(0.022)	(0.202)	(0.025)	(0.227)	(0.028)	(0.201)	(0.024)	(0.211)
Parents' education												
Degree	-0.002	-0.583	0.169	-1.444*	0.088	-0.559	-0.021	0.279	0.167	2.127**	0.276**	2.504**
	(0.107)	(0.695)	(0.106)	(0.871)	(0.102)	(0.985)	(0.115)	(0.896)	(0.109)	(0.830)	(0.110)	(0.975)
A-Levels	-0.030	0.158	0.096	-0.114	0.011	0.188	-0.167*	0.214	-0.014	1.979***	0.012	2.376***
	(0.092)	(0.589)	(0.089)	(0.745)	(0.088)	(0.859)	(0.096)	(0.799)	(0.093)	(0.752)	(0.090)	(0.812)
GCSEs	-0.046	0.134	0.093	0.149	-0.063	0.630	-0.186**	0.761	-0.082	2.052***	-0.006	2.632***
	(0.090)	(0.575)	(0.082)	(0.741)	(0.082)	(0.876)	(0.089)	(0.809)	(0.088)	(0.725)	(0.089)	(0.798)
Other qualifications	-0.364*	1.752	-0.123	2.133	-0.305	0.017	-0.177	0.061	-0.140	-0.447	0.136	2.264
	(0.212)	(1.356)	(0.193)	(1.450)	(0.188)	(2.149)	(0.203)	(1.728)	(0.185)	(1.638)	(0.222)	(2.007)
Parents' SES												
NSSEC 1-2	0.030	-0.675*	0.008	-0.210	0.076	0.374	0.142**	-1.105**	-0.007	-0.487	0.052	0.161
	(0.070)	(0.385)	(0.062)	(0.376)	(0.060)	(0.533)	(0.064)	(0.529)	(0.061)	(0.422)	(0.063)	(0.487)
NSSEC 3	0.137	-0.706	0.034	-1.578**	0.195**	-0.412	0.037	-0.753	0.024	-0.800	0.039	0.831
	(0.091)	(0.578)	(0.091)	(0.650)	(0.096)	(0.859)	(0.092)	(0.661)	(0.095)	(0.709)	(0.097)	(0.762)
NSSEC 4 (self-employed)	-0.235***	0.049	-0.128	-0.114	-0.001	0.474	0.069	0.740	0.036	1.385**	0.021	1.610**
	(0.085)	(0.464)	(0.085)	(0.599)	(0.095)	(0.785)	(0.080)	(0.577)	(0.089)	(0.639)	(0.092)	(0.712)
$\text{NSSEC8}_i mp$	-0.068	-0.530	0.068	-1.336	-0.047	-0.287	-0.003	-0.408	0.028	0.033	0.155	0.946
	(0.136)	(0.963)	(0.139)	(1.177)	(0.140)	(1.294)	(0.129)	(1.381)	(0.128)	(1.254)	(0.158)	(1.410)
Lone parent	0.054	-0.061	0.081	0.301	-0.014	-0.535	-0.027	1.144*	0.116	0.977*	0.152*	1.726***
	(0.081)	(0.493)	(0.072)	(0.524)	(0.074)	(0.670)	(0.086)	(0.632)	(0.074)	(0.524)	(0.078)	(0.628)
Observations	4854		4854		4854		4846		4846		4846	

Notes: *: $p \leq 0.1$; **: $p \leq 0.05$ ***: $p \leq 0.01$. Standard errors, clustered by school, in parentheses. Longitudinal weights applied.

Table A3: Complete maximum likelihood estimation results: Stackelberg system with parent as leader, setting 'fixed' transfer level in advance (continued)

	Boys						Girls					
	Wave 1		Wave 2		Wave 3		Wave 1		Wave 2		Wave 3	
	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours
Youth's ethnicity												
Mixed race	-0.026	-3.013***	0.100	-2.401**	0.032	-2.048**	-0.112	-0.136	-0.053	-0.149	-0.117	-1.567
	(0.132)	(0.940)	(0.121)	(1.148)	(0.119)	(0.940)	(0.128)	(0.922)	(0.142)	(0.889)	(0.132)	(1.093)
Indian	-0.549***	-3.725***	-0.423***	-5.036***	-0.355***	-7.292***	-0.633***	-3.738**	-0.576***	-8.796***	-0.313***	-10.703***
	(0.096)	(0.836)	(0.093)	(1.062)	(0.101)	(1.293)	(0.111)	(1.472)	(0.102)	(1.100)	(0.106)	(1.395)
Pakistani or	0.143	-6.182***	0.113	-6.802***	0.297**	-6.688***	0.072	-9.158***	0.083	-12.876***	0.061	-11.102***
Bangladeshi	(0.112)	(0.880)	(0.119)	(1.029)	(0.124)	(1.370)	(0.113)	(1.487)	(0.109)	(2.097)	(0.116)	(1.478)
Black African or	-0.068	-2.049*	0.043	-2.456*	-0.035	-4.948**	-0.031	-1.726*	-0.078	-3.010***	0.242**	-3.252***
Caribbean	(0.127)	(1.240)	(0.142)	(1.325)	(0.136)	(1.944)	(0.108)	(0.940)	(0.111)	(1.039)	(0.120)	(1.078)
Other	0.005	0.163	-0.171	-2.334	0.060	-3.420*	-0.344*	-1.340	-0.518***	-4.484**	-0.505***	-7.416***
	(0.206)	(1.203)	(0.190)	(1.498)	(0.201)	(1.988)	(0.182)	(1.566)	(0.158)	(1.925)	(0.159)	(2.148)
Special Ed' Needs	-0.097	-0.432	-0.026	-0.914*	-0.047	-1.071*	-0.064	-0.335	0.003	-0.965	-0.054	-2.141***
	(0.066)	(0.438)	(0.064)	(0.517)	(0.067)	(0.638)	(0.084)	(0.687)	(0.080)	(0.642)	(0.081)	(0.698)
Town or Village	-0.007	-0.154	-0.089	0.865*	-0.012	1.264**	-0.117*	1.580***	-0.217***	1.479***	-0.193***	1.663***
	(0.071)	(0.377)	(0.066)	(0.463)	(0.064)	(0.537)	(0.069)	(0.521)	(0.066)	(0.420)	(0.064)	(0.533)
Isolated area	-0.256*	-0.110	-0.224*	0.554	-0.454***	0.392	-0.045	1.130	-0.219*	2.749***	-0.047	3.054***
	(0.145)	(0.743)	(0.120)	(0.965)	(0.124)	(1.115)	(0.127)	(0.952)	(0.128)	(0.732)	(0.141)	(0.884)
Ill health limits	0.154**	0.147	0.083	0.101	0.058	-0.009	-0.049	-0.189	0.039	-0.819**	0.026	-0.073
parent's activities	(0.068)	(0.405)	(0.068)	(0.503)	(0.062)	(0.552)	(0.062)	(0.483)	(0.059)	(0.413)	(0.065)	(0.513)
Home owner (mortgage	-0.063	0.058	0.105	0.513	-0.092	-0.150	-0.031	-0.580	-0.051	0.044	0.058	0.329
or outright)	(0.066)	(0.430)	(0.066)	(0.517)	(0.065)	(0.622)	(0.074)	(0.519)	(0.068)	(0.485)	(0.073)	(0.548)
StepFamily	0.106	-0.099	0.081	-0.079	-0.007	-0.050	0.129	-0.094	-0.003	0.018	-0.084	-0.317
	(0.075)	(0.472)	(0.072)	(0.523)	(0.067)	(0.645)	(0.081)	(0.607)	(0.075)	(0.506)	(0.072)	(0.592)
Not Greater London	-0.161*	2.081***	-0.064	1.234	-0.099	2.073**	0.078	1.908***	0.105	2.689***	0.116	1.239*
	(0.086)	(0.681)	(0.096)	(0.767)	(0.093)	(0.831)	(0.087)	(0.721)	(0.078)	(0.778)	(0.084)	(0.733)
Time of interview												
March	-0.093	0.175	-0.042	0.225	-0.037	-0.480	-0.032	0.502	0.043	1.835**	-0.073	-0.732*
	(0.065)	(0.376)	(0.127)	(0.868)	(0.054)	(0.452)	(0.068)	(0.512)	(0.125)	(0.873)	(0.054)	(0.406)
April	-0.056	0.353	-0.110	0.248	-0.055	0.712	-0.029	0.391	0.013	2.202**	0.002	1.093
	(0.067)	(0.433)	(0.126)	(0.890)	(0.081)	(0.727)	(0.073)	(0.532)	(0.124)	(0.869)	(0.077)	(0.692)
May	-0.057	0.908*	-0.123	0.159	-0.287**	-2.224	-0.068	1.305**	0.068	1.895**	-0.311***	-1.883
	(0.088)	(0.519)	(0.129)	(0.934)	(0.142)	(1.497)	(0.092)	(0.641)	(0.126)	(0.898)	(0.118)	(1.180)
June	-0.089	1.115	-0.170	1.185	-0.241	-1.256	-0.061	1.142	-0.074	1.440	-0.288	2.429
	(0.111)	(0.873)	(0.137)	(0.989)	(0.206)	(2.172)	(0.127)	(1.096)	(0.133)	(0.982)	(0.208)	(1.692)
July	0.194	0.654	0.061	1.370	-0.091	.	0.029	0.380	-0.041	2.140	0.092	1.595
	(0.152)	(0.855)	(0.204)	(1.318)	(0.637)	.	(0.158)	(1.120)	(0.205)	(1.683)	(0.625)	(2.683)
After birthday	-0.166**	0.182	0.071	0.386	0.029	-0.308	0.052	-0.123	-0.063	-0.460	0.087	-0.410
	(0.073)	(0.486)	(0.079)	(0.589)	(0.075)	(0.709)	(0.079)	(0.596)	(0.079)	(0.497)	(0.077)	(0.635)
Observations	4854		4854		4854		4846		4846		4846	

Notes: *: $p \leq 0.1$; **: $p \leq 0.05$ ***: $p \leq 0.01$. Standard errors, clustered by school, in parentheses. Longitudinal weights applied.

Table A4: Complete maximum likelihood estimation results: Stackelberg system with child as leader, or parent setting contingent transfer schedule

	Boys						Girls					
	Wave 1		Wave 2		Wave 3		Wave 1		Wave 2		Wave 3	
	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours
Work Hours	-0.018		-0.033*		-0.023		-0.008		-0.031		-0.055***	
	(0.022)		(0.017)		(0.015)		(0.026)		(0.022)		(0.017)	
'Permanent' income	0.381***	0.341	0.347**	-1.299	0.181	-0.375	0.333**	-0.124	0.355**	-1.664*	0.322**	-0.641
percentile	(0.135)	(0.915)	(0.137)	(1.016)	(0.130)	(1.285)	(0.148)	(0.988)	(0.140)	(1.007)	(0.146)	(1.194)
IMD (standardized)		-0.830***		-1.034***		-1.178***		-0.786***		-0.389		-0.582*
		(0.207)		(0.268)		(0.317)		(0.238)		(0.257)		(0.320)
Birth month		-0.076		-0.040		-0.331***		-0.120*		-0.078		-0.393***
		(0.052)		(0.053)		(0.089)		(0.064)		(0.051)		(0.083)
LEA age 16-64		-0.122		-0.499**		-0.843***		-0.489**		-0.849***		-1.018***
unemployment rate		(0.185)		(0.202)		(0.223)		(0.203)		(0.219)		(0.232)
Prior educational performance												
KS3 (age 14) point score			-0.021	0.014	-0.019	-0.125			0.007	0.744***	0.002	0.483*
(standardized)			(0.028)	(0.234)	(0.030)	(0.275)			(0.032)	(0.213)	(0.033)	(0.258)
KS2 (age 11) point score	0.015	0.256					-0.026	0.553***				
(standardized)	(0.032)	(0.187)					(0.033)	(0.200)				
Parents' employment:												
Two FT	-0.017	0.984	-0.166	2.430***	0.036	1.365	-0.122	1.814**	-0.023	2.118**	0.087	3.371**
	(0.126)	(0.839)	(0.110)	(0.907)	(0.178)	(1.508)	(0.119)	(0.801)	(0.113)	(0.896)	(0.193)	(1.617)
One FT, one PT	-0.019	1.147	-0.064	2.649***	0.014	0.610	-0.080	1.302	-0.044	1.958**	0.121	2.855*
	(0.122)	(0.792)	(0.104)	(0.837)	(0.180)	(1.494)	(0.115)	(0.809)	(0.104)	(0.832)	(0.188)	(1.617)
One FT only	-0.005	0.679	-0.067	1.632**	0.033	0.344	0.002	0.980	-0.071	0.632	0.041	1.211
	(0.105)	(0.707)	(0.098)	(0.783)	(0.159)	(1.343)	(0.096)	(0.685)	(0.099)	(0.778)	(0.172)	(1.477)
One/two PT, no FT	0.141	1.078	0.050	0.891	0.168	0.668	0.040	0.711	-0.052	0.657	0.021	0.482
	(0.119)	(0.763)	(0.107)	(0.834)	(0.157)	(1.391)	(0.108)	(0.750)	(0.105)	(0.761)	(0.176)	(1.452)
Non-resident	-0.015	-0.004	0.003	0.207	-0.019	0.342	-0.017	0.252	-0.023	0.538***	-0.038	-0.159
siblings	(0.030)	(0.169)	(0.022)	(0.166)	(0.023)	(0.212)	(0.034)	(0.202)	(0.023)	(0.184)	(0.026)	(0.227)
Resident siblings	-0.052**	0.566***	-0.020	0.410**	-0.055**	0.723***	-0.111***	0.750***	-0.097***	0.902***	-0.065***	0.587***
	(0.024)	(0.135)	(0.023)	(0.160)	(0.023)	(0.198)	(0.025)	(0.157)	(0.028)	(0.175)	(0.025)	(0.168)
Parents' education												
Degree	-0.037	-0.608	0.098	-1.742**	0.021	-1.024	-0.056	0.300	0.149	1.762**	0.264**	1.594*
	(0.107)	(0.709)	(0.105)	(0.865)	(0.103)	(0.970)	(0.116)	(0.809)	(0.111)	(0.795)	(0.112)	(0.932)
A-Levels	-0.061	0.164	0.047	-0.275	-0.032	0.055	-0.187*	-0.167	-0.020	2.033***	0.018	2.309***
	(0.093)	(0.593)	(0.088)	(0.755)	(0.089)	(0.836)	(0.097)	(0.695)	(0.094)	(0.733)	(0.092)	(0.813)
GCSEs	-0.068	0.165	0.060	-0.021	-0.079	0.867	-0.194**	0.295	-0.079	2.289***	-0.002	2.688***
	(0.091)	(0.573)	(0.082)	(0.746)	(0.082)	(0.863)	(0.089)	(0.676)	(0.090)	(0.704)	(0.090)	(0.796)
Other qualifications	-0.371*	1.917	-0.130	2.452*	-0.292	1.459	-0.198	-0.462	-0.132	-0.143	0.142	1.749
	(0.212)	(1.342)	(0.185)	(1.435)	(0.182)	(2.122)	(0.202)	(1.506)	(0.187)	(1.674)	(0.220)	(1.926)
Parents' SES												
NSSEC 1-2	0.015	-0.723*	0.009	-0.187	0.046	0.041	0.128**	-0.582	-0.026	-0.437	0.006	-0.054
	(0.070)	(0.398)	(0.062)	(0.387)	(0.059)	(0.543)	(0.063)	(0.411)	(0.061)	(0.418)	(0.063)	(0.480)
NSSEC 3	0.137	-0.747	0.025	-1.657**	0.185*	-1.277	0.022	-0.593	-0.026	-0.818	0.044	0.649
	(0.092)	(0.565)	(0.092)	(0.655)	(0.096)	(0.869)	(0.092)	(0.561)	(0.095)	(0.667)	(0.101)	(0.759)
NSSEC 4 (self-	-0.254***	0.127	-0.144*	0.224	-0.053	0.550	0.062	0.977*	0.017	1.305**	0.016	1.533**
employed	(0.083)	(0.458)	(0.084)	(0.580)	(0.097)	(0.783)	(0.081)	(0.502)	(0.091)	(0.601)	(0.095)	(0.729)
NSSEC 8 (long-	-0.039	-0.513	0.078	-1.543	-0.080	-0.070	0.023	-0.308	0.062	-0.159	0.117	0.578
term unemployed)	(0.136)	(0.971)	(0.141)	(1.184)	(0.137)	(1.243)	(0.122)	(1.328)	(0.128)	(1.242)	(0.154)	(1.349)
Lone parent	0.035	-0.023	0.066	0.080	-0.022	-0.471	-0.028	0.964*	0.122	0.617	0.172**	1.353**
	(0.080)	(0.516)	(0.073)	(0.539)	(0.077)	(0.701)	(0.087)	(0.566)	(0.076)	(0.528)	(0.079)	(0.640)
Observations	4854		4854		4854		4846		4846		4846	

Notes: *: $p \leq 0.1$; **: $p \leq 0.05$ ***: $p \leq 0.01$. Standard errors, clustered by school, in parentheses. Longitudinal weights applied.

Table A5: Complete maximum likelihood estimation results: Stackelberg system with child as leader, or parent setting contingent transfer schedule (continued)

	Boys						Girls					
	Wave 1		Wave 2		Wave 3		Wave 1		Wave 2		Wave 3	
	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours	transfer	Work Hours
Youth's ethnicity												
Mixed race	-0.023	-3.032***	0.109	-2.617**	0.074	-2.247**	-0.094	-0.437	-0.023	-0.055	-0.035	-1.346
	(0.132)	(0.948)	(0.125)	(1.126)	(0.128)	(0.978)	(0.132)	(0.755)	(0.139)	(0.860)	(0.122)	(1.200)
Indian	-0.520***	-3.602***	-0.410***	-4.029***	-0.326***	-5.698***	-0.619***	-5.734***	-0.573***	-7.132***	-0.360***	-9.613***
	(0.096)	(0.685)	(0.093)	(0.964)	(0.102)	(1.068)	(0.112)	(1.216)	(0.105)	(1.045)	(0.112)	(1.222)
Pakistani or	0.157	-6.248***	0.108	-7.117***	0.301**	-7.575***	0.114	-9.147***	0.115	-13.012***	0.092	-11.396***
Bangladeshi	(0.113)	(0.890)	(0.124)	(1.040)	(0.133)	(1.275)	(0.114)	(1.483)	(0.114)	(2.094)	(0.117)	(1.439)
Black African or	-0.001	-2.087*	0.069	-2.564*	0.090	-5.208**	0.018	-1.844**	-0.013	-2.882***	0.304**	-3.886***
Caribbean	(0.120)	(1.254)	(0.141)	(1.333)	(0.125)	(2.061)	(0.108)	(0.920)	(0.113)	(1.006)	(0.124)	(1.056)
Other	0.042	0.131	-0.163	-1.934	0.073	-3.706**	-0.342*	-2.447*	-0.507***	-3.038	-0.514***	-5.429***
	(0.206)	(1.212)	(0.191)	(1.448)	(0.209)	(1.776)	(0.192)	(1.482)	(0.158)	(1.861)	(0.164)	(1.934)
Special Ed' Needs	-0.091	-0.411	-0.035	-0.841	-0.065	-0.787	-0.057	-0.477	0.003	-0.993	-0.123	-1.937***
	(0.067)	(0.441)	(0.064)	(0.522)	(0.067)	(0.623)	(0.085)	(0.614)	(0.081)	(0.623)	(0.082)	(0.687)
Town or Village	-0.077	-0.099	-0.164**	1.169***	-0.123*	1.546***	-0.161**	1.263***	-0.251***	2.159***	-0.243***	2.422***
	(0.071)	(0.379)	(0.064)	(0.448)	(0.065)	(0.523)	(0.069)	(0.444)	(0.068)	(0.404)	(0.065)	(0.456)
Isolated area	-0.323**	0.013	-0.279**	1.190	-0.533***	3.036***	-0.082	1.011	-0.245*	3.486***	-0.077	3.287***
	(0.146)	(0.724)	(0.122)	(0.892)	(0.124)	(1.080)	(0.127)	(0.836)	(0.130)	(0.721)	(0.146)	(0.859)
Ill health limits	0.153**	0.126	0.072	-0.072	0.043	-0.187	-0.048	-0.335	0.030	-0.948**	0.038	-0.131
parent's activities	(0.068)	(0.417)	(0.067)	(0.504)	(0.062)	(0.545)	(0.062)	(0.425)	(0.061)	(0.410)	(0.066)	(0.532)
Home owner (mortgage	-0.065	0.047	0.102	0.316	-0.108*	0.221	-0.064	-0.609	-0.058	0.240	0.018	0.128
or outright)	(0.064)	(0.438)	(0.067)	(0.505)	(0.063)	(0.634)	(0.071)	(0.458)	(0.069)	(0.480)	(0.070)	(0.547)
Step family	0.096	-0.117	0.071	-0.263	-0.008	-0.081	0.135*	0.222	0.015	0.024	-0.091	-0.000
	(0.075)	(0.464)	(0.072)	(0.515)	(0.068)	(0.631)	(0.081)	(0.490)	(0.077)	(0.507)	(0.073)	(0.536)
Not GreaterLondon	-0.176**	2.158***	-0.094	1.369*	-0.067	2.372***	0.080	2.099***	0.116	2.287***	0.128	0.929
	(0.086)	(0.678)	(0.096)	(0.790)	(0.093)	(0.794)	(0.085)	(0.673)	(0.077)	(0.707)	(0.085)	(0.698)
Month of interview:												
March	-0.096	0.212	-0.046	0.316	-0.033	-0.329	-0.024	0.421	0.012	1.803**	-0.085	-0.522
	(0.064)	(0.371)	(0.129)	(0.865)	(0.056)	(0.420)	(0.069)	(0.438)	(0.128)	(0.865)	(0.054)	(0.402)
April	-0.051	0.373	-0.101	0.497	-0.058	1.020	-0.023	0.309	0.008	2.189**	0.052	1.096
	(0.067)	(0.434)	(0.128)	(0.867)	(0.080)	(0.718)	(0.073)	(0.462)	(0.130)	(0.874)	(0.078)	(0.674)
May	-0.054	0.932*	-0.092	0.403	-0.318**	-0.671	-0.041	1.181**	0.062	1.742*	-0.306***	-0.776
	(0.086)	(0.524)	(0.131)	(0.924)	(0.139)	(1.260)	(0.091)	(0.535)	(0.131)	(0.896)	(0.118)	(1.098)
June	-0.083	1.168	-0.120	1.564	-0.216	-0.159	-0.020	1.051	-0.087	1.709*	-0.145	3.388*
	(0.111)	(0.887)	(0.138)	(0.974)	(0.215)	(2.222)	(0.118)	(0.969)	(0.137)	(0.960)	(0.207)	(1.836)
July	0.194	0.634	0.155	1.242	-0.731	.	0.058	0.472	-0.088	2.442	0.496	0.929
	(0.151)	(0.862)	(0.202)	(1.349)	(0.744)	.	(0.158)	(0.948)	(0.200)	(1.592)	(0.533)	(3.815)
After Birthday	-0.149***	0.208	-0.012	0.280	-0.009	-0.406	-0.007	-0.015	-0.034	-0.237	-0.042	-0.684
	(0.053)	(0.461)	(0.061)	(0.585)	(0.048)	(0.703)	(0.058)	(0.539)	(0.063)	(0.486)	(0.052)	(0.628)
Observations	4854		4854		4854		4846		4846		4846	

Notes: *: $p \leq 0.1$; **: $p \leq 0.05$ ***: $p \leq 0.01$. Standard errors, clustered by school, in parentheses. Longitudinal weights applied.