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The impact of higher education on the living standards of female graduates

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The Impact of Higher Education on the Living Standards of Female Graduates*

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Abstract

There have been many studies of the impact of higher education (HE) on the wages and earnings of graduates. However, for working women, the variation in wages only explains 30% of the variance in net family income. To understand the overall impact of HE on the living standards of female graduates, we explore the wider impact of HE. We exploit the rich cohort study data in the UK to show that, for women, acquiring HE qualifications increases net family income by around 20%. We find that this increase is driven by higher wages, more working hours and assortative mating, which drives higher partner earnings. We show that the impact on women's own earnings is more important in their early 30s but the role of assortative mating becomes increasingly important at older ages. We compare two cohorts of women born 12 years apart and we show that the overall impact of HE on incomes has remained relatively unchanged. The impact on female labour supply has increased slightly, but this has been counteracted by a smaller wage effect. The role of assortative mating has become no less important. These results shed new light on the benefits for women of pursuing HE in the context of ever increasing participation rates.

Keywords: Female employment, Higher education, Returns to education

JEL: I26, I23, I31, J16

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1 Introduction

The proportion of young people pursuing higher education (HE) has rapidly expanded across the developed world (Becker *et al.*, 2010), with around half of young people now attending some form of college after age 18. This expansion has been especially prevalent in England where HE participation rates have nearly tripled in the last 40 years[1]. The pursuit of HE represents a significant investment in an individual's human capital with a potentially considerable pay-off. Accordingly, there is an extensive body of literature dedicated to estimating the impact of this investment and how it varies for individuals studying different subjects and attending different institutions. This literature has predominantly focused on estimating the impact of HE on the individual's earnings and wages in later life. However, wages are far from the only outcome that HE can affect. While wage rates might be indicative of the graduates' productivity, their living standards are more likely to be determined by their overall income levels in adulthood and, for women in particular, the variation in wages is not especially predictive of income levels; for example, at age 42, only 30% of the variance in working women's net incomes is explained by variation in wages.

The aim of this paper is to estimate the impact that graduating from HE has on women's net family income in adulthood, and in doing so to produce a closer approximation of the impact of HE on the living standards of female graduates. Net family income is often used as a measure of living standards because it gives the overall level of resources that a family has available to buy goods and services. While this does not incorporate all of the factors that influence individuals' well-being, it represents a significant improvement over focusing solely on women's own wages or earnings. Our focus is on women because, historically, this is a group that has had a weaker attachment to the labour market and whose living standards have been, at least partially, determined by the earning power of their partners

In addition, we provide a deeper understanding of the channels through which HE affects women's income. We estimate the effect of HE on female labour supply and partnering decisions,

[1]Participation in HE is here defined by the Age Participation Index (API) in 1975 and by its replacement the age 17-20 Higher Education Initial Participation Rate (HEIPR) in 2015. This measures the proportion of young adults (18 to 19 in the API and 17-20 in the HEIPR) which participates in Higher Education. Numbers from http://webarchive.nationalarchives.gov.uk/+/http:/www.dius.gov.uk/research/documents/DIUS-RR-08-14.pdf and https://www.gov.uk/government/statistics/participation-rates-in-higher-education-2006-to-2015

and we take into account the role of the tax and benefit system. This exploits the value of detailed survey data, which record a wider set of information about individuals and their families than new advances in administrative data.

Finally, we compare how returns, and the mechanisms underlying these returns, change both over the life cycle and across different cohorts of women. We repeat our estimation for two cohorts born in 1958 and 1970, and at ages 33/34 and 42. In doing so, we explore how the impact of HE has changed during a period of rapidly increasing female participation rates and employment rates. We also address the concerns discussed by Bhuller *et al.* (2014) that changes over the life cycle might influence the estimated returns. We are in a unique position to perform these comparisons as we are able to exploit newly available income and earnings data that has been harmonised both across and within studies.

