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Youth employment, academic performance and labour market outcomes: Production functions and policy effects☆

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ABSTRACT

We use instrumental variables for teenage employment opportunities to identify the causal effects of part-time work during compulsory education in England on educational performance at age 16 and labour market outcomes to age 25. We identify the total 'policy effect', partly driven by resulting changes in other inputs, and the direct effect or 'production function parameter', which holds these constant. The total effects of an additional hour of part-time work per week at age 15 include reducing educational performance in school-leaving qualifications by males by 2.5% and females by 6.7% of a standard deviation, and increasing duration of unemployment experience before age 25 by two months. Direct effects on long-run outcomes are generally beneficial for women and less so for men. What human capital or signalling benefits there are to teenage part-time work are substantially offset by the effects of reduced educational investments.

1. Introduction

Across developed economies, many children participate in part-time employment alongside compulsory schooling. OECD figures from 2015 show 30% of 15 year-olds in the United States taking paid work, 23% in the United Kingdom, 18% in Germany and 14% in France. Declining participation in part-time work by teenagers in the UK has been blamed by employers' organizations for young adults being increasingly ill-prepared for full-time employment, with negative implications for workforce productivity and economic growth (UK Commission on Employment and Skills, 2015). Working while still in education may improve teenagers' stock of cognitive and non-cognitive human capital, in the form of financial literacy, communication skills, and lower discount rates (Light, 2001; Oettinger, 1999), but could also crowd out time allocated to productive educational 'investments' (Becker, 1965; Ruhm, 1997). Since qualifications obtained from compulsory education help determine subsequent education opportunities, the effect of in-school employment on test scores is likely to restrict or enhance trajectories of human capital accumulation over a much longer period (Dustmann and van Soest, 2007). Indeed, in the UK there remains a significant direct wage return to obtaining more age-16 academic qualifications, and at higher grades, even holding constant qualifications obtained later (Dearden et al., 2002; McIntosh, 2006).

In this paper we evaluate the effect of part-time work during school term-time at age 15 on educational performance at age 16 and retention in full-time education, unemployment experience, earnings, and occupational attainment up to age 25. Our contribution is to identify both the 'policy effect' effect of part-time work, and its parameter in the 'production function' for educational or labour market performance. The 'policy effect' includes indirect effects of resulting changes to other inputs, while the 'production function parameter' is the direct effect holding these other inputs constant. This distinction, and the mechanisms underlying it, matter for policy implications in education. For example, De Fraja et al., (2010) and Datar and Mason (2008) show that students and parents substitute school inputs for their own, meaning that policy effects of increased school quality are expected to understate such inter-

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ventions' benefits in the education production function. In our application, it is important to know both whether part-time work as a teenager fosters accumulation or effective signalling of human capital, and the extent to which any such benefits are reduced or outweighed by crowding out of educational investments.

We use data from "Next Steps", a longitudinal survey tracking a cohort born in 1989–90 and attending school in England in 2004, up to age 25 in 2015. Following Tyler (2003), Rothstein, (2007) and Kalenkoski and Pabilonia (2010)'s studies on part-time work and the educational performance of US High School students, we obtain identification by using time-varying indicators of local labour market opportunities for teenagers as instrumental variables for in-school employment, namely the youth unemployment rate and density of small businesses in the retail, wholesale, hotel and restaurant sectors. In our range of outcome variables, we follow Ruhm (1997), who adopts a similar IV approach and finds a positive effect of teenage part-time work on total and hourly earnings and occupational attainment between 6 and 9 years after High School graduation despite a negative effect on completed education; and Hotz et al. (2002) who show the long-run positive effects on wages to be small and statistically insignificant once they account for individuals' entire history of work experience.

We are guided by and contribute to two further related literatures. The first is on the relationships between part-time work, educational performance, and teenagers' allocation of time, attitude to schoolwork, and consumption patterns. Sabia (2009) finds few important effects of part-time work on schooling-related attitudes and investments among 12–15 year-olds, while Kalenkoski and Pabilonia (2009, 2012) find an additional hour of employment reduces homework time by 11min, with significant crowd-out also of screen time, sport, and other extra-curricular activities. Meanwhile, part-time work may facilitate contemporaneous consumption of risky substances (alcohol, cigarettes and cannabis) through the child's budget constraint (Markowitz and Tauras, 2006) or exposure to different peers (Clark and Lohéac, 2007) either in the working environment or by providing more opportunities freely to associate without parental supervision (Lee, 2013). The next piece of the puzzle is whether these changes in behaviour have independent effects on performance. Kalenkoski and Pabilonia (2017) show that marginal homework time has positive effects on academic achievement only for boys, who devote less time to homework on average, while Rees and Sabia (2010) yield no strong evidence that sporting participation enhances academic performances of adolescents of either sex. Alcohol, cigarette and drug consumption have all been shown to reduce educational performance and retention (Bray et al., 2000; Yan and Brocksen, 2013), with only Dee and Evans (2003) finding no direct effects of alcohol consumption.

The second literature is on the bias in estimates of returns to education caused by part-time work experience. Light (2001) shows the returns to an additional year of schooling in the original NLSY (1979) cohort are at least 25% higher when in-school work experience is omitted. The direction of this effect is robust to analysis on more recent cohorts (Ashworth et al. 2017). However Hotz et al. (2002), show that the return to "school plus work" can be lower than "school only". This accords with the time allocation literature, suggesting that part-time work can reduce the quality or quantity of engagement with education during nominally "full-time schooling". Analogously to Light (2001), our research questions can be stated: "How does the causal effect of part-time work change when the education enhancing role of study time is netted out?" and "How does the causal effect of part-time work change when the wage enhancing role of school performance is netted out?".

We analyse how the magnitude of each of these effects differ by sex, in contrast to the prior literature on part-time work during schooling which has focused intentionally on males (Hotz et al., 2002; Light, 2001; Molitor and Leigh, 2005), or considered gender differences only as a robustness check (Tyler, 2003, who finds no differences) or a control variable (Kalenkoski and Pabilonia, 2010). We find a significant negative total or 'policy effect' of age-15 part-time work on age 16 educational performance that is somewhat larger (effect size of 6.7% of a standard deviation per hour worked per week) for females than males (2.5%). We also show that part-time work crowds out study time, attitude to schoolwork, and 'active leisure' (sporting and music) activities, and facilitates consumption of risky substances. Holding these constant, the production function parameter is negative but smaller and statistically insignificant. We find detrimental or zero total effects of age-15 part-time work on labour market performance by age 25, including duration of unemployment for both sexes, and occupational attainment for women. These results appears substantially to be driven by reduced educational performance at age 16. The direct effect of part-time work at age 15 on these outcomes is somewhat beneficial.

2. Institutional background

2.1. Employment of children in England

Children in England are allowed to take paid part-time work from age 13 (Department for Children, Schools and Families - DCSF, 2009). There is no national minimum wage for children aged 16 or below. Next Steps data shows 22% of 14 year-olds and 28% of 15 year-olds in part-time work. These figures are lower than in the most comparable data for the United States, namely the National Longitudinal Study of Youth 1997 (NLSY97), in which 41% of male and 34% of female 10th graders (15–16 year-olds) were observed in part-time work in 2000 and 2004 (Rothstein, 2007).

A Department for Education review into the regulation of child workers (McKechnie et al., 2011) shows those below the school leaving age to be concentrated in the catering (23%), retail (16%) and delivery (39%) sectors. Most employers of children are small businesses (40% employ 10 staff or fewer, and 88% employ 50 or fewer) who recruit informally by responding to unsolicited approaches (56%) and/or obtain employees through word of mouth (40%). There are age-specific legal restrictions on hours and tasks. Those under 16 cannot work 'mainly or solely' for the sale of alcohol, for example, while those in compulsory education may work only 12 h per week in term-time, including a maximum of 2 h on a weekday or Sunday; 8 h on a Saturday (5 h if under 15 years); one hour before school on a weekday; and none during school hours or after 7pm on a school night (Department for Children, Schools and Families - DCSF, 2009). While we are unable to ascertain whether the daily limits or the types of work permitted are adhered to, in the Next Steps data we observe 97% and 95% of those in part-time work at ages 14 and 15 working 12 h per week or less, suggesting that self-regulation keeps them to within sensible levels. The informality of this labour market is underlined by how few employers obtain the permit from the Local Education Authority required to enable them to employ children legally: 14–15% of child workers are correctly covered (Howieson et al., 2006; McKechnie et al., 2005). See Appendix A.1 for further explanation of the regulation of child employment in England.

Sectoral differences may help explain sex differences in the effects of part-time work. Delivery work is most prevalent among the youngest child employees, and among males (43%, versus 11% of females - Howieson et al., 2012), and is more likely to be broken down into short, predictable, daily or weekly shifts than retail or catering work. It may then be less disruptive to schoolwork. However, retail and catering jobs are more likely to promote communication, interpersonal skills, self-confidence, and numeracy (McKechnie et al., 2010), through tasks requiring co-operation with others, dealing directly with customers, or supervising and training other employees (81%, 76% and 22% of child workers in the retail sector do these tasks; Howieson et al., 2012).

2.2. Measuring educational performance

Our measure of academic performance at age 16 is a standardized transformation of the 'GCSE and equivalent total point score'. For each

student this is derived from grades in academic GCSE (General Certificate of Secondary Education) and equivalent level vocational qualifications in around 10 subjects, of which GCSEs in English, Maths and Science are compulsory. These courses are taken over the two academic years (running September-July) during which they turned age 15 and 16. Approximately 80% of the marks contributing to GCSE grades are derived from final exams taken at the end of this second year, which for our cohort marked the end of compulsory schooling.[1] The remainder, and almost all marks in vocational qualifications, come from coursework and mid-term tests. A higher final grade in each subject contributes more points to a student's total score.

All these qualifications are criterion-based, measuring performance against a fixed standard rather than relative to peers. A "good pass" (grade C, on an A* to G scale) in both English and Maths is a formal requirement for public-sector occupations such as social work or teaching, regardless of any higher qualifications obtained (Machin et al., 2018). Moreover, GCSEs are the only completed qualifications that 17–18 year-old prospective undergraduates hold when they apply to university, making the overall profile of GCSE results a key determinant of subsequent opportunities. We report results based on a z-score obtained by subtracting the sample mean and dividing by the standard deviation. Henceforth we refer to this as the "GCSE z-score". To account for each student's predetermined academic outcomes, we also control for the total point score in low-stakes 'National Tests' in English, Maths and Science at age 11 and age 14.

3. Data and descriptive statistics

We use data from the Secure Access version of "Next Steps" (University College London et al., 2018), formerly issued as the "Longitudinal Study of Young People in England" (LSYPE). This is linked to data on performance in school exams in the National Pupil Database (NPD), and to detailed geographical identifiers. This sample is drawn from a single academic cohort of teenagers in England who are interviewed at age 14 in 2004, annually until 2010, then again in 2015.

3.1. Employment and other activities during compulsory schooling

Table 1 shows estimates of participation rates, hours and earnings from part-time work, and demographic characteristics, educational outcomes, and other activity levels by employment status, for the population of 14 and 15 year-old males and females at school in England in 2004 and 2005. The unweighted sample sizes are presented in the table, but all statistics are based on probability-weighted observations.

Term time employment is captured by the questions "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)", and for those answering 'yes', "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". At age 14 (15), 25% (29%) of boys and 19% (27%) of girls have a part-time job in term-time. The large initial gap is consistent with males and females being active in distinct labour markets with different demand-side factors and human capital implications (Erdogan. et al., 2012; Kooreman, 2009). This makes it important to estimate our models separately by sex. Those in employment are positively selected on age 11 educational performance, and go on to have higher GCSE scores. Age-15 workers outperform age-15 non-workers by 14% (males) or 20% (females) of a standard deviation. Females outperform males on average by 27% of a standard deviation.

We measure five additional inputs to the production function for educational and labour market performance: Attitude to schoolwork, study effort, active leisure, social life, and risky behaviours. All are measured as a z-score (standard deviations from the pooled sample mean) of the principal component of an ordered logit measurement model derived from questions on time use and frequency of participation in key activities. These are described in full in Tables 2 and 3. Table 1 shows that those in work on average have very similar attitudes to and undertake very similar levels of schoolwork to those not employed. However, those in work engage more frequently in active leisure (participation in music and sport), social activities (frequency of going out with friends, or attendance at entertainment venues), and risky behaviours (cigarette, alcohol and cannabis consumption), with differences significant at the 1% level in all cases. We evaluate the causal effect of part-time work on these activities, and the difference that accounting for these makes in the production function, in Sections 5.3 and 5.4 below.

Figs. 1 and 2 plot the proportion of 14 and 15 year old males and females in part-time work by, respectively, parental income decile and parental subjective household financial situation, with 95% confidence intervals. Both show that in general children with higher earning or more financially comfortable parents are more likely to be in part-time work. While there may be significant levels of involuntary non-participation (due to a lack of opportunities) in the lowest income deciles or the 7.6% of households in financial difficulties, these figures suggest very few of the children taking part-time work are doing so because it is necessary to contribute to household finances. Appendix A.2 shows similar positive selection by parental occupation and education levels.

Table 4 compares teenagers' (and in one case, their parents') educational and occupational aspirations by part-time work status. The upper panel of Table 4 shows small deficits in intention to remain in full-time education or apply to university for those in part-time work relative to those who are not. Nevertheless, most 14–15 year-olds in part-time work clearly intend to continue at school, which does not support investment in experience to improve immediate job prospects being a common motivation. Taken together, these results suggest that immediate consumption is more likely to be motivation for part-time work than any forward-looking investment in gaining independence and control after the school-to-work transition (through becoming self-employed, having a job that is interesting to them, or with regular hours) or raising future consumption (given the lower valuation of career progression possibilities).

3.2. Long-run education and labour market outcomes

We evaluate effects on a further 15 variables representing education or labour market outcomes up to 10 years after we measure part-time work. These include retention in full-time education or training at age 17; participation in college or university at age 19; the status known as NEET, "Not in Employment, Education or Training" at ages 17, 19 and 25; and the total duration of unemployment over the 10 years to August 2015, when they are aged 25. We analyse total weekly earnings of those who have left full-time education at age 17 (including the zeroes for all those with no labour market earnings), enabling us to determine whether there is any human capital or signalling benefit to part-time work experience at this earliest opportunity to work full-time. For earnings at age 25, we again use a weekly measure including the zeroes for those not in employment, but also analyse hourly wages for those who are, and the number of hours worked. We also analyse whether, by age 25, the student is in a Higher or Lower Managerial or Professional Occupation (Categories 1 and 2 in the National Statistics Socio-economic Classification), or is self-employed (a "small employer or own account worker" - category 4). Finally, we use the count of items (out of 12) indicating poor mental health in General Health Questionnaire, which we observe at ages 17 and 25, to represent wider effects on wellbeing.[2] We

[1] It is now compulsory to remain in full-time education or training until one's 18th birthday.

[2] Respondents are also asked about their "general health" at both ages 17 and 25, but this is elicited using a different number of and differently worded cat-

Table 1
Descriptive statistics by gender.

	Wave 1 (age 14)				Wave 2 (age 15)			
	Male		Female		Male		Female	
Employed (%)	25.26		19.30		28.74		27.20	
Observations	7,645		7,349		6,620		6,399	
In Work:	Yes	No	Yes	No	Yes	No	Yes	No
Hours and earnings[1]								
Mean hours employment	4.13 (3.42)	·	4.16 (3.18)	·	5.13 (4.09)	·	5.35 (3.65)	·
Mean earnings, £	14.43 (13.80)	·	14.18 (11.78)	·	20.53 (17.59)	·	18.83 (11.83)	·
Other inputs[2]								
Attitude	0.014	0.040	0.092	0.121	−0.281	−0.277	−0.157	−0.151
Study	−0.145	−0.189	−0.155	−0.119	−0.052	−0.083	0.064	0.019
Active Leisure	0.491	0.326	−0.069	−0.294	0.414	0.223	−0.0196	−0.495
Social Life	0.117	−0.104	0.277	−0.009	0.296	0.016	0.458	0.123
Risky Behaviours	0.060	−0.160	0.079	−0.099	0.467	0.246	0.580	0.342
Demographics								
Higher Educated parent (%)	17.7	18.8	19.5	18.4	17.4	19.5	19.8	18.36
Lone Parent (%)	21.3	27.2	23.5	26.4	20.4	27.9	21.8	27.5
Self-employed parent (%)	12.2	9.4	12.8	9.4	11.1	9.0	11.8	8.8
Educational performance								
Mean KS2 (age 11) Average Point Score	27.44 (3.82)	26.73 (4.35)	27.91 (3.37)	27.03 (4.05)	27.37 (3.85)	26.79 (4.36)	28.02 (3.36)	26.86 (4.14)
Mean GCSE (age 16) total score	374.90 (150.40)	356.37 (165.80)	411.50 (136.48)	393.24 (153.74)	371.65 (152.41)	348.497 (167.79)	415.92 (132.68)	383.03 (158.96)
Observations	1,668	5,977	1,171	6,178	1,681	4,939	1,484	4,915
Complete cases in input factor models	*1,257*	*4,189*	*915*	*4,424*	*1,434*	*4,012*	*1,314*	*4,025*

Notes: Standard deviations of continuous variables in parentheses. Population means, proportions and standard deviations estimated using age-14 population probability weights and account for clustering at the school level. [1]: Time use and earnings are per week. [2] 'Other inputs' are all measured as the z-score of the principal component from the factor models. See Tables 2 and 3.

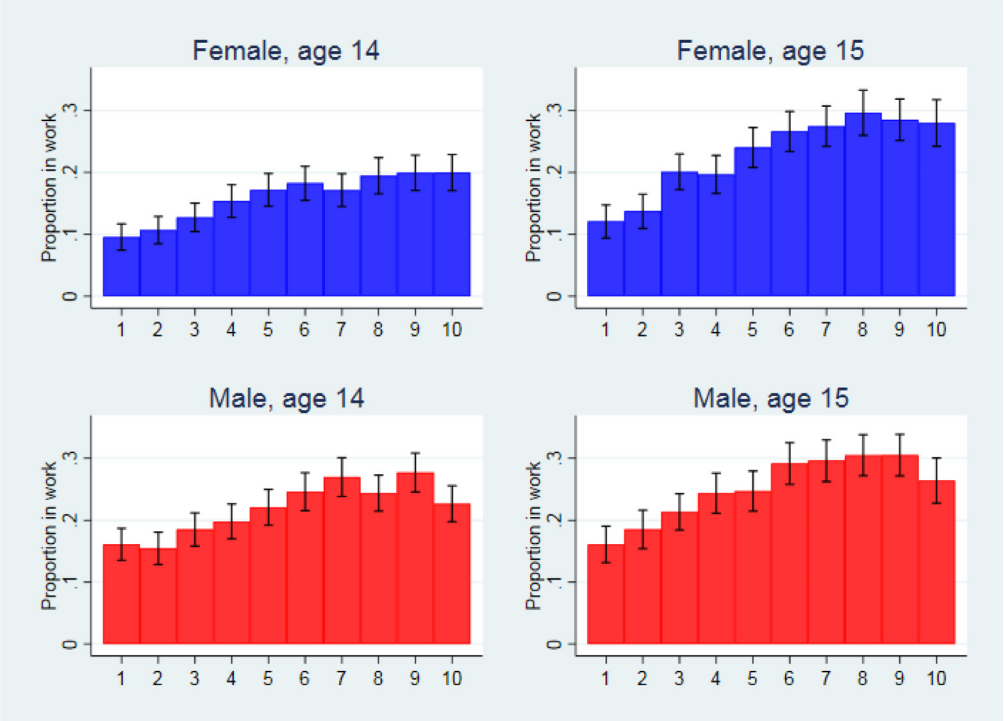

Fig. 1. Part-time work prevalence by parental income decile.

Table 2
Factor loadings and cut points in ordered logit measurement models.

Factor loadings:									
Attitude		Study		Active Leisure		Social Life		Risky Behaviour	
Work hard	1	Not truant	1	Play sport	1	Nightclub	1	Smoke	1
Worth it	0.832	Homework	1.453	School sport	0.687	Pub or bar	0.700	Alcohol	0.594
	(0.020)		(0.080)		(0.025)		(0.046)		(0.022)
Work waste	0.954	Outside	2.500	Sport in gen	0.903	Concert	0.336	Cannabis	1.347
	(0.025)		(0.251)		(0.027)		(0.018)		(0.074)
Interest	1.228	Study club	2.563	School clubs	0.329	Arcade	0.647		
	(0.027)		(0.249)		(0.015)		(0.046)		
				Play music	0.186	Friends out	0.442		
					(−0.257)		(0.027)		
Cut Points:									
Attitude		Study		Active Leisure		Social Life		Risky Behaviour	
Work hard		Not truant		Play sport		Nightclub		Smoke	
1	−5.028	1	−1.511	1	−0.257	1	1.303	1	3.422
2	−2.048			School sport					
3	−1.992			1	0.250				
4	−1.898			2	0.917				
5	1.404			3	3.020	Pub or bar		Alcohol	
6	1.467			4	4.684	1	2.222	1	0.126
Worth it		Homework		Sport in gen				2	0.882
1	−3.888	1	−2.101	1	−3.683			3	0.927
2	−2.996	2	−1.376	2	−2.596			4	0.971
3	0.197	3	0.002	3	−2.010	Concert		5	1.578
4	0.053	4	1.183	4	−0.699	1	0.045	6	2.118
5	0.078	5	2.530	5	−0.695			7	3.260
6	0.103			6	−0.691			8	5.797
Work waste		Outside		7	1.136				
1	−4.642	1	0.497	School clubs		Arcade		Cannabis	
2	−3.07	2	1.620	1	0.553	1	2.014	1	4.418
3	0.584	3	3.827	2	1.059				
4	0.641	4	6.028	3	3.068				
5	0.685			4	4.946				
6	0.740								
Interest		Study club		Play music		Friends out			
1	−5.148	1	1.099	1	1.437	1	−1.390		
2	−2.134	2	2.054			2	0.246		
3	−2.013	3	4.056			3	0.255		
4	−1.854	4	5.626			4	1.509		
5	−1.710								
6	2.953								
Variance:									
Attitude	2.414	Study	0.263	Active Leisure	4.454	Social Life	2.489	Risky	7.032

Notes: Standard errors, clustered by individual, in parentheses. Measures are defined as follows. **Attitude:** 'Work hard': "I work as hard as I can in school". 'Worth it': "School work is worth doing". 'Work waste': "The work I do in lessons is a waste of time" (recoded). 'Interest': "The work I do in lessons is interesting to me". **Study**: 'Not truant': Student has not truanted in last 12 months (dummy variable). 'Homework': Estimate of hours per week spent doing homework, based on reported time spent on a computer doing schoolwork, nights per week doing so, and nights per week doing any homework. (Categories are zero, 1 to under 2 h, 2 to under 4, 4 to under 6, 6 to under 10, and 10 or more). 'Outside': Works towards exams with teachers outside of lessons (frequency on 5-point scale). 'Study club': Attends school study clubs (frequency on 5-point scale). **Active Leisure**: 'Play sport': Played any kind of sport in the last four weeks (dummy). 'School sport': Frequency of using school sports facilities (5-point scale). 'Sport in gen': Frequency of doing sport (5-point scale). 'School clubs': Frequency of participation in school clubs or societies. (5-point scale). 'Play music': Played a musical instrument in the last four weeks. **Social Life**: 'Nightclub': Gone to a party, dance, nightclub or disco in the last four weeks. 'Pub or bar': Gone to a pub or bar in the last four weeks. 'Concert': Gone to a cinema, theatre or concert in the last four weeks. 'Arcade': Gone to an amusement arcade in the last four weeks. 'Friends out': How many times gone out with friends in last seven days. **Risky behaviours**: 'Smoke': Whether cohort member "ever smokes" (dummy variable). 'Alcohol': Frequency of alcohol consumption (6-point scale). 'Cannabis': Whether cohort member "ever tried cannabis" (dummy variable). 'Don't know' is coded as the within-wave mean, creating up to three extra categories for the following measures: Work hard (3rd, 4th, 6th categories), Worth it (4rd–6th), Work waste (4th–6th), Interest (3rd–5th), Sport in gen' (5th-6th), Friends out (3rd), Alcohol (3rd, 4th, 6th).

might expect a negative effect on health stemming from selection into risky behaviours and a reduction in active leisure, though any resulting reduction in schooling may also be a channel if reduced education levels results in fewer behavioural investments in health (Cutler and Lleras-Muney, 2010) or more frequent experience of stressful circumstances such as unemployment (Audhoe et al., 2010).

egories so are not comparable. Results using threshold measures are presented in Appendix A.5.

Population means and standard deviations for each of these outcomes are presented in Tables 8 and 9 with the estimated total and direct effects of teenage part-time work, for ease of interpretation of their magnitudes. On average, females have stronger educational retention, lower probabilities of being NEET and shorter accumulated unemployment durations, but lower hourly and weekly earnings and hours of work than males. Females are marginally more likely to be in a Managerial or Professional occupation at age 25, but are less likely (4.5 percentage points, or 64%) to be a small employer or own account worker. Females

Table 3
Interpretations of a one standard deviation change in each latent factor.

Input	Measure	Interpretation	Baseline
Attitude			
	A 1 s.d. change on average is equivalent to all of:		
	Work hard	33.4 p.pt more likely to 'strongly agree' that "I always work hard in school"	26.1% strongly agree
	Worth it	29.2 p.pt more likely to 'strongly agree' that "School work is worth doing".	47.3% strongly agree
	Work waste	35.4 p.pt more likely to 'strongly disagree' that "The work I do in lessons is a waste of time".	36.6% strongly disagree
	Interest	21.4 p.pt more likely to 'strongly agree' that "The work I do in lessons is interesting to me".	12.7% strongly agree
Study			
	A 1 s.d. change on average is equivalent to all of:		
	Not truant	6.4 p.pt less likely to have truanted in the last year.	19.2% answer yes.
	Homework	1 h additional homework per week.	Median response: ≥ 4, < 6 h p.w.
	Outside	1 extra visit to work with teacher outside lessons per week.	Median: Never; 75th%^{ile}: $<$ 1 p.w.
	Study club	1 extra visit to school study clubs per week.	Median: Never; 75th%^{ile}: $<$ 1 p.w.
Active Leisure			
	A 1 s.d. change on average is equivalent to all of:		
	Play sport	33.4 p.pt more likely to have played any kind of sport in the last four weeks.	53.9% answer yes.
	School sport	1.5 additional occasions to use school sport facilities each week.	Median: Never; 75th%^{ile}: 1–2 p.w.
	Sport in gen	Move from "hardly ever" participate in sport to once per week *or* move from once per week to several but not "most" days per week.	25th%^{ile}: 1 p.w.; Median: $>$ 1 p.w.; 75th%^{ile}: "Most days"
	School clubs	0.5 additional occasions to participate in other school clubs each week.	Median: Never; 75th%^{ile}: 1–2 p.w.
	Play music	6.8 p.pt more likely to have played a musical instrument in the last four weeks.	19.9% answer yes.
Social Life			
	A 1 s.d. change on average is equivalent to all of:		
	Nightclub	35.5 p.pt more likely to have gone to a party, dance, nightclub or disco in last four weeks.	28.8% mention.
	Pub or bar	14.9 p.pt more likely to have gone to a pub or bar in the last four weeks.	13.8% mention.
	Concert	13.0 p.pt more likely to have gone to a cinema, theatre or concert in the last four weeks.	49.0% mention.
	Arcade	15.3 p.pt more likely to have gone to an amusement arcade in the last four weeks.	15.5% mention.
	Friends out	1 additional trip out with friends in last week.	Median: 1–2 p.w.; 75th%^{ile}: 3–5 p.w.
Risky Behaviours			
	A 1 s.d. change on average is equivalent to all of:		
	Smoke	29.8 p.pt more likely to "ever smoke".	14.0% answer yes
	Alcohol	34.7 p.pt more likely to ever consume alcohol. (Conditional on some consumption: More than double frequency: bi-monthly to monthly/ monthly to 2–3 times per month/2-3 per month to 1–2 per week).	52.2% never consume alcohol 75th%^{ile}: once every 2 months; 90th%^{ile}: 2–3 p.m.
	Cannabis	28.8 p.pt more likely to have "ever tried cannabis".	13.3% answer yes

Abbreviations: "p.pt" = "percentage point". "p.w" = "'per week". "p.m" = "per month". "%^{ile}" = "percentile". **Note:** Changes expressed as percentage point change in unconditional probability that condition is met due to a uniform one standard deviation change in the latent input across the entire pooled sample population, from the levels observed in the data.

have markedly worse mental health than males at age 17 (almost one additional item indicating poor health), but this remains stable to age 25, while that of males deteriorates to almost the same level.

4. Identification strategy

4.1. Empirical models

We distinguish between the total and direct effects of employment on academic performance and labour market outcomes. The total or 'policy effect' includes indirect effects of part-time work via inputs crowded out or facilitated by employment. This is a parameter of interest to policymakers who, for example, may mandate the maximum hours of paid work for teenagers, but not for minimum hours of study outside school. The 'production function parameter' is the direct effect of part-time work, holding other inputs constant.

Following Cunha and Heckman (2007, 2009)'s approach to the technology of human capital formation we adopt a cumulative model, labelling our outcome variable as Y_{iT}, measured in the final period (time T). We label hours of employment per week as L_{it}, and a vector of other inputs into the production function during compulsory schooling as $\mathbf{S}_{it}$, for the periods of compulsory schooling $t = 1 \dots T'$. $\mathbf{X}_i$ includes any socio-economic, demographic and school characteristics and prior educational performances, that we expect directly to affect individuals' academic and labour market performance. In this framework the policy effect is equal to ϕ_t^L in the following specification:

$$Y_{iT} = \sum_{t=1}^{T'} [\phi_t^L L_{it}] + \boldsymbol{\psi} \mathbf{X}_i + \zeta_{iT} \tag{1}$$

while the production function parameter is equal to π_t^L in the following specification:

$$Y_{iT} = \sum_{t=1}^{T'} [\pi_t^L L_{it} + \boldsymbol{\pi}_t^S \mathbf{S}_{it}] + \boldsymbol{\beta} \mathbf{X}_i + \epsilon_{iT} \tag{2}$$

There are two potential barriers to obtaining unbiased estimates. Firstly, we could expect some unobservable characteristic to determine selection into both employment and other productive activities, such that $E[\zeta_{iT} | \mathbf{L}_i, \mathbf{X}_i] \neq 0$ and $E[\epsilon_{iT} | \mathbf{L}_i, \mathbf{S}_i, \mathbf{X}_i] \neq 0$. Secondly, there may be measurement error in teenagers' hours of work and other investment activities, which will attenuate the OLS coefficient on these variables (Tyler,

Fig. 2. Part-time work prevalence by parental subjective financial situation.

Table 4
Educational and occupational aspirations by child's employment status.

	Wave 1 (age 14)				Wave 2 (age 15)			
	Male		Female		Male		Female	
In Work:	Yes	No	Yes	No	Yes	No	Yes	No
Educational aspirations Parent intends child to stay in	72.36	77.16	88.12	88.39	70.57	74.76	88.00	88.13
full-time education at 16, (%)	(1.37)	(0.89)	(1.07)	(0.58)	(1.41)	(1.00)	(0.97)	(0.67)
Child intends to stay in	76.16	78.51	91.01	88.56	75.79	77.49	91.00	90.72
full-time education at 16, (%)	(1.23)	(0.87)	(0.89)	(0.56)	(1.32)	(0.97)	(0.79)	(0.58)
Child "very" likely	28.60	32.05	36.81	37.19	26.09	27.95	33.39	37.94
to apply to university, (%)	(1.50)	(1.17)	(1.77)	(1.20)	(1.52)	(1.32)	(1.57)	(1.42)
Occupational aspirations								
Percent for whom each factor matters "a lot":								
To have a job which pays well	69.42	71.20	57.59	61.81	.	.	.	.
	(1.25)	(0.77)	(1.54)	(0.87)	.	.	.	.
To be my own boss or have my	26.30	28.73	14.07	18.88	.	.	.	.
own business	(1.15)	(0.83)	(1.04)	(0.67)	.	.	.	.
To have a job that's	70.93	70.81	67.05	67.29	.	.	.	.
interesting	(1.21)	(0.79)	(1.53)	(0.78)	.	.	.	.
To have a job where I can	64.87	62.73	49.49	55.10	.	.	.	.
get promoted	(1.32)	(0.86)	(1.67)	(1.67)	.	.	.	.
To have a job with regular	46.02	46.50	45.16	46.00	.	.	.	.
hours	(1.35)	(0.08)	(1.52)	(0.83)	.	.	.	.
N:	1,668	5,977	1,171	6,178	1,681	4,939	1,484	4,915

Notes: Standard errors in parentheses. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

2003). To address these barriers, we exploit variation over time and among individuals in two local labour market characteristics as instrumental variables for children's hours of employment $\mathbf{Z}_{it}$, and include a rich set of additional controls that vary at the same school or neighbourhood level ($\mathbf{N}_i$).

Hence the policy effect equation we estimate can be written:

$$E[Y_{iT}|\mathbf{Z}_i,\mathbf{X}_i,\mathbf{N}_i] = \sum_{t=1}^{T'}[\phi_t^L E[L_{it}|\mathbf{Z}_{it},\mathbf{X}_i,\mathbf{N}_i]] + \boldsymbol{\psi}_X\mathbf{X}_i + \boldsymbol{\psi}_N\mathbf{N}_i \quad (3)$$

and the production function equation as:

$$E[Y_{iT}|\mathbf{Z}_i,\mathbf{X}_i,\mathbf{N}_i] = \sum_{t=1}^{T'}[\pi_t^L E[L_{it}|\mathbf{Z}_{it},\mathbf{X}_i,\mathbf{N}_i] + \boldsymbol{\pi}_t^S\mathbf{S}_{it}] + \boldsymbol{\beta}_X\mathbf{X}_i + \boldsymbol{\beta}_N\mathbf{N}_i \quad (4)$$

We use Full Information Maximum Likelihood (FIML) with the 'conditional mixed process' ("cmp") program in Stata (Roodman, 2011) simultaneously to estimate first-stage tobit equations for hours of employment per week at both ages 14 and 15 with a final stage equation carrying the appropriate likelihood function for the dependent variable; either linear, probit or tobit.[3] The policy effect results on educational performance obtained with our full set of covariates are shown in columns

[3] Accounting for the censoring of hours of employment at zero in this way will improve the precision of our second stage estimates over those that would be obtained from a linear IV specification, without affecting its bias or consistency properties.

Table 5
Policy effect specifications for effect of part-time work on age 16 educational performance.

	Male					Female				
	(1) Individual demographics only	(2) Plus Local Authority counterparts	(3) Plus school controls and teaching resources	(4) Plus prior performance at age 11	(5) Plus prior performance at age 14 (Full)	(6) Individual demographics only	(7) Plus Local Authority counterparts	(8) Plus school controls and teaching resources	(9) Plus prior performance at age 11	(10) Plus prior performance at age 14 (Full)
	Second-stage for age 16 educational performance: (GCSE *z*-score)									
Hours per week in paid work, age 15/Wave 2	−0.032*	−0.029*	−0.029**	−0.033**	−0.025**	−0.051**	−0.045	−0.046	−0.045	−0.067***
	(0.017)	(0.016)	(0.014)	(0.013)	(0.012)	(0.026)	(0.027)	(0.031)	(0.048)	(0.017)
Hours per week in paid work, age 14/Wave 1	0.018	0.014	0.017	0.029	0.022	−0.024	−0.025	−0.037	−0.019	0.020
	(0.021)	(0.021)	(0.019)	(0.018)	(0.016)	(0.028)	(0.030)	(0.033)	(0.049)	(0.017)
	First-stage for Wave 2 / Age 15 h of employment per week:									
Age 18–24 claimant count unemp' rate	−0.524	−9.417	−13.466	−13.490	−13.567	−33.934***	−44.231***	−23.892	−22.436	−23.657
	(11.888)	(16.340)	(16.770)	(16.527)	(16.643)	(11.271)	(14.817)	(15.051)	(15.915)	(14.874)
SIC G/H VAT-registered businesses per 100 youths	0.176***	0.217***	0.216***	0.211***	0.211***	0.102***	0.138*	0.144**	0.145*	0.130*
	(0.045)	(0.070)	(0.074)	(0.074)	(0.074)	(0.039)	(0.071)	(0.072)	(0.076)	(0.069)
First-stage for Wave 1 / Age 14 h of employment per week:										
Age 18–24 claimant count unemp' rate	2.520	−1.858	−7.709	−8.111	−7.950	−14.752	−9.167	1.284	1.225	−1.287
	(9.560)	(13.672)	(13.875)	(13.874)	(13.787)	(12.134)	(16.469)	(16.695)	(17.278)	(16.630)
SIC G/H VAT-registered businesses	0.121***	0.082	0.115*	0.121*	0.121*	0.105**	0.052	0.065	0.071	0.079
	(0.041)	(0.061)	(0.063)	(0.064)	(0.064)	(0.041)	(0.070)	(0.069)	(0.069)	(0.069)
		per 100 youths								
Observations	5446	5446	5446	5446	5446	5339	5339	5339	5339	5339

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard errors in parentheses. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

Table 6
Coefficient on hours of employment per week in IV regression for other uses of time (measured in standard deviations).

	Attitude		Study		Active Leisure		Social Life		Risky Behaviours	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Age 15 h of part-time Work per week	−0.033***	−0.037**	−0.021*	−0.027*	−0.057***	−0.020*	0.013	0.015	0.038***	0.031**
Standard error:	(0.013)	(0.015)	(0.012)	(0.015)	(0.012)	(0.010)	(0.010)	(0.012)	(0.011)	(0.013)
p-value (unadjusted)	0.010	0.014	0.072	0.067	0.000	0.054	0.200	0.200	0.001	0.022
p-value (adjusted for multiple hypothesis testing)#	**0.037**##	**0.056**#	**0.245**	**0.221**	**0.000**###	**0.168**	**0.543**	**0.549**	**0.004**###	**0.063**#
r(.k) (Average correlation of other four dependent variables)	0.170	0.122	0.176	0.203	0.225	0.256	0.220	0.210	0.165	0.331
Observations	5446	5339	5446	5339	5446	5339	5446	5339	5446	5339

Notes: *: $p < 0.1$, **: $p < 0.05$, ***: $p < 0.01$. Standard errors in parentheses. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level. All coefficients from single-factor-single-wave models. First stage equation for hours of employment not shown. Effect of hours of employment is identified by exclusion of labour market variables from second stage. # Adjusted *p*-values account for testing of multiple hypotheses using the following modified Bonferroni Adjustment: $p_{adj} = 1 - (1 - p(k))^{g(k)}$ *where* $g(k) = M^{1-r(.k)}$, where M is the number of outcomes being tested (here 5 for each sex), $p(k)$ is the unadjusted *p*-value for the kth outcome and $r(.k)$ is the mean of the (absolute) pairwise correlations between all the outcomes other than k. (See Sankoh et al., 1997, pp.2534–2535, for discussion).

(5) and (10) of Table 5, and production function estimates are shown in columns (2) and (4) of Table 7. The policy effect and production function parameter results on age 17 and 19 labour market outcomes are shown in Table 8, and age 25 outcomes in Table 9. We do not estimate the Mincer functions that are standard in the literature on returns to education and experience, because the durations of these are endogenous.

The difference between the policy effect ϕ_t^L and production function parameter π_t^L is driven by changes in the other inputs $\mathbf{S}_{it}$ resulting from changes in part-time work. We estimate instrumental variables models for the effect of part-time work on each of these inputs:

$$E[s_{it}^q|\mathbf{Z}_{it}, \mathbf{X}_i] = \gamma_t^q E[L_{it}|\mathbf{Z}_{it}, \mathbf{X}_i, \mathbf{N}_i] + \theta_t^q \mathbf{X}_i \quad (5)$$

In Eq. (5), the parameters γ_t^q represent the crowd-out (or facilitation) of factor s_{it}^q by hours of employment. These are presented in Table 6.

4.2. Instrumental variables

Our instruments are the (i) age 18–24 claimant count unemployment rate in month of interview, and (ii) density of small business registered for Value Added Tax (VAT) in the "Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods" (G) and "Hotels and restaurants" (H) sectors of the Standard Industrial Classification (SIC).

Both are measured in the Local Authority District (LAD) of residence. These have an average population of 164,000 and size of 155 square miles, 1.6 times the average population but 12.5% of the average area of a US county, the smallest geography used in the US literature with this method (Kalenkoski and Pabilonia, 2010). This local measure is appropriate for these teenagers, who will be reliant on parental or public transport, or cycle-or-walkable distances. (The youngest age at which

Table 7
Production function specifications for effect of part-time work on age 16 educational performance. Second stage coefficients.

	Male		Female	
	(1) OLS	(2) IV for Work Hours	(3) OLS	(4) IV for Work Hours
Work Hours age 15	−0.003	−0.010	−0.004	−0.038
	(0.003)	(0.013)	(0.003)	(0.029)
Work Hours age 14	0.004	0.015	−0.002	0.007
	(0.004)	(0.016)	(0.004)	(0.027)
Attitude age 15	0.075***	0.075***	0.062***	0.061***
	(0.010)	(0.010)	(0.013)	(0.012)
Attitude age 14	0.038***	0.038***	0.018	0.019
	(0.010)	(0.010)	(0.012)	(0.012)
Study age 15	0.075***	0.075***	0.066***	0.064***
	(0.011)	(0.010)	(0.010)	(0.011)
Study age 14	0.016	0.017	0.018	0.018
	(0.012)	(0.011)	(0.012)	(0.012)
Active Leisure age 15	0.062***	0.062***	0.051***	0.049***
	(0.012)	(0.012)	(0.013)	(0.013)
Active Leisure age 14	−0.025*	−0.025**	−0.014	−0.014
	(0.013)	(0.013)	(0.013)	(0.013)
Social Life age 15	−0.003	−0.003	−0.019*	−0.019*
	(0.009)	(0.009)	(0.011)	(0.011)
Social Life age 14	−0.000	0.000	0.002	0.001
	(0.010)	(0.010)	(0.010)	(0.010)
Risky Behaviours age 15	−0.080***	−0.079***	−0.079***	−0.078***
	(0.012)	(0.012)	(0.013)	(0.013)
Risky Behaviours age 14	−0.019	−0.019	−0.019	−0.020
	(0.015)	(0.015)	(0.016)	(0.015)
Observations	5446	5446	5339	5339

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard errors in parentheses. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

one may learn to drive in England is 17). Moreover, our age restriction in unemployment should increase precision. Even children not intending to invest in a connection to the adult labour market may be working in jobs for which they are close substitutes for young adult employees (Hobbs et al., 2007). A reduction in the youth unemployment rate may bid-up the young adult wage rate, or make young adults less prepared to work flexibly or for few hours per week. In either case this makes it more attractive for employers to hire children on an informal basis.

VAT registrations are published by the Department for Business, Innovation and Skills as the official record of business start-ups and closures (see Office for National Statistics, 2008). Our instrument is the stock of these businesses in sectors G and H per 100 18–24 year-olds resident in the LAD. It is well documented from numerous targeted surveys that the employment of individuals in full-time education in the UK is concentrated in these sectors (Curtis and Lucas, 2001; Howieson-Cathy. et al., 2006; McKechnieJim. et al., 2011; Mizen et al., 1999).

On average teenagers in our samples face a local youth (18–24) unemployment rate of 4.25%, and there are just over 10 VAT-registered enterprises in the relevant sectors per 100 youths. There is significant between-variation in both instruments at both points in time, with those at the 75th percentile facing local youth unemployment and density of relevant employers that are twice as high (5.8% versus 2.8%, and 12.8 versus 6 per 100 youths at age 15 respectively) as those on the 25th percentile, for example.

It is possible that local youth labour market opportunities are correlated with school characteristics and resources that are productive for educational performance and hence subsequent labour market outcomes. It is also possible that local labour market conditions affect students' perceived relative return to effort at school versus accumulating labour market experience, and to continuing in post-compulsory education versus transitioning into full-time work. We therefore control for a rich set of characteristics of the school each child is attending, and for several measures of teacher numbers and quality for schools of the same type in the same Local Education Authority.[4] We describe these variables and show population means and standard deviations in Appendix A.3.

We might still be concerned if, conditional on all these individual, neighbourhood, and school characteristics, the instruments help predict other behaviours and attitudes relevant to the decision to exert effort at school or continue into post-compulsory education. In Appendix A.4 we describe tests for effects on (i) qualification subject choices and (ii) intentions to remain in full-time education, from which we found no evidence to question the validity of our final empirical specifications. Columns (1–4) and (6–9) of Table 5 also show that the estimated policy effect of part-time work on educational performance results is highly robust to the progressive inclusion Local Authority, school and teacher controls.

5. Results

5.1. Effects of the instruments on part-time work

The middle and bottom panels of Table 5 show the first stage tobit coefficients from Eq. (3) on the instruments for part-time working hours at age 14 and 15, for specifications adding progressively more controls. (The coefficients on all remaining explanatory variables included in the final specification, columns (5) and (10) are shown in Appendix A.7). At age 14, the youth unemployment rate has no significant effect on

[4] School characteristics are available linked to the Next Steps Survey in its Secure Access version. The author linked teacher characteristics at the LAD-by-school-type level using publicly available "Schools, pupils and their characteristics" data from the Department for Education website, https://tinyurl.com/y2ranhj3, accessed 1st July 2019.

Table 8
Population means, policy effects and production function parameters for age 17 and 19 outcomes.

	Male				Female			
	(1) *Dep' var mean (sd)/ proportion 2nd stage n*	(2) Policy effect (s.e.) ***(p^{adj})***	(3) Prod'n func incl. GCSE *z*-score (s.e.) ***(p^{adj})***	(4) Prod'n func plus age 14/15 inputs (s.e.) ***(p^{adj})***	(5) *Dep' var mean (sd)/ proportion 2nd stage n*	(6) Policy effect (s.e.) ***(p^{adj})***	(7) Prod'n func incl. GCSE *z*-score (s.e.) ***(p^{adj})***	(8) Prod'n func plus age 14/15 (s.e.) ***(p^{adj})***
Age 17 outcomes								
In full-time education or training	*0.715* *n = 5197*				*0.786* *n = 5088*			
Hours paid work p.wk, age 15		−0.017*** (0.006) **(0.012)##**	−0.014** (0.006) **(0.048)##**	−0.012** (0.006) **(0.110)**		0.008 (0.008) **(0.725)**	0.011 (0.007) **(0.288)**	0.011 (0.007) **(0.288)**
GCSE total points, *z*-score			0.153*** (0.014)	0.122*** (0.014)			0.135*** (0.012)	0.108*** (0.012)
NEET: Not in employment, education or training	*0.116* *n=5197*				*0.095* *n = 5088*			
Hours paid work p.wk, age 15		−0.001 (0.005) **(0.992)**	−0.002 (0.004) **(0.920)**	−0.002 (0.004) **(0.920)**		−0.005 (0.004) **(0.484)**	−0.006 (0.004) **(0.329)**	−0.006 (0.004) **(0.329)**
GCSE total points, *z*-score			−0.080*** (0.010)	−0.068*** (0.010)			−0.063*** (0.010)	−0.052*** (0.010)
Weekly gross earnings (If left FT education)	*83.47* *(95.77)* *n = 1031*				*69.78* *(112.97)* *n = 755*			
Hours paid work p.wk, age 15		0.629 (1.602) **(0.974)**	0.603 (1.593) **(0.976)**	0.233 (1.602) **(0.999)**		3.582** (1.574) **(0.071)#**	3.643** (1.542) **(0.056)#**	3.400** (1.586) **(0.098)#**
GCSE total points, *z*-score			4.089 (5.254)	5.204 (5.479)			10.595* (5.771)	4.427 (6.429)
Poor health (GHQ, items out of 12)	*1.571* *(2.311)* *n = 4891*				*2.497* *(2.974)* *n = 4784*			
Hours paid work p.wk, age 15		0.083 (0.249) **(0.920)**	0.067 (0.186) **(0.908)**	0.008 (0.085) **(0.992)**		0.040 (0.054) **(0.714)**	0.033 (0.053) **(0.789)**	0.022 (0.050) **(0.889)**
GCSE total points, *z*-score			−0.166* (0.086)	0.058 (0.085)			−0.390*** (0.106)	−0.198* (0.107)
Age 19 outcomes								
At college or university	*0.463* *n = 4268*				*0.495* *n = 4408*			
Hours paid work p.wk, age 15		−0.010 (0.008) **(0.426)**	−0.009 (0.008) **(0.521)**	−0.007 (0.008) **(0.690)**		0.012 (0.007) **(0.252)**	0.011 (0.008) **(0.370)**	0.011 (0.007) **(0.265)**
GCSE total points, *z*-score			0.132*** (0.017)	0.098*** (0.018)			0.142*** (0.017)	0.114*** (0.017)
At university	*0.252* *n = 4268*				*0.323* *n = 4408*			
Hours paid work p.wk, age 15		−0.004 (0.006) **(0.729)**	−0.003 (0.007) **(0.907)**	0.000 (0.007) **(1.000)**		0.009* (0.005) **(0.187)**	0.009 (0.006) **(0.281)**	0.010* (0.006) **(0.206)**
GCSE total points, *z*-score			0.130*** (0.012)	0.113*** (0.012)			0.118*** (0.014)	0.091*** (0.014)
NEET: Not in employment, education or training	*0.105* *n = 4268*				*0.057* *n = 4135*			
Hours paid work p.wk, age 15		0.002 (0.005) **(0.851)**	0.004 (0.005) **(0.563)**	0.005 (0.005) **(0.436)**		−0.009 (0.005) **(0.147)**	−0.011 (0.008) **(0.961)**	−0.009 (0.008) **(0.344)**
GCSE total points, *z*-score			−0.058*** (0.011)	−0.037*** (0.011)			−0.048*** (0.011)	−0.046*** (0.011)

Notes: First stage sample size *n* is 5446 for males and 5339 for females for all specifications. *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard errors in parentheses, above *p*-value adjusted for multiple hypothesis testing of outcomes measured at the same age in **bold** and parentheses (see procedure in Table 6). #: $p < 0.1$; ##: $p < 0.05$ ###: $p < 0.01$; all adjusting for multiple hypothesis testing. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and clustering at the school level.

the part-time working hours of males or females. This is consistent with children this age not being close substitutes for young adult workers, or the jobs they do not being suitable for adult workers (such as a weekly delivery round). The age 14 density of SIC G or H businesses has a positive effect that is stable but only marginally significant for males, and smaller and insignificant for girls when anything beyond individual demographics are included.

At age 15 the local youth unemployment rate is never significant for boys, though takes on a large magnitude of effect size once school and teaching resources are included in the model, of around 0.13 h per percentage point lower unemployment rate. For girls, the corresponding coefficient is always larger, but it loses significance with Local Authority, school and teacher controls. We see a significant and stable positive effect of SIC G or H businesses on the working hours of both boys and

Table 9
Population means, policy effects and production function parameters for age 25 outcomes.

	Male				Female			
	(1) *Dep' var mean (sd)/ proportion 2nd stage n*	(2) Policy effect (s.e.) ***(p^{adj})***	(3) Prod'n func incl. GCSE *z*-score (s.e.) ***(p^{adj})***	(4) Prod'n func plus age 14/15 inputs (s.e.) ***(p^{adj})***	(5) *Dep' var mean (sd)/ proportion 2nd stage n*	(6) Policy effect (s.e.) ***(p^{adj})***	(7) Prod'n func incl. GCSE *z*-score (s.e.) ***(p^{adj})***	(8) Prod'n func plus age 14/15 (s.e.) ***(p^{adj})***
Age 25 outcomes								
NEET: Not in employment, education or training	*0.080* *n = 2715*				*0.054* *n = 3397*			
Hours paid work p.wk, age 15		0.008	0.011**	0.010**		−0.004	−0.004	−0.005
		(0.005)	(0.005)	(0.005)		(0.008)	(0.007)	(0.007)
		(0.627)	**(0.140)**	**(0.220)**		**(0.992)**	**(0.990)**	**(0.971)**
GCSE total points, *z*-score			−0.072***	−0.060***			−0.024***	−0.024**
			(0.013)	(0.012)			(0.009)	(0.010)
Total duration of unemployment, months, Sept 2006-Aug 2015	*7.75* *(18.18)* *n = 2715*				*4.89* *(15.90)* *n = 3397*			
Hours paid work p.wk, age 15		2.000**	−1.519***	−1.536***		2.425***	−1.174***	−1.197***
		(0.781)	(0.315)	(0.308)		(0.383)	(0.293)	(0.272)
		(0.049)##	**(0.000)###**	**(0.000)###**		**(0.000)###**	**(0.000)###**	**(0.000)###**
GCSE total points, *z*-score			−3.311***	−3.075***			−4.777***	−4.840***
			(0.817)	(0.871)			(1.480)	(1.397)
Weekly net earnings (All)	*275.68* *(210.31)* *n = 2678*				*211.29* *(178.59)* *n = 3345*			
Hours paid work p.wk, age 15		0.333	3.060	3.661		−3.450	−7.262	−6.024
		(6.025)	(4.815)	(4.525)		(3.874)	(4.458)	(4.395)
		(1.000)	**(0.987)**	**(0.959)**		**(0.944)**	**(0.490)**	**(0.684)**
GCSE total points, *z*-score			64.359***	57.635***			59.955***	57.413***
			(11.817)	(11.144)			(9.167)	(9.297)
Hourly net earnings (In Work only)	*8.99* *(4.80)* *n = 2203*				*8.46* *(4.58)* *n = 2569*			
Hours paid work p.wk, age 15		0.269*	0.205	0.196		−0.101	0.680***	0.687***
		(0.151)	(0.142)	(0.145)		(0.090)	(0.167)	(0.159)
		(0.332)	**(0.571)**	**(0.639)**		**(0.810)**	**(0.000)###**	**(0.000)###**
GCSE total points, *z*-score			0.398	0.382			0.913***	0.900***
			(0.252)	(0.250)			(0.225)	(0.228)
Weekly hours of work (All)	*34.28* *(19.56)* *n = 2726*				*27.42* *(18.89)* *n = 3362*			
Hours paid work p.wk, age 15		−0.114	0.600	0.589		−0.209	−0.520	−0.421
		(0.824)	(0.568)	(0.579)		(0.368)	(0.538)	(0.516)
		(0.994)	**(0.862)**	**(0.881)**		**(0.994)**	**(0.914)**	**(0.961)**
GCSE total points, *z*-score			4.767***	3.902***			5.859***	5.213***
			(1.104)	(1.079)			(1.002)	(1.021)
Occupation: Managerial or professional	*0.320* *n = 2704*				*0.340* *n = 3296*			
Hours paid work p.wk, age 15		−0.019**	−0.001	−0.000		0.011	0.016**	0.017**
		(0.009)	(0.008)	(0.008)		(0.010)	(0.008)	(0.008)
		(0.117)	**(1.000)**	**(1.000)**		**(0.854)**	**(0.237)**	**(0.180)**
GCSE total points, *z*-score			0.092***	0.074***			0.102***	0.091***
			(0.017)	(0.017)			(0.016)	(0.018)
Occupation: Small employer or own account worker	*0.070* *n = 2704*				*0.025* *n = 3296*			
Hours paid work p.wk, age 15		0.010**	0.010**	0.008*		0.003	−0.001	−0.001
		(0.004)	(0.005)	(0.005)		(0.002)	(0.002)	(0.002)
		(0.063)#	**(0.208)**	**(0.440)**		**(0.746)**	**(0.992)**	**(0.992)**
GCSE total points, *z*-score			0.000	0.009			0.001	0.005
			(0.010)	(0.011)			(0.006)	(0.006)
Poor health (GHQ, items out of 12)	*2.289* *(3.209)* *n = 2651*				*2.53* *(3.272)* *n = 3287*			
Hours paid work p.wk, age 15		0.148	0.001	−0.018		−0.116**	−0.077	−0.076
		(0.138)	(0.146)	(0.107)		(0.051)	(0.065)	(0.061)
		(0.812)	**(1.000)**	**(1.000)**		**(0.108)**	**(0.751)**	**(0.709)**
GCSE total points, *z*-score			−0.227	−0.108			−0.376**	−0.262
			(0.173)	(0.170)			(0.163)	(0.172)

Notes: First stage sample size *n* is 5446 for males and 5339 for females for all specifications. *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard errors in parentheses, above *p*-value adjusted for multiple hypothesis testing of outcomes measured at the same age in **bold** and parentheses (see procedure in Table 6). #: $p < 0.1$; ##: $p < 0.05$ ###: $p < 0.01$; all adjusting for multiple hypothesis testing. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and clustering at the school level. Second stage equations for hours and earnings use a tobit specification with these outcomes topcoded at the sample 99th percentiles, which are weekly earnings of £923, hourly earnings of £37.50, and 78 weekly hours of work).

girls, at around 0.2 and 0.13 additional hours per week worked per additional registration per 100 youths.

Though insignificant, the magnitude of the gender-within-age, and age-within-gender differences in the age 18–24 unemployment coefficients suggest that girls are more likely than boys, and 15 year-olds more likely than 14 year-olds to be working in sectors where they work alongside young adult workers, and to be considered close substitutes for them.

All but the 'demographics only' specifications show we lack identifying variation from local labour market conditions for the effects of part-time work at age 14 on later outcomes. For the remainder of this paper we therefore focus on the effects of part-time work at age 15, by which age we do have significant identifying variation driven by the density of SIC G and H small businesses. Given this, in our final specification we control in our second-stage equation for educational performance at age 14. Its inclusion ensures that the estimated coefficients on employment hours at age 15 capture solely the learning gain that occurs after age 14. All further estimates presented include the full set of covariates as used in columns (5) and (10).

We retain the first-stage equation for age 14 employment, and keep this variable in the second stage equation, for two reasons. Firstly, it means we observe and control for the initial condition - i.e. the employment decision in the first academic year in which the child is legally permitted to work. Secondly, this Full Information Maximum Likelihood specification, by accounting for the correlation of errors among the first and second stage equations, controls for any unobserved factors driving children to take up part-time work at this earliest opportunity, which may be an important source of heterogeneity also driving educational performance.

5.2. Policy effects on educational performance

The top panel of Table 5 shows that the estimated total effect (ϕ_t^L in Eq. (3)) of an additional hour of part-time work per week at age 15 on the GCSE z-score is robust to the exact set of controls. In particular, additionally including prior educational performance at age 11 (columns 4 and 9) makes little difference to the age 15 coefficient for either boys or girls. This shows that our instruments must be conditionally uncorrelated with this predetermined measure of educational performance, which is supporting evidence of the validity of the instruments. Additionally controlling for age 14 educational performance in our preferred specification (columns 5 and 10), we find a negative effect of age 15 part-time work for boys of 2.5% and girls of 6.7% of a standard deviation per hour worked per week.[5]

Working the mean hours of employment (conditional on positive hours) observed for 15 year-olds in this population, the expected overall effect would be to reduce a male's GCSE z-score by 12% of a standard deviation, and a female's by 34.8%. The magnitude of this figure for females is about 50% larger than benchmark estimates for the effect of having a very high quality, rather than average, teacher (Hanushek, 2011), or the progress a 14–15 year-old in the United States is expected to make in standardized tests over one year (Hill et al., 2008). This suggests that part-time work is highly disruptive to educational performance. This makes it important to evaluate the mechanisms through which this occurs, and whether the deleterious effect on educational performance at the end of compulsory schooling outweighs any benefits in terms of human capital accumulation, for future labour market outcomes.

[5] The positive, though insignificant, coefficient on age 14 part-time work for males in column (4) is not in our preferred specification but is identified. This suggests part-time work at age 14 earlier age may help accumulate skills without affecting the allocation of time during the later periods in which the high-stakes qualifications are actually studied for.

5.3. Crowding out of other inputs

In Table 6 we show estimates of γ_t^q from Eq. (5), showing the contemporaneous crowd-out (or facilitation) of five other potential inputs (s_{it}^q) to the education production function, caused by an hour of part-time work per week at age 15. Three results stand out. Firstly, part-time work reduces schoolchildrens' 'Attitude', i.e. motivation for schoolwork, with an effect size of approximately 3.5% of a standard deviation per hour, and 'Study' by a smaller, marginally significant magnitude. Secondly, part-time work crowds out the active leisure of males with an additional hour per week having an effect size of 5.7% of a standard deviation, almost three times that for females. Thirdly, part-time work increases both males' and females' participation in risky behaviours, here meaning consumption of illicit substances, by the margin of 3.8% and 3.1% of a standard deviation per hour per week. Referring back to Table 3, this can be interpreted as a typical employment burden of 6 h per week raising the probability of 'ever smoking', 'ever having tried cannabis', and 'ever consuming alcohol' by approximately 6 percentage points each, or by 50%, 50% and 20% respectively. By contrast, the effects in relation to non-risky social activities are never statistically different from zero.

5.4. Production function parameters for educational performance

In Table 7 we present estimates of the OLS and IV production function parameters for work hours and the additional inputs at ages 14 and 15 on the GCSE z-score (π_t^L and $\boldsymbol{\pi}_t^S$ in Eqs. (2) and 4). These direct effects of work hours at age 15 are less negative for both males and females than the estimated total effects. Neither are statistically significant, at −1% of a standard deviation per hour for males and −3.8% for females. The latter remains a large effect size. We do not have the identifying variation to produce IV estimates of the production function parameters on the other inputs $\boldsymbol{S}_{it}$. However the negative causal relationship between part-time work and Attitude, Study and Active Leisure at age 15 in Table 6 and positive coefficients on these variables in Table 7, and *vice-versa* for Risky Behaviours, are consistent with the larger negative total than direct effects being due to changes in these inputs.

5.5. Policy effects and production function parameters on labour market outcomes

We now evaluate the effects of part-time work at age 15 on educational retention and labour market outcomes beyond the end of compulsory schooling in Tables 8 (for outcomes measured at age 17 and age 19) and 9 (for outcomes measured at age 25). For each outcome variable, columns (1) and (5) list the estimated population mean or proportion, standard deviation (for continuous variables), and the raw sample size from which these are estimated. Columns (2) and (6) present the policy effects ϕ_t^L from Eq. (3). These include any indirect effects via contemporaneous changes in behaviour, and endogenous changes in the GCSE z-score. Columns (3) and (7) present the production function parameter π_t^L from a specification of Eq. (4), and the parameter $\pi_t^{Y'}$ on the GCSE z-score from age 16, with this included as the only factor in the vector $\boldsymbol{S}_{it}$. Columns (4) and (8) present the same two parameters from a specification also including the age 14 and 15 inputs Attitude, Study, Active Leisure, Social Life, and Risky Behaviours in the vector $\boldsymbol{S}_{it}$.

In this Full Information Maximum Likelihood framework, the first stages are estimated on the same sample as for educational performance (5446 males, 5339 females). The second stages are estimated on the available sample at each age (shown in columns (1) and (5)), weighted to the characteristics of this population when it was aged 14. We additionally control for the adult (aged 16–64) unemployment rate in the Local Authority District at time of interview, and up to five historical annual or five-year average rates to cover the entire period since June 2006. Conditional on these, we assume that the density of small businesses in just two sectors, and the youth unemployment rate between two and ten years earlier, will have no direct effect on the subsequent

outcomes. Moreover the degree of mobility between LADs in England for this age group should make conditions in the origin district less relevant. The Office for National Statistics (2016) estimates that on average, 38% of 19 year-olds will leave each Local Authority District in a given year Office for National Statistics (2016). These will predominantly be to attend university, but mobility remains high at 21% of 20 year-olds, and 12–15% of 21–25 year-olds, versus for example 4% of 17 year-olds and 5% of 40 year-olds. Abreu et al. (2015) estimate that 33% of graduates move their place of employment by over 15km between 6 months and 3.5 years after graduation.

Throughout Tables 8 and 9 we find in most cases that the direct effect (production function parameter) of part-time work at age 15 is less damaging or more beneficial than the total or policy effect. This is consistent with our finding in Tables 5 and 7 that part-time work has both a negative total and direct effect on the age-16 GCSE *z*-score, and our expectation that there is a positive causal relationship between educational and labour market performance. In other words, the damaging short-term effect on educational performance reduces the longer-term benefits or increases the longer-term costs of part-time work, compared with its direct effects through human capital accumulation or signalling. However, the difference between the total and direct effect of part-time work is not usually quantitatively large or statistically significant.

We find a negative effect on early educational retention for males. For each hour per week worked per week at age 15, a male is 1.7 (total effect) or 1.2 (direct effect) percentage points less likely to be in full-time education at 17. We find no significant effects for females, but a consistent effect size with each hour worked per week at age 15 increasing their probability of being in full-time education at 17 and at college or university at age 19 all by around 1 percentage point. These results are consistent with part-time work affecting the performance of females from a sufficiently high base that their decisions to continue in education are not constrained.

For those who have left full-time education by age 17, we find no significant effect of part-time work experience on weekly gross earnings for males, but small positive total and direct effects of approximately £3.50 for females. This suggests that having accumulated experience by age 16 does, for females, generate or signal human capital that is valued by employers, and this outweighs any negative effects of reduced educational performance. The lack of any effect on educational retention for females means this not an artefact of 'higher quality' workers being induced to enter the labour market early due to their poorer exam results.

Looking to longer term outcomes in Table 9 we find the total or policy effect of part-time work experience at age 15 is to reduce the probability that males will end up in a 'Managerial or Professional' job at age 25, by 2 percentage points per hour per week; and increases the probability that they will be self-employed (a "small employer or own account worker") by 1 percentage point. Corresponding effects for females are insignificant. However, for males we see a precisely estimated zero and for females a larger positive and significant effect production function parameter for being 'Managerial or Professional'. Table A8 in Appendix A.7 shows a persistent long-run positive association of Attitude to schoolwork with this outcome for both males and females. This supports the crowd-out of Attitude to schoolwork by age 15 part-time work playing a role, both indirectly through its effects on educational performance, and directly in negatively biasing the policy effect for part-time work on this outcome relative to the production function parameter.

Even more starkly, the total effect of taking part-time work at age 15 is to increase the total duration of unemployment experience during the first 10 years of potential full-time labour market participation, by 2 and 2.4 months per hour per week for males and females. Several mechanisms could explain this large effect, including earlier dropout from full-time education for males, the reduction in educational performance or an increase in the reservation wage. However, shutting down the indirect effect by controlling for the GCSE *z*-score in the production function produces negative (i.e. beneficial) direct effects of a similar magnitude.

We find no effect on total weekly earnings or hours of work where we include zero values for those not in work, and a zero total effect but large positive production function parameter for females' hourly wages, with an hour of part-time work per week at age 15 adding £0.70 to hourly wages 10 years later. These results show that for females there are long-run human capital or signalling benefits of part-time work at age 15, that are almost exactly offset by the detrimental effect this has on educational performance. Note that the opposite-signed weekly (negative and insignificant) and hourly (positive and significant) wage production function parameters for women must therefore be reconciled by a higher reservation wage and hence lower participation for females with part-time work experience at age 15, rather than differences in working hours at the intensive margin.

Finally, we find no significant effects on mental health at age 17, a small (0.12 fewer items of poor health out of 12) and significant beneficial policy effect at age 25 for females, and larger but insignificant detrimental policy effect at age 25 for males, but no significant or quantitatively large direct effects at this age. The relation of these measures to the other age 14–15 inputs, and robustness to alternative threshold measures of health, or discussed in Appendix A.5

6. Discussion and conclusions

In this paper we have evaluated the total and direct effects of part-time work at age 15 on performance in high-stakes qualifications taken at age 16 in England, and on health, educational attainment, and labour market outcomes up to age 25.

We find large negative policy effect sizes of −2.5% and −6.7% of a standard deviation in the GCSE *z*-score, per hour worked per week at age 15. We show robust evidence that a mechanism for this is part-time work reducing teenagers' attitude to schoolwork, and to a smaller extent their study time outside of school. However, negative total and direct effects on educational retention at age 17 are only found for males, while positive total and direct effects on age 17 earnings for those who do drop out and on progression into Higher Education by age 19 are only found for females. Our long-run production function estimates show females with part-time work experience at age 15 gaining higher hourly earnings (by 0.70 per hour worked per week at age 15) and being more likely to enter a Managerial or Professional occupation at age 25 (by 1.7 percentage points per hour worked per week at age 15). There are corresponding zero effects for males.

Differences by sex in these effects on educational retention, progression and labour market performance may reflect the stronger overall performance levels among girls at age 16, but females are also more likely to participate in retail and catering jobs and males in delivery. The former are more likely to promote cognitive skills such as financial literacy, mental arithmetic, and interpersonal skills that have long-run educational and labour market returns. Their pre-existing non-cognitive traits may also make females more persistent in adapting their habits (e.g. to not procrastinate over schoolwork, even if no longer employed) or upgrading their educational and occupational aspirations having experienced low-skilled work as a teenager.

The exceptional result where a significant effect is found on males', but not females', subsequent labour market outcomes, is for the probability of entering self-employment (0.8% percentage points per hour worked per week at age 15). We have shown this outcome ("To be my own boss or have my own business"), matters a lot to many more males than females.

The distinction between production function parameters and policy effects is very important for the interpretation and implications of our results. For example the skills obtained through age 15 part-time work by females are beneficial for entering Managerial and Professional occupations, but somewhat offset by reduced educational performance. Another direct effect of part-time work experience at age 15 is to reduce

unemployment duration for both males and females, but the damaging total effects shows this benefit is more than outweighed by the detrimental effects of reduced educational performance.

Teenagers in compulsory schooling with part-time jobs do not appear to be working out of financial necessity. Nor are they taking these positions as a conscious investment ahead of their school-to-work transition. Nevertheless, for females, it appears to play this role well. In contrast, males at risk of dropping out of full-time education at the earliest opportunity would be advised to find work with more opportunities for human capital acccumulation, or to focus on improving their performance in the educational qualifications they will leave school with, as this will make a larger difference in the long-run.

Appendix A

A1. Compliance with regulations on child employment

Those employing children are required to obtain the signature of a parent and permit from the Local Education Authority (LEA), which must be satisfied that the child's education will not be damaged. An example of the application form and guidance for one Local Authority can be seen at https://www.essex.gov.uk/child-employment/apply-for-a-work-permit (accessed 18th October 2019). Howieson et al. (2006) and McKechnie et al. (2005) estimate only 14% of child workers in Scotland, and 15% in the county of Cumbria, England, had the required permit.

McKechnie et al. (2011) and Hobbs et al. (2007) attribute this low compliance to a lack of resources among LEAs to provide information to employers or to undertake inspections; and a lack of awareness among employers of the law, of the possibility of detection, or the penalty if detected. This penalty is in turn is somewhat mild (a maximum fine of £1000), even if there are potentially more serious implications such as invalidating their insurance (National Network for Children in Employment and Entertainment, 2019). McKechnie et al. (2011) and Hobbs et al. (2007) also suggest that the evidence base on whether part-time work by schoolchildren does harm school outcomes needs to be strengthened before regulatory enforcement or reform would become a political priority, in light of concerns about burdens for small businesses and a prevailing view that work experience for children is a good thing.

A2. Part-time work prevalence by parental occupation and education

In Fig. A1, parental occupation categories are ordered from 1 ("Higher Managerial and Professional") to 7 ("Routine occupations") and 8 ("Never worked and long-term unemployed"). The gradient in participation is shallow apart from a significant drop-off for those with the weakest labour market attachment. Category 4 ("Small employers and own-account workers") capture children of self-employed workers, who are among the most likely to be in part-time work, and this is more obvious for females than males, though the gaps are still small. In Fig. A2, the children of parents with no educational qualifications are least likely to be in part-time work, but there are only small differences by parental education for those with GCSE-level qualifications or higher.

A3. School and neighbourhood level controls

We control for whether the school is single-sex, selective, independent (i.e. fee-paying), or a religious school. All thesefactors are likely to affect cohort members' and teachers' peer group quality and cost of effort. The school having a 'sixth form' would mean the cohort member could continue in full-time education after age 16 without changing institution, so may affect the perceived costs of doing so, as well as access to information, advice and guidance about Higher Education. As measures of peer-group socio-economic and educational background we control for the proportion of pupils entitled to Free School Meals (which is means-tested by parental income), who are not native English speakers, who have a Statement of Special Educational Needs (SEN) or less serious documented SEN condition, and the ethnic composition of the school, along with two pre-determined measures of school quality: The average GCSE point score and age 11–16 value-added measures for the 2004 cohort, two academic years above the Next Steps cohort. As measures of school resourcing we control for the number of Full-Time Equivalent (FTE) teachers with Qualfied Teacher Status (QTS), and number of other teachers (the vast major-

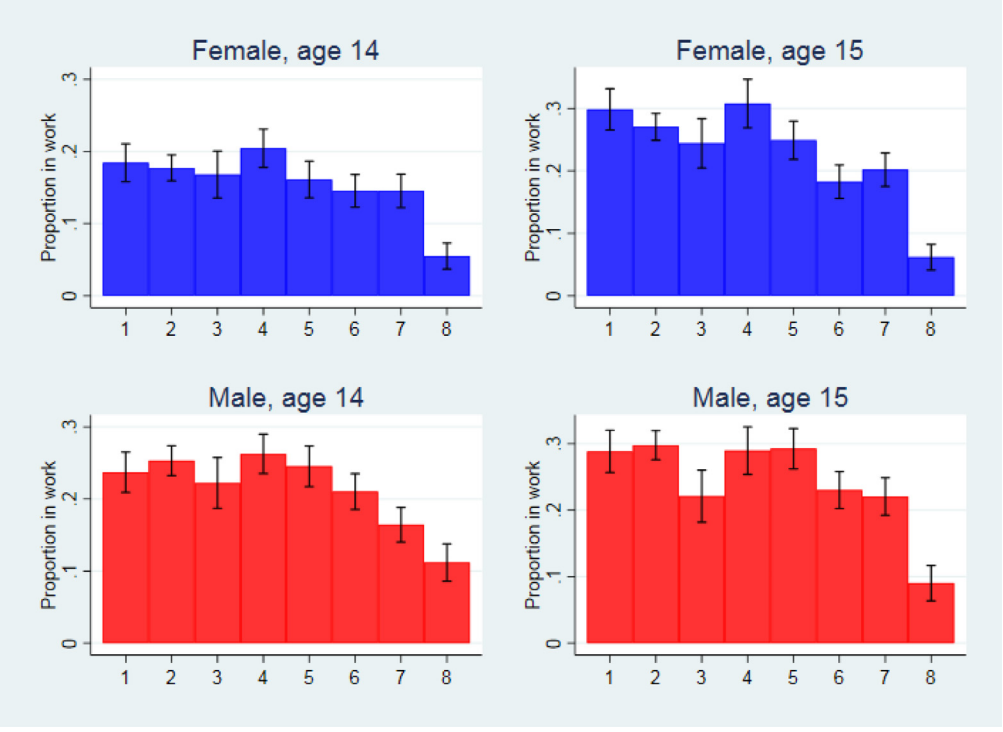

Fig. A1. Part-time work prevalence by parental occupation.

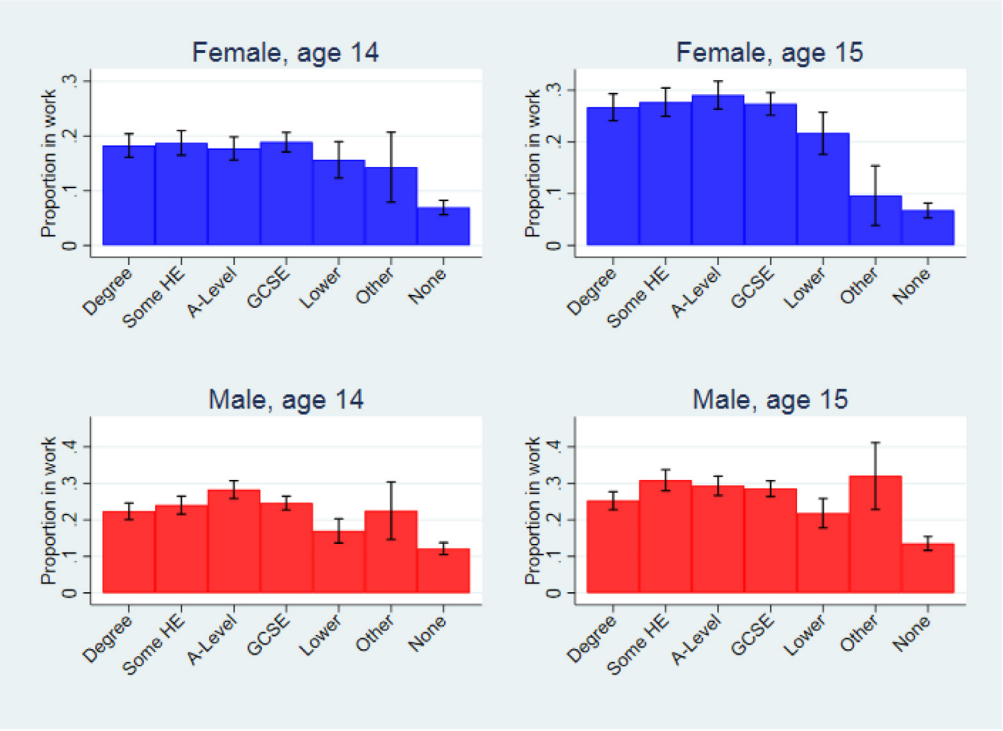

Fig. A2. Part-time work prevalence by parental qualifications.

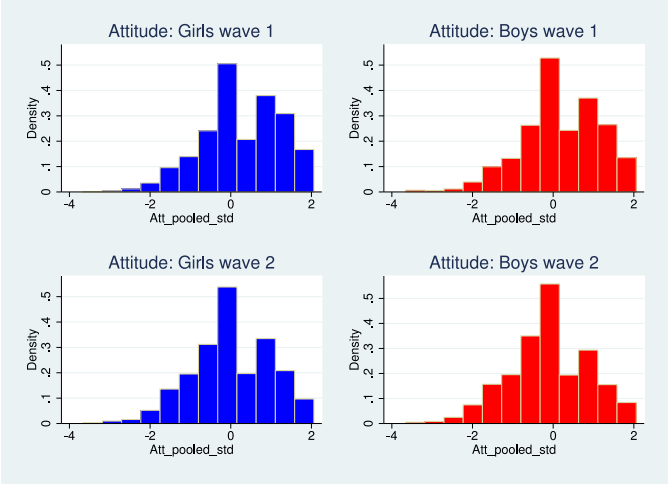

Fig. A3. Distribution of principal component of Attitude by wave and sex.

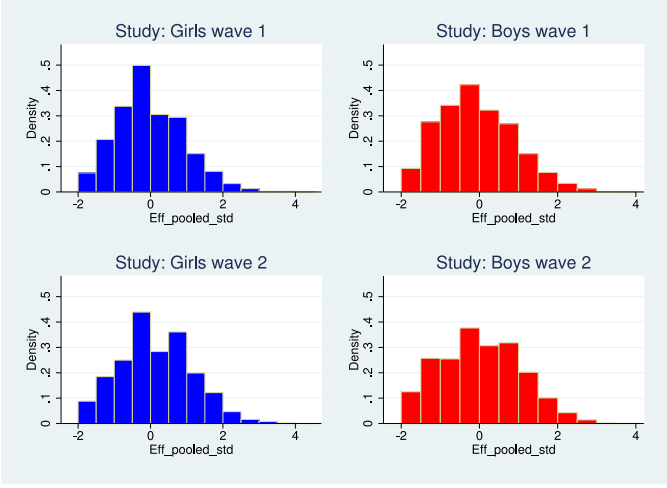

Fig. A4. Distribution of principal component of Study by wave and sex.

ity on programmes leading to QTS), per pupil. QTS accreditation requires a postgraduate teacher-training qualification involving school experience over a range of pupil ages. We also control for the number of Teaching Assistants and Support Staff per pupil; and the number of qualified SEN support staff per pupil with a SEN statement or SEN condition.

We also control for LAD-level counterparts to all the household characteristics in our model. These are the skills sub-domain of the Index of Multiple Deprivation (a standardized measure of the prevalence of adults with no or low qualifications)[6], the proportion of adults aged 35–59 who received Disability Living Allowance, the number of full-time and part-time jobs per 100 adult residents, and number of self-employed per 100 adult residents.[7] As measures of housing wealth, we use the median selling price of houses in 2004–2006, and proportion of dwellings that are owner-occupied between 2012 and 2017 (the furthest back that data are available).[8]

Estimates of the population means and standard deviations are shown in Table A1.

[6] This is publicly available from the National Archives at https://tinyurl.com/y6deqor7.

[7] These are all publicly available to download from the NOMIS interface of the Office for National Statistics, at https://tinyurl.com/y64ty6sb.

[8] House Price data were downloaded from: https://tinyurl.com/y5eubb4a and Owner Occupation rates from: https://tinyurl.com/y64zufue. The latter are estimates and not official statistics on dwelling stock by tenure.

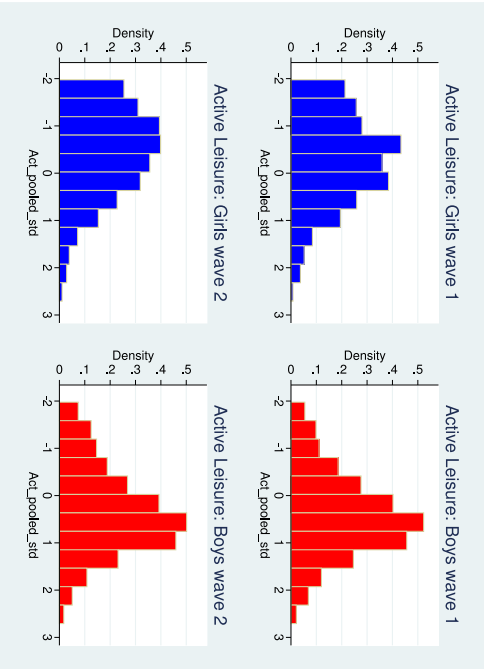

Fig. A5. Distribution of principal component of Active Leisure by wave and sex.

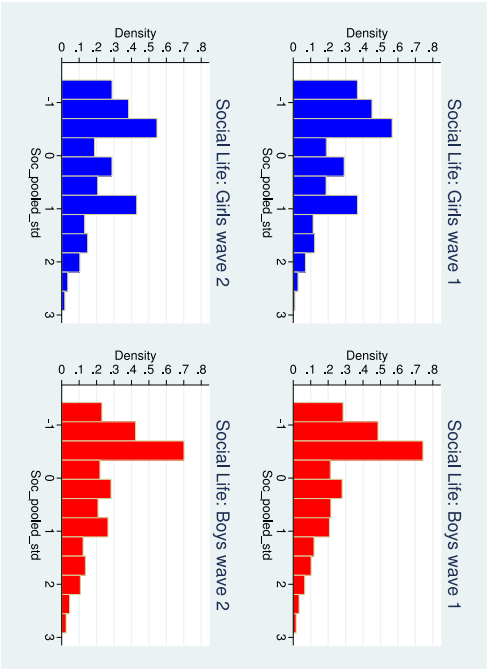

Fig. A6. Distribution of principal component of Social Life by wave and sex.

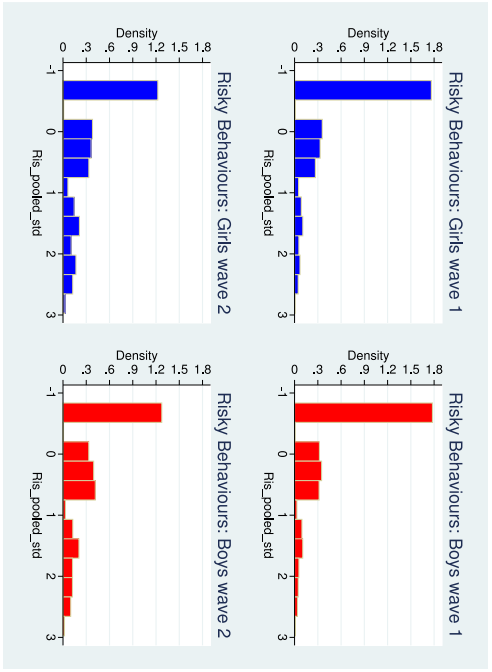

Fig. A7. Distribution of principal component of Risky Behaviours by wave and sex.

Table A1
Estimated population mean and standard deviation of additional control variables.

(1)		(2)		(3)		(4)	
Local Authority District controls		School controls		School controls (cont'd)		Teacher controls	
Skills sub-domain of Index of Multiple Deprivation	0.136 (0.602)	Single-sex,	0.089 (0.285)	Pupils with SEN statement (%)	2.40 (1.56)	Qualified Teachers per pupil	0.089 (0.050)
Population aged 35–59 claiming Disability Living Allowance (%)	5.35 (2.10)	Selective	0.036 (0.186)	Pupils with SEN but no statement (%)	13.51 (8.30)	Other teachers per pupil	0.006 (0.007)
Full-time jobs per 100 working age residents	44.62 (5.46)	Independent	0.075 (0.263)	(Sample members with missing value for SEN prevalence)	0.098 (0.297)	Teaching Assistants per pupil	0.009 (0.005)
Part-time jobs per 100 working age residents	15.62 (2.92)	Faith	0.211 (0.408)	Pupils entitled to Free School Meals (FSM), (%)	13.89 (13.38)	Support staff per pupil	0.020 (0.008)
(Sample members with missing value for full/part-time jobs)	0.046 (0.212)	Has a sixth-form	0.535 (0.499)	Pupils with English as foreign language	8.53 (16.37)	SEN support staff per pupil with SEN statement	0.154 (0.008)
Self-Employed workers per 100 economically active	9.03 (2.60)	2004 cohort mean GCSE total score	342.13 (95.79)	Ethnicity: Indian, (%)	2.32 (6.81)	SEN support staff per pupil with other SEN	0.025 (0.015)
Median house price	161,025 (55,234)	2004 cohort age 11–16 value-added	988.95 (27.48)	Pakistani, (%)	2.38 (7.60)	No registered SEN pupils	0.052 (0.221)
Owner-occupation rate, %	63.93 (9.85)	(Sample members with missing values for school prior performance)	0.046 (0.209)	Bangladeshi, (%)	0.87 (4.95)		
Mean of Index of Multiple Deprivation	−0.197 (0.926)	Average class size	22.03 (2.07)	Black Caribbean, (%)	1.69 (3.27)		
In Greater London	0.131 (0.337)	(Sample members with missing values for class size)	0.101 (0.301)	Black African, (%)	1.34 (2.41)		
Observations:	14,994		14,994		14,994		14,994

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard deviations in parentheses. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

Table A2
Effect of changes in local labour market conditions on subject choice and educational aspirations.

Dependent variable:	Child takes qualification in a "Food Subject"				Child intends to stay in Full-time Education after age 16			
	Male		Female		Male		Female	
	Age 14	Age 15	Age 14	Age 15	Age 14	Age 15	Age 14	Age 15
Age 18–24 claimant count unemp' rate	−0.331	−0.689	−0.140	−0.275	0.844	0.596	0.011	−0.282
	(0.575)	(0.561)	(0.815)	(0.779)	(0.647)	(0.577)	(0.457)	(0.369)
SIC G/H VAT-registered businesses per 100 youths	0.002	0.003	0.006	0.006	−0.006**	0.000	0.002	0.003
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
Observations	5446	5446	5339	5339	4943	5025	4790	4967

Notes: A "Food Subject" is a GCSE in Food Technology or a National Vocational Qualification in Leisure and Tourism, or Hospitality and Catering. Standard errors in parentheses. *: $p < 0.1$, **: $p < 0.05$, ***: $p < 0.1$. Longitudinal weights applied. **Additional covariates**: As in 'Full' specification (columns 5 and 10 of Table 5). Standard errors in parentheses. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

A4. Non-employment responses to the instrumental variables

If teenagers observe and respond to our instrumental variables in ways other than their part-time working hours, this would invalidate our instruments. An example of this could be students becoming more likely to take qualifications in subjects that would prepare them well to work in the retail, wholesale, hotel or restaurant sectors, in Districts where there is a higher density of businesses in these sectors. In Table A2 we therefore first present results showing the effect of the instruments measured at ages 14 (when GCSE subjects must initially be made) and 15 (allowing for changes in subject choices) on the probability that at age 15 the child is working towards a qualification in a 'Food subject'. By this we mean a GCSE in Food Technology, or a National Vocational Qualification in Leisure and Tourism, or Hospitality and Catering. For neither males nor females does this decision respond significantly or by a quantitatively large magnitude either to the youth unemployment rate, or more importantly to the density of VAT-registered small businesses in the industries relevant to these subjects.

Another threat to validity would be if schoollhildren with present-biased preferences treat the presence of suitable labour market opportunities as creating high opportunity costs of further education and low return to higher grades. This may cause them to reduce their effort, in which case our estimated effect of in-school employment on school performance, study time and attitude to schoolwork would be negatively biased. On the right-hand-side of Table A2 we therefore show the effects of the instruments at age 14 and 15 on the contemporaneous probability that the child intends to leave full-time education at age 16. The cleanest test is with the coefficients on the youth unemployment rate at age 14, because as shown in Table 5, the local youth unemployment rate has zero effect on employment opportunities at age 14. This means we are not concerned that any response to this variable observed in educational aspirations is endogenous to accumulated part-time work experience. This enables us to test whether there is some anticipatory effect on educational aspirations that may influence educational performance over the longer-run. However, we find no effect for either males or females.

We also find no reduced form effect for: the youth unemployment rate at age 15, which although Table 5 shows is not significant, will be partially correlated with age 15 part-time work; for the SIC G/H density at age 14 for girls (not significant but will be partially correlated with age 14 part-time work); or for the SIC G/H density at age 15, which we will show does positively influence selection into part-time work. One coefficient here *is* significant. Increasing the density of SIC G/H businesses locally at age 14 reduces boys' intention to remain in full-time education after 16. This may directly result from selection into part-time work caused by this instrument leading boys to feel better prepared to leave school, but it could indicate that prospective school-leaving employment opportunities reduce motivation to perform well in education. Reassuringly, by age 15, this coefficient becomes a precisely estimated zero. In our final specification (columns 5 and 10 in Table 5 and all subsequent estimates) we include age 14 educational performance as a control variable. This absorbs the contemporaneous effects of labour market opportunities on educational motivation, and we focus on the effects of age 15 part-time work, the instruments for which this exercise has given no reason to doubt the validity.

A5. Measures of health

Our main results show no significant effects on mental health at age 17, though at face-value, the magnitude of the detrimental estimated effect for males reduces somewhat when inputs during compulsory schooling are accounted for, with losses in Active Leisure and Attitude to schoolwork being netted out (see coefficients in Table A7 in Appendix A.7). This stability of the coefficients shows that although risky behaviours are strongly detrimentally associated with mental health for females, part-time work does not facilitate these risky behaviours to a sufficient extent, or for enough people, for this to explain any differences in mental health even at this short range. In Tables A3 and A4 below, we show the results of this exercise for the threshold measures of at least four items, and for self-reported 'fairly good' or 'very good' general health. The policy effects are all statistically indistinguishable from zero, but the production function parameters for 'very good' health become more positive when educational performance, and then other activities at age 15, are controlled for. This supports there being a beneficial effect of part-time work at age 15, that is suppressed in policy effect estimations by consumption of risky substances and loss of Active Leisure opportunities. Table A5 shows that by age 25 there are small but significant negative (i.e. detrimental) effects on all three thresholds for males, and positive but insignificant coefficients for females at the 'good' and 'very good' margins.

A6. Distribution of latent inputs

Recall that the measurement model (reported in Table 2) was estimated using the pooled sample of both waves and sexes. This ensures that a standard deviation change in each factor represents a common unit in terms of absolute activity levels, the interpretations of which are provided in Table 3. In turn, this means that the parameters representing the crowd-out or facilitation of each activity by employment, and their production function parameters, are directly comparable between waves and sexes.

Figs. A3–A7 show the distribution of the principal component of each latent factor by wave and sex. Each histogram has 12 bins, and the four histograms within each figure share a common scale on both axes. The similarity or overlap between groups mean that the proposed

Table A3
Marginal effects on probability of having at least four items (out of 12) of poor mental health at age 17.

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.005	0.001	0.001	−0.005**	−0.002	−0.002
	(0.005)	(0.005)	(0.004)	(0.002)	(0.004)	(0.003)
GCSE total points, *z*-score		−0.008	−0.004		−0.008	−0.005
		(0.008)	(0.008)		(0.007)	(0.008)
Attitude, age 15			0.002			0.003
			(0.005)			(0.005)
Study, age 15			−0.001			0.002
			(0.005)			(0.004)
Active Leisure, age 15			−0.020***			−0.011**
			(0.006)			(0.006)
Social Life, age 15			−0.003			−0.007*
			(0.005)			(0.004)
Risky Behaviours, age 15			−0.004			0.002
			(0.006)			(0.005)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2651	2651	2651	3287	3287	3287

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

Table A4
Marginal effects on probability of having "fairly" or "very good" health at age 17.

Panel A: 'Fairly' or 'very' good health at age 17

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.000	0.001	0.001	−0.001	−0.000	−0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
GCSE total points, *z*-score		0.003	0.000		0.013***	0.010***
		(0.002)	(0.003)		(0.004)	(0.004)
Attitude, age 15			0.003*			−0.001
			(0.002)			(0.002)
Study, age 15			−0.000			−0.004**
			(0.001)			(0.002)
Active Leisure, age 15			0.000			0.002
			(0.002)			(0.002)
Social Life, age 15			−0.000			−0.000
			(0.001)			(0.002)
Risky Behaviours, age 15			0.000			−0.006***
			(0.002)			(0.002)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	5059	5059	5059	5003	5003	5003

Panel B: 'Very' good health at age 17

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	−0.002	0.002	0.004	0.000	0.005*	0.006*
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
GCSE total points, *z*-score		0.029***	0.007		0.028***	0.017***
		(0.005)	(0.005)		(0.005)	(0.006)
Attitude, age 15			0.018***			0.010**
			(0.004)			(0.004)
Study, age 15			−0.002			−0.012***
			(0.003)			(0.004)
Active Leisure, age 15			0.017***			0.007*
			(0.004)			(0.004)
Social Life, age 15			0.002			−0.005
			(0.004)			(0.004)
Risky Behaviours, age 15			−0.014***			−0.014***
			(0.004)			(0.004)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	5059	5059	5059	5003	5003	5003

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

Table A5
Policy effects: Marginal effects on probability of general health surpassing self-reported thresholds at age 17 and age 25.

	Age 17				Age 25					
	'Fairly good' or better		'Very good'		'Good' or better		'Very good' or better		'Excellent'	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Age 15 part-time working hours per week	0.000	−0.001	−0.002	0.000	−0.011***	0.005	−0.006*	0.004	−0.006**	−0.001
	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
(Estimated pop' mean)	0.938	0.901	0.541	0.442	0.867	0.870	0.615	0.603	0.248	0.200
Observations	5059	5003	5059	5003	2692	3335	2692	3335	2692	3335

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level. Age 17 elicited on four-point scale, top two categories used as thresholds; Age 25 elicited on five-point scale, top three categories used as thresholds.

Table A6
Production functions estimates for age 25 earnings and hours.

Panel A: Weekly take home earnings at age 25, £

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.333	3.060	3.661	−3.450	−7.262	−6.024
	(6.025)	(4.815)	(4.525)	(3.874)	(4.458)	(4.395)
GCSE total points, *z*-score		64.359***	57.635***		59.955***	57.413***
		(11.817)	(11.144)		(9.167)	(9.297)
Attitude, age 15			−5.556			16.334***
			(7.726)			(5.519)
Study, age 15			1.047			2.733
			(6.548)			(5.207)
Active Leisure, age 15			11.666			14.953**
			(8.413)			(7.055)
Risky Behaviours, age 15			17.714**			−1.464
			(8.597)			(5.538)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2678	2678	2678	3345	3345	3345

Panel B: Hourly wages for those in work at age 25, £

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.269*	0.205	0.196	−0.101	0.680***	0.687***
	(0.151)	(0.142)	(0.145)	(0.090)	(0.167)	(0.159)
GCSE total points, *z*-score		0.398	0.382		0.913***	0.900***
		(0.252)	(0.250)		(0.225)	(0.228)
Attitude, age 15			−0.090			0.343**
			(0.182)			(0.162)
Study, age 15			0.110			−0.081
			(0.142)			(0.143)
Active Leisure, age 15			0.000			0.355**
			(0.174)			(0.142)
Social Life, age 15			0.023			0.083
			(0.120)			(0.100)
Risky Behaviours, age 15			0.463***			0.127
			(0.165)			(0.141)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2203	2203	2203	2569	2569	2569

Panel C: Weekly hours of work at age 25, £

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	−0.114	0.600	0.589	−0.209	−0.520	−0.421
	(0.824)	(0.568)	(0.579)	(0.368)	(0.538)	(0.516)
GCSE total points, *z*-score		4.767***	3.902***		5.859***	5.213***
		(1.104)	(1.079)		(1.002)	(1.021)
Attitude, age 15			−0.424			1.206*
			(0.735)			(0.653)
Study, age 15			0.618			0.399
			(0.631)			(0.590)
Active Leisure, age 15			2.160***			0.682
			(0.767)			(0.685)
Social Life, age 15			0.853			0.053
			(0.649)			(0.602)
Risky Behaviours, age 15			0.054			−0.724
			(0.838)			(0.635)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2726	2726	2726	3362	3362	3362

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

changes in activity levels will represent a relevant and plausible adjustment for each group. The distributions are most similar for Study (Fig. A4), though girls are slightly more concentrated in the middle and less at the bottom of the distribution. Differences are more apparent for Social Life; girls are slightly more frequent at the foot of the distribution, but also have a mass point at one standard deviation above the mean; and Active Leisure, where though there is considerable overlap between the sexes the distribution for boys is always to the right of that for girls. Risky behaviours are highly postively skewed, though in a verysimilar way for boys and girls. For all groups the modal density is at no risky behaviours.

A7. Complete estimation output

Tables A6–A13 show coefficients and standard errors on covariates omitted from Tables in the main text for reasons of space.

Table A7
Production function estimates for health at ages 17 and 25.

Panel A: General Health Questionnaire: Items of poor health (out of 12) at age 17						
	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.083	0.067	0.008	0.040	0.033	0.022
	(0.249)	(0.186)	(0.085)	(0.054)	(0.053)	(0.050)
GCSE total points, *z*-score		−0.166*	0.058		−0.390***	−0.198*
		(0.086)	(0.085)		(0.106)	(0.107)
Attitude, age 15			−0.149***			−0.045
			(0.053)			(0.075)
Study, age 15			−0.011			0.105
			(0.053)			(0.079)
Active Leisure, age 15			−0.128**			−0.088
			(0.057)			(0.076)
Social Life, age 15			−0.091*			0.023
			(0.051)			(0.062)
Risky Behaviours, age 15			0.080			0.446***
			(0.065)			(0.077)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	4891	4891	4891	4784	4784	4784
Panel B: General Health Questionnaire: Items of poor health (out of 12) at age 25						
	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.148	0.001	−0.018	−0.116**	−0.077	−0.076
	(0.138)	(0.146)	(0.107)	(0.051)	(0.065)	(0.061)
GCSE total points, *z*-score		−0.227	−0.108		−0.376**	−0.262
		(0.173)	(0.170)		(0.163)	(0.172)
Attitude, age 15			−0.020			0.025
			(0.105)			(0.101)
Study, age 15			−0.043			0.079
			(0.089)			(0.088)
Active Leisure, age 15			−0.460***			−0.229**
			(0.122)			(0.113)
Social Life, age 15			−0.137			−0.062
			(0.093)			(0.083)
Risky Behaviours, age 15			−0.011			0.091
			(0.124)			(0.104)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2651	2651	2651	3287	3287	3287

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

Table A8
Production function estimates for unemployment experience and occupational attainment at age 25.

Panel A: Total duration of unemployment (months) September 2006–August 2015

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	2.000**	−1.519***	−1.536***	2.425***	−1.174***	−1.197***
	(0.781)	(0.315)	(0.308)	(0.383)	(0.293)	(0.272)
GCSE total points, *z*-score		−3.311***	−3.075***		−4.777***	−4.840***
		(0.817)	(0.871)		(1.480)	(1.397)
Attitude, age 15			−0.636			0.301
			(0.636)			(0.529)
Study, age 15			0.090			−0.906
			(0.567)			(0.624)
Active Leisure, age 15			−0.416			0.108
			(0.723)			(0.582)
Social Life, age 15			−0.695			0.520
			(0.532)			(0.481)
Risky Behaviours, age 15			0.037			0.062
			(0.744)			(0.550)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2715	2715	2715	3397	3397	3397

Panel B: In a Managerial or Professional Occupation at age 25

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	−0.019**	−0.001	−0.000	0.011	0.016**	0.017**
	(0.009)	(0.008)	(0.008)	(0.010)	(0.008)	(0.008)
GCSE total points, *z*-score		0.092***	0.074***		0.102***	0.091***
		(0.017)	(0.017)		(0.016)	(0.018)
Attitude, age 15			0.027*			0.027***
			(0.014)			(0.010)
Study, age 15			0.011			0.002
			(0.011)			(0.010)
Active Leisure, age 15			0.006			0.017
			(0.013)			(0.011)
Social Life, age 15			0.003			0.008
			(0.011)			(0.010)
Risky Behaviours, age 15			0.004			−0.016
			(0.012)			(0.011)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2704	2704	2704	3296	3296	3296

Panel C: Small Employer or Own Account Worker at age 25

	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.010**	0.010**	0.008*	0.003	−0.001	−0.001
	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)
GCSE total points, *z*-score		0.000	0.009		0.001	0.005
		(0.010)	(0.011)		(0.006)	(0.006)
Attitude, age 15			−0.016*			−0.011**
			(0.008)			(0.005)
Study, age 15			0.004			0.000
			(0.006)			(0.004)
Active Leisure, age 15			0.012			0.002
			(0.008)			(0.005)
Social Life, age 15			−0.001			0.006
			(0.006)			(0.004)
Risky Behaviours, age 15			0.013*			−0.003
			(0.008)			(0.005)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	2704	2704	2704	3296	3296	3296

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

Table A9
Production functions estimates for educational retention and earnings for early labour market entrants.

Panel A: In full-time education or training at age 17						
	Male			Female		
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	−0.017***	−0.014**	−0.012**	0.008	0.011	0.011
	(0.006)	(0.006)	(0.006)	(0.008)	(0.007)	(0.007)
GCSE total points, *z*-score		0.153***	0.122***		0.135***	0.108***
		(0.014)	(0.014)		(0.012)	(0.012)
Attitude, age 15			0.007			0.019**
			(0.010)			(0.008)
Study, age 15			0.008			−0.005
			(0.008)			(0.008)
Active Leisure, age 15			−0.002			0.016*
			(0.010)			(0.009)
Social Life, age 15			−0.020**			−0.003
			(0.009)			(0.007)
Risky Behaviours, age 15			−0.019*			−0.026***
			(0.010)			(0.008)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	5197	5197	5197	5088	5088	5088
Panel B: Weekly Earnings, £s, conditional on not being in Full-time Education, at age 17						
		Male			Female	
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	0.629	0.603	0.233	3.582**	3.643**	3.400**
	(1.602)	(1.593)	(1.602)	(1.574)	(1.542)	(1.586)
GCSE total points, *z*-score		4.089	5.204		10.595*	4.427
		(5.254)	(5.479)		(5.771)	(6.429)
Attitude, age 15			−10.639***			−1.784
			(3.695)			(3.648)
Study, age 15			1.704			8.927
			(3.502)			(6.882)
Active Leisure, age 15			3.960			9.435**
			(4.141)			(4.154)
Social Life, age 15			5.090			1.599
			(3.466)			(4.285)
Risky Behaviours, age 15			−0.564			−7.874
			(3.888)			(5.979)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	1031	1031	1031	755	755	755
Panel C: In Higher Education at age 19						
		Male			Female	
	Policy effect	Add educational performance	Add attitudes and activities	Policy effect	Add educational performance	Add attitudes and activities
Hours paid work p.wk, age 15	−0.004	−0.003	0.000	0.009*	0.009	0.010*
	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)
GCSE total points, *z*-score		0.130***	0.113***		0.118***	0.091***
		(0.012)	(0.012)		(0.014)	(0.014)
Attitude, age 15			0.019***			0.030***
			(0.007)			(0.008)
Study, age 15			−0.011			0.007
			(0.007)			(0.008)
Active Leisure, age 15			0.012*			0.015*
			(0.007)			(0.008)
Social Life, age 15			−0.010			−0.017**
			(0.007)			(0.007)
Risky Behaviours, age 15			−0.029***			−0.011
			(0.008)			(0.010)
N (first stage)	5446	5446	5446	5339	5339	5339
N (second stage)	4268	4268	4268	4408	4408	4408

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Observations shown is raw sample size, but estimates obtained using age-14 population probability weights and accounting for clustering at the school level.

Table A10
Coeffients on all non-instrument or instrumented covariates: "Full" policy effect specification for effect of part-time work on age 16 educational performance (page 1 of 4).

	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
	Work hours Age 14	Work hours Age 15	GCSE *z*-score (IV)	Work hours Age 14	Work hours Age 15	GCSE *z*-score (IV)
Age 14 KS3 performance (*z*-score)		−0.053	0.675***		−0.819**	0.620***
		(0.425)	(0.028)		(0.330)	(0.030)
Age 11 KS2 performance (*z*-score)	0.045	−0.278	0.032	0.437**	1.494***	0.081***
	(0.179)	(0.411)	(0.025)	(0.198)	(0.343)	(0.028)
Age 14 KS3 performance missing		−0.125	−0.555***		−1.362	−0.348*
		(1.833)	(0.153)		(1.758)	(0.184)
Age 11 KS2 performance missing	−2.181**	−1.445	0.043	−3.672***	−0.295	0.092
	(0.891)	(1.051)	(0.061)	(1.266)	(1.040)	(0.073)
Index of Multiple Deprivation	−0.757***	−0.695**	−0.038**	−0.539**	−0.219	−0.011
	(0.235)	(0.303)	(0.017)	(0.266)	(0.278)	(0.018)
Permanent income percentile	−0.262	−2.277***	−0.021	0.178	−0.838	0.110**
	(0.722)	(0.803)	(0.047)	(0.769)	(0.794)	(0.052)
Month of birth within academic year	−0.052	−0.017	0.006	−0.163***	−0.123**	0.004
	(0.048)	(0.054)	(0.004)	(0.056)	(0.050)	(0.004)
Parent receives disability benefit	−1.216***	−0.974*	−0.012	−0.078	−1.431**	−0.063*
	(0.467)	(0.544)	(0.032)	(0.591)	(0.591)	(0.035)
Parents own home (outright/mortgage)	0.217	0.443	0.081***	−0.918**	0.201	0.147***
	(0.411)	(0.461)	(0.026)	(0.437)	(0.480)	(0.031)
Parent in part-time work	0.377	0.634	0.089**	0.127	0.813	0.172***
	(0.684)	(0.837)	(0.041)	(0.766)	(0.789)	(0.048)
Parent in full-time work	−0.088	1.500*	0.068*	0.314	0.638	0.061
	(0.644)	(0.783)	(0.040)	(0.712)	(0.747)	(0.045)
Parents' highest qualifications (omitted = no qualifications):						
Degree	−0.048	−1.015	0.076*	−0.082	1.531**	0.104**
	(0.649)	(0.823)	(0.044)	(0.781)	(0.755)	(0.048)
A-Levels	0.455	0.257	0.046	−0.240	2.094***	0.087*
	(0.547)	(0.719)	(0.040)	(0.678)	(0.701)	(0.045)
GCSEs	0.526	0.465	0.034	0.450	2.183***	0.058
	(0.538)	(0.689)	(0.037)	(0.650)	(0.680)	(0.043)
Other	1.636	2.352*	−0.025	−0.024	0.691	0.061
	(1.205)	(1.305)	(0.073)	(1.440)	(1.553)	(0.079)
Non-resident siblings	−0.048	−0.037	−0.021***	−0.101	0.056	−0.050***
	(0.123)	(0.140)	(0.008)	(0.142)	(0.140)	(0.011)
Co-resident siblings	0.549***	0.596***	−0.009	0.593***	0.714***	0.041***
	(0.127)	(0.151)	(0.009)	(0.153)	(0.166)	(0.011)
Lone parent	−0.642*	0.117	−0.184***	0.235	−0.507	−0.151***
	(0.364)	(0.492)	(0.028)	(0.396)	(0.426)	(0.028)
Parental occupation: (omitted = Supervisory/Technical/Semi-routine)						
Self-employed	0.112	0.908	0.018	0.746	0.634	−0.046
	(0.475)	(0.564)	(0.034)	(0.524)	(0.567)	(0.042)
Managerial/professional	−0.726*	0.249	0.064**	−0.465	−0.182	0.018
	(0.377)	(0.414)	(0.025)	(0.387)	(0.392)	(0.025)
Intermediate	−1.448***	−0.822	0.069*	−1.155*	−0.102	0.010
	(0.535)	(0.659)	(0.040)	(0.595)	(0.625)	(0.039)
Long-term unemployed	−0.270	−1.018	0.018	−1.630**	−0.277	0.003
	(0.676)	(0.874)	(0.044)	(0.781)	(0.895)	(0.052)

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Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard deviations in parentheses. Observations shown is raw sample size, but population means and standard deviations are estimated using probability weights.

Table A11
Coeffients on all non-instrument or instrumented covariates: "Full" policy effect specification for effect of part-time work on age 16 educational performance (page 2 of 4).

	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
	Work hours Age 14	Work hours Age 15	GCSE *z*-score (IV)	Work hours Age 14	Work hours Age 15	GCSE *z*-score (IV)
	Continued from previous page					
Ethnicity: (omitted = White)						
Mixed	−3.122***	−2.932***	0.150***	−0.436	−0.655	0.087*
	(0.810)	(1.048)	(0.052)	(0.816)	(0.826)	(0.052)
Indian	−3.366***	−4.273***	0.280***	−5.102***	−7.170***	0.277***
	(0.755)	(0.988)	(0.048)	(1.230)	(1.205)	(0.048)
Pakistani	−6.896***	−6.206***	0.274***	−8.448***	−9.358***	0.304***
	(1.088)	(1.199)	(0.062)	(2.056)	(2.212)	(0.061)
Bangladeshi	−6.665***	−7.795***	0.300***	−8.035***	−8.278***	0.295***
	(1.890)	(1.473)	(0.082)	(2.413)	(2.478)	(0.103)
Black Caribbean	−1.462	−2.964*	0.211***	−0.896	−1.578	0.208***
	(1.588)	(1.555)	(0.066)	(1.126)	(1.164)	(0.068)
Black African	−3.289**	−3.379**	0.265***	−1.426	−2.933**	0.382***
	(1.336)	(1.601)	(0.087)	(1.310)	(1.473)	(0.064)
Other	−1.608	−3.069**	0.244***	−2.593*	−2.885	0.442***
	(1.202)	(1.324)	(0.074)	(1.354)	(1.794)	(0.076)
Has Special Educational	−0.047	−0.501	−0.273***	−0.294	−0.290	−0.252***
Needs (SEN)	(0.387)	(0.487)	(0.033)	(0.610)	(0.648)	(0.046)
SEN missing	−3.839	−3.056*	−0.362	−3.393*	−5.980*	−0.596**
	(3.211)	(1.736)	(0.240)	(1.927)	(3.085)	(0.249)
Geography: Omitted = Urban areas						
Town/village (< 10,000 inhabitants)	−0.422	0.623	−0.021	0.933**	1.843***	0.034
	(0.378)	(0.445)	(0.030)	(0.423)	(0.426)	(0.033)
Isolated settlement	0.297	1.192	−0.022	0.547	2.749***	0.081
	(0.701)	(0.873)	(0.049)	(0.835)	(0.724)	(0.058)
Not Greater London	0.468	−0.799	−0.070	1.296	0.919	−0.040
	(0.852)	(1.017)	(0.061)	(1.046)	(1.082)	(0.073)
Timing of interview, wave 1:						
February	−1.227		0.033	−1.396*		−0.017
	(0.750)		(0.070)	(0.849)		(0.066)
March	−0.856		0.004	−0.566		−0.015
	(0.763)		(0.067)	(0.842)		(0.067)
April	−0.731		−0.034	−0.745		−0.007
	(0.763)		(0.066)	(0.839)		(0.070)
May	−0.365		0.054	−0.132		−0.050
	(0.787)		(0.070)	(0.827)		(0.072)
June	0.129		−0.151*	−0.242		−0.088
	(0.933)		(0.082)	(1.150)		(0.074)
After birthday	0.387		0.043	−0.104		0.047
	(0.410)		(0.035)	(0.465)		(0.036)
Timing of interview, wave 2:						
February		−0.071	0.006		−2.137	0.063
		(1.180)	(0.073)		(1.469)	(0.083)
March		−0.292	−0.049		−1.032	−0.021
		(1.006)	(0.054)		(1.310)	(0.071)
April		−0.078	−0.010		−0.341	0.038
		(0.996)	(0.050)		(1.287)	(0.070)
May		−0.341	0.000		−0.515	0.031
		(1.004)	(0.052)		(1.283)	(0.072)
June		0.365	0.014		−0.591	0.047
		(1.059)	(0.053)		(1.301)	(0.072)
After birthday		0.504	−0.035		−0.593	−0.044
		(0.529)	(0.033)		(0.460)	(0.036)
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Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard deviations in parentheses. Observations shown is raw sample size, but population means and standard deviations are estimated using probability weights.

Table A12
Coeffients on all non-instrument or instrumented covariates: "Full" policy effect specification for effect of part-time work on age 16 educational performance (page 3 of 4).

	Male			Female		
	(1) Work hours Age 14	(2) Work hours Age 15	(3) GCSE z-score (IV)	(4) Work hours Age 14	(5) Work hours Age 15	(6) GCSE z-score (IV)
Continued from previous page						
Local Authority controls:						
Disability recipients aged 35–59	0.201	−0.071	0.015	−0.102	−0.273**	−0.012
	(0.149)	(0.180)	(0.012)	(0.162)	(0.136)	(0.014)
Full-time jobs per 100 working age pop'	−0.006	−0.076**	0.001	−0.051*	−0.031	0.002
	(0.027)	(0.034)	(0.002)	(0.030)	(0.028)	(0.002)
Part-time jobs per 100 working age pop'	0.112	0.254***	0.001	0.103	0.070	−0.002
	(0.069)	(0.086)	(0.006)	(0.077)	(0.072)	(0.007)
Self-employed per 100 econ-active	0.016	−0.247	−0.006	0.025	−0.011	0.001
	(0.126)	(0.178)	(0.009)	(0.131)	(0.140)	(0.009)
Median house price	−0.004	−0.004	−0.000	0.001	−0.010	−0.001*
	(0.006)	(0.007)	(0.001)	(0.008)	(0.007)	(0.001)
Owner-occupation rate	0.047	0.052	0.005*	0.003	−0.006	−0.003
	(0.031)	(0.037)	(0.003)	(0.030)	(0.033)	(0.003)
School controls:						
Single sex	−0.782	−0.662	0.062	−0.435	−0.627	−0.174***
	(0.539)	(0.736)	(0.055)	(0.810)	(0.689)	(0.047)
Selective	0.170	−0.170	−0.290***	−0.674	−0.354	−0.114
	(0.993)	(1.320)	(0.094)	(1.549)	(1.823)	(0.146)
Independent	5.076	9.185**	0.405	15.293***	10.003**	−0.123
	(3.863)	(3.644)	(0.561)	(3.735)	(4.146)	(0.424)
Faith	−0.076	−0.150	0.008	0.529	−0.221	−0.062
	(0.381)	(0.488)	(0.038)	(0.473)	(0.475)	(0.041)
Has sixth form	−0.306	0.392	0.014	−0.635	0.025	0.025
	(0.373)	(0.507)	(0.036)	(0.461)	(0.450)	(0.034)
2004 cohort GCSE point score	0.000	0.002	0.003***	−0.012**	−0.009*	0.003***
	(0.003)	(0.005)	(0.000)	(0.005)	(0.005)	(0.000)
2004 cohort value-added	−0.009	−0.014	0.000	0.014	0.005	−0.001
	(0.009)	(0.012)	(0.001)	(0.012)	(0.013)	(0.001)
2004 cohort value-added missing	−9.009	−13.077	0.442	10.658	0.668	−0.550
	(8.688)	(11.533)	(0.953)	(11.379)	(12.437)	(0.934)
Average class size	0.040	0.059	−0.001	0.050	0.110	−0.001
	(0.082)	(0.113)	(0.008)	(0.104)	(0.100)	(0.008)
Average class size missing	−5.549**	−4.414	−0.410*	−0.903	2.745	0.286
	(2.369)	(3.270)	(0.214)	(2.818)	(3.241)	(0.214)
Pupils with SEN statements (%)	0.138	0.012	−0.006	−0.036	−0.041	−0.006
	(0.110)	(0.144)	(0.009)	(0.130)	(0.141)	(0.010)
SEN pupils without statements (%)	−0.043	−0.026	0.010***	−0.039	−0.014	0.010***
	(0.026)	(0.031)	(0.002)	(0.029)	(0.030)	(0.002)
SEN statistics missing	3.872*	0.893	0.994***	−5.172**	−4.915	0.251
	(2.217)	(3.070)	(0.226)	(2.537)	(3.372)	(0.191)
Free school meal entitlement, %	−0.021	−0.015	0.009***	−0.067**	−0.080***	0.007***
	(0.025)	(0.030)	(0.002)	(0.029)	(0.030)	(0.002)
English as a foreign language, %	−0.051	0.061	0.003	0.038	0.040	0.002
	(0.053)	(0.059)	(0.003)	(0.054)	(0.053)	(0.003)
Continued on next page						

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard deviations in parentheses. Observations shown is raw sample size, but population means and standard deviations are estimated using probability weights.

Table A13
Coeffients on all non-instrument or instrumented covariates: "Full" policy effect specification for effect of part-time work on age 16 educational performance (page 4 of 4).

	Male			Female		
	(1) Work hours Age 14	(2) Work hours Age 15	(3) GCSE z-score (IV)	(4) Work hours Age 14	(5) Work hours Age 15	(6) GCSE z-score (IV)
	Continued from previous page					
School ethnicity composition, (%):						
Indian	0.039	−0.081	−0.004	−0.087	−0.084	−0.005
	(0.054)	(0.064)	(0.004)	(0.064)	(0.062)	(0.003)
Pakistani	0.074	−0.060	−0.010**	−0.046	−0.067	−0.005
	(0.057)	(0.066)	(0.004)	(0.062)	(0.063)	(0.004)
Bangladeshi	0.118*	−0.058	−0.006	−0.006	−0.059	−0.002
	(0.065)	(0.090)	(0.004)	(0.067)	(0.076)	(0.004)
Black Carribbean	0.090	0.237	−0.002	0.036	−0.011	0.017***
	(0.110)	(0.177)	(0.009)	(0.102)	(0.104)	(0.005)
Black African	−0.080	−0.236	0.004	−0.214*	−0.107	−0.016**
	(0.143)	(0.144)	(0.009)	(0.115)	(0.118)	(0.006)
Mixed	0.208*	0.059	−0.009	0.032	0.229*	−0.015*
	(0.107)	(0.124)	(0.009)	(0.105)	(0.125)	(0.009)
Other	−0.007	−0.027	0.001	−0.024	−0.024	0.002
	(0.014)	(0.020)	(0.002)	(0.015)	(0.018)	(0.002)
Teaching resourcing:						
Qualified teachers	−2.531	−10.660	−1.370	−21.399	−1.283	1.817
per pupil	(11.574)	(11.899)	(1.257)	(17.230)	(22.063)	(2.051)
Other teachers per	44.699	4.015	−0.832	29.661	−72.295*	−3.971
pupil	(33.407)	(43.070)	(3.154)	(48.583)	(40.920)	(3.241)
Teaching Assistants	19.919	29.774	−4.248	−247.607***	−25.210	−4.354
per pupil	(79.835)	(102.543)	(7.253)	(86.731)	(83.133)	(6.713)
Support staff per pupil	−6.789	−56.331	8.337	178.797**	45.064	6.537
	(64.489)	(76.416)	(5.125)	(70.101)	(68.029)	(5.462)
SEN support staff per	3.029*	1.314	−0.281**	0.972	−0.246	−0.009
SEN-statement pupil	(1.823)	(2.139)	(0.142)	(1.582)	(1.358)	(0.127)
SEN support staff per	−2.645	20.854	3.719***	14.456	3.000	0.771
SEN pupil with no statement	(14.250)	(17.941)	(1.394)	(15.637)	(14.395)	(1.203)
No SEN pupils	0.990	3.614***	−0.010	0.500	0.973	0.047
	(0.934)	(1.197)	(0.123)	(1.533)	(1.569)	(0.171)
Observations	5446	5446	5446	5339	5339	5339

Notes: *: $p < 0.1$; **: $p < 0.05$ ***: $p < 0.01$. Standard deviations in parentheses. Observations shown is raw sample size, but population means and standard deviations are estimated using probability weights.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.labeco.2020.101806.

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