When estimating the casual impact of HE on these outcomes, it is vital to consistently control for the differences between those who pursue HE and those who do not (Card, 2001). Because of the scarcity of experiments and the quasi-random variation in HE, many studies rely on observable characteristics to control for this selection.[2] These estimates are only consistent if there remains no selection into HE on unobservable characteristics that are important determinants of outcomes in later life. This can be problematic when only a few background characteristics are available, as might be the case in many studies using cross-sectional labour force surveys (Altonji, 1993; Walker and Zhu, 2001, 2003; McIntosh, 2004; O'Leary and Sloane, 2005; Webber, 2014). However, a number of studies use data from cohort studies, which follow individuals throughout their lives and collect rich data on ability, family background, expectations and choices (Blundell *et al.*, 2000; Dearden *et al.*, 2004; Bratti *et al.*, 2008). Some studies, including Card (1993), attempt to exploit exogenous variation in college attendance using instrumental variables techniques. These methods account for selection on unobservable characteristics but encounter additional issues, such as weak instrument bias and only identifying a specific local average treatment effect (Angrist and Imbens, 1995; Bound *et al.*, 1995).[3]

Following previous literature in the UK, we exploit the rich and detailed background charac-

[2]Kirkeboen *et al.* (2016) is a notable exception here, as they make use of quasi-random variation in acceptance cut-offs to identify the returns to specific HE courses.

[3]Berger (1988) and Blundell *et al.* (2005) also used a control function approach to control for the selection into education. This can also account for the selection into education, given a consistent exclusion restriction

teristics recorded in British cohort studies – specifically the National Child Development Survey (NCDS) and the British Cohort Study (BCS) – to control for the selection into HE. Unlike the use of administrative data, we are able to control for full trajectories of both cognitive and non-cognitive skills throughout childhood. Furthermore, we control for background characteristics including the income, social class and education levels of the individuals' parents. As shown by Blundell *et al.* (2005), this rich array of background characteristics accounts for the endogenous selection into HE for the group of individuals with at least one A level.

We investigate the impact of HE on a measure of *net family income*, which includes the earnings of the woman, any partner in the household and other sources of income, such as transfers of non-household members; it is measured after taxes have been paid and benefits have been received. The use of this outcome measure overcomes another of the difficulties traditionally associated with estimating the wage returns to HE for women; that is, wages are only observed for those who are in work and hence selection into the labour market might bias results.[4] Net family income is defined for all individuals – both those in and out of work – and so it is not affected by this issue. We then decompose the net family income returns into the impact of HE on gross wages and labour supply, partnering decisions and partner income, and the effect of the tax and benefit system. When estimating the wage returns to HE, selection into the labour market becomes an issue. We address this by using a Heckman selection correction with the presence of children and a partner in the household and partner's income as instruments for working – following Gronau (1974) and Schultz (1990).

Our main results show that gaining a HE qualification increases women's net family income in adulthood by around 20% relative to leaving school at 18. We show that focusing simply on gross wages would miss an important part of this effect. Attending HE also increases the number of hours women work, further boosting their own gross earnings, and it also significantly increases the likelihood that a woman has a partner with a HE qualification. As a result, this partner is more likely to work and to have higher wages, and so the household's gross earnings are higher. However, households with higher gross earnings typically pay more in tax and receive less in benefits, due to the progressive tax and benefit system, and this acts to reduce the net

[4]In 1995, only 70% of women aged 25–50 were in work, compared to 85% of men (as measured by the UK Labour Force Survey).

return to HE.

We show that this return is stable across the life cycle; however, the mechanisms through which HE affects incomes change. At a younger age (i.e. 33/34), the most important mechanism is a woman's own earnings but by age 42 the impact on her partner's earnings is increasingly important. In fact, for the cohort born in 1958, at age 42 a woman achieving an HE qualification increases the level of a partner's earnings by a similar amount as it does her own earnings.

Although these two cohorts are separated by a period of expansion in the HE participation rate and female employment rate, we show that the overall net income return to HE for women is similar for both cohorts. The mechanisms for this return have changed, however. For the cohort of women born in 1958, we show that HE increases wages by around 40%, while for the cohort born 12 years later this falls to around 30%. However, this is compensated by a larger impact on employment rates, particularly full-time work. There is also evidence that the increased progressivity of the tax and benefit system does more to mitigate the returns to HE for the more recent cohort: at age 33/34, we estimate that having a HE qualification increases the net tax - taxes paid minus benefits received - paid per week by the earlier cohort by around £75, and this rises to £115 for the cohort born 12 years later.

The rest of the paper is set out as follows. In Section 2, we describe the data that we use in our analysis and we set out our methodology. In Section 3, we show and discuss our findings. We conclude in Section 4.

2 Data and methodology

We use data from two British cohort studies: the NCDS and the BCS. Both studies are longitudinal surveys, which track individuals from birth up to the present day. They contain detailed information on family background, education, economic circumstances and individual characteristics. In particular, both surveys contain very rich information on ability and family background that allows us to control for innate ability and family background, which is not possible in cross-sectional studies such as the Labour Force Survey (LFS).

The NCDS follows all 18,562 individuals born in England, Scotland and Wales in a single week in March 1958 throughout their lives. The individuals in the NCDS have been surveyed a

further nine times after birth, at ages 7, 11, 16, 23, 33, 42, 46, 50 and 55. The most recent wave took place in 2013.

The BCS follows the lives of the 17,196 individuals born in Britain between 5 and 11 April 1970. After birth, individuals were surveyed for a further eight times, at ages 5, 10, 16, 26, 30, 34, 38 and 42. The most recent survey took place in 2012.

For the purposes of this study, the birth surveys and the surveys at ages 7, 11 and 16 in the NCDS and at ages 5, 10 and 16 in the BCS are used to obtain controls on family background and ability. We use data on income and earnings from the follow-up surveys at ages 33/34 and 42.

The background characteristics that we use as controls are quintiles of equivalised parental income at age 16, the age at which the mother and father left education, the father's social class at age 11 (age 10 in the BCS), the mother's social class at age 16, the number of older and younger siblings, whether both natural parents were present in the household at age 11 (age 10 in the BCS), ethnicity, type of school at age 16 and region of domicile at age 16 (age 0 in the BCS). We control for ability by including a range of test scores. In the NCDS, these are quintiles of test scores at age 7 (maths, reading, drawing and copying) and age 11 (maths, reading and general ability). In the BCS, we include quintiles of test scores at age 5 (reading and general ability) and age 10 (maths, reading and general ability).

2.1 Sample selection

Instead of comparing those who obtained a HE qualification with all those who did not, we only use individuals who have obtained at least one A level or equivalent as a comparison group. This is in line with much of the previous literature (e.g. Blundell *et al.*, 2000). As A levels are essentially prerequisites in the UK for pursuing HE,[5] this selection of the sample brings us closer to estimating the returns to education for those who had the prospect of pursuing HE, and it reduces issues of common support resulting from comparisons with very different individuals. As such, our estimates represent the returns to acquiring HE qualifications over and above having at least one A level.

[5]In practice, a small number of individuals acquire HE qualifications without A levels, as noted in Blundell *et al.* (2000). However, this represents a small minority of the sample. Of those who have attended a HE institution in the NCDS, 7% of individuals have no A levels, and this is 13% for those in the BCS cohort.

Table 1: Highest qualification for women by age 33/34

	N	%
NCDS (1958)		
Below GCSE	1219	25.3
GCSE or equivalent	1875	38.9
A-level or equivalent	398	8.3
Higher education	1332	27.6
Total	4824	100.0
BCS (1970)		
Below GCSE	591	14.2
GCSE or equivalent	1697	40.7
A-level or equivalent	312	7.5
Higher education	1570	37.6
Total	4170	100.0

Table 1 shows the highest qualifications obtained at age 34 (33 for the BCS) by the 1958 and 1970 cohorts. The expansion in HE is clear between these two cohorts: 28% of women born in 1958 acquired a degree by age 34 while for those born 12 years later this had risen to 38%.[6] However, it is important to note that even our younger cohort turned 18 around 30 years ago, and the HE system has continued to change and expand in the intervening period. This time lag is always going to occur when analysing long-run impacts for individuals up to mid-40s.

Between the two cohorts, the proportion of individuals who have taken at least one A level (and so can be included in our sample) increased from 35% to 45%, and as a result both the control group and the treatment group have become less selective. In the NCDS, 90% of those whose highest qualification is at A level had above average scores in a maths tests at age 16. For the BCS cohort 12 years later, this had fallen to 80%. Similarly, the proportion of university graduates who were above average at age 16 in maths fell from 96% to 82%. It is important to consider that these compositional changes in the treatment and control groups over time might

[6]Following Dearden *et al.* (2004), we define HE as any National Vocation Qualification (NVQ) Level 4 qualification or higher, which includes university degrees, diplomas and foundation courses, nursing or teaching qualifications, Higher National Certificate (HNC), Higher National Diploma (HND), BTEC (Advanced) Professional award, City & Guilds (C&G) Insignia Award in Technology and C&G Full Technological Award.

drive some of the differences in our results across cohorts; however, this reflects the real trends of increased participation in non-compulsory education during this period.

The sample in our analysis is considerable smaller than the original cohort size due to attrition. There were around initially 9,000 women in each cohort; however, only around 4,000 of these are successfully followed to age 33/34. Our sample is further reduced by our selection criteria; around 65% and 55% of individuals in the NCDS and BCS cohorts, respectively, do not acquire A-level qualifications or equivalents and are therefore excluded from the analysis. Finally, item non-response on key control variables or outcome measures reduces the final analysis sample and, as shown in Table 2, we are left with around 1,000 women per cohort for each age.

Table 2: Descriptives of our sample

	Age 33	Age 42
NCDS (1958)		
Employed	0.76	0.84
Of which full-time	0.71	0.61
Of which part-time	0.29	0.39
Gross weekly earnings (£s)	391.67	463.76
Net family income (£s)	691.62	885.80
Lives with partner	0.76	0.79
Has kids	0.59	0.75
Observations	874	1020
BCS (1970)		
Employed	0.81	0.86
Of which full-time	0.76	0.66
Of which part-time	0.24	0.34
Gross weekly earnings (£s)	548.47	605.91
Net family income (£s)	908.27	1066.38
Lives with partner	0.72	0.76
Has kids	0.54	0.68
Observations	1038	1101

Notes: Employment includes self-employed individuals. The part-time and full-time distinction is only defined for employees (not self-employed individuals) for whom we have data on hours worked.

Summary statistics for the women in our sample (women having obtained at least one A level) are presented in Table 2.[7] We see that employment rates increase has women age and increase between the two cohorts, reflecting women's increased attachment to the labour market over timed 42 in 2000. In both cohorts, the proportion of employed women who work full-time decline as they age, potentially a result of being more likely to have children. The percentage of married or cohabiting women and the proportion with children are lower in the BCS, which is in line with the existing literature that has shown that fertility rates are falling as women are

[7]Descriptives for all women are shown in Table A1 in the Appendix.

marrying and having children later in life.

2.2 Analytical framework

The objective of this paper is to estimate the impact of HE on the net family incomes of female graduates, as we consider net income to be a good proxy for current living standards (following Cribb *et al.*, 2018).[8] Furthermore, we aim to identify the channels through which HE affects the net income of women. To do this, we set up an analytical framework where net family income is decomposed into various components. This is given by

$$\begin{aligned} NetIncome_i &= W_i * Hr_i + P_i * (W_i^p * Hr_i^p) + OtherInc_i - Tax_i + Ben_i, \qquad (1) \\ NetIncome_i &= OwnGrossEarn_i + PartGrossEarn_i + OtherInc_i \\ &\quad -Tax_i(OwnGrossEarn_i, PartGrossEarn_i) \\ &\quad +Ben_i(OwnGrossEarn_i, PartGrossEarn_i), \end{aligned}$$

where $NetIncome_i$ is the net family income of individual i, W_i is her wage rate and Hr_i is the number of hours she works. P_i is an indicator equal to one if individual i has a cohabiting partner, W_i^p is the partner's wage rate and Hr_i is the number of hours the partner works. Both $OwnGrossEarn_i$ and $PartGrossEarn_i$ include earnings from employment and self-employment. $OtherInc_i$ is income from other sources, such as investment income. This makes up a very small proportion of income for most households, so we do not study this in detail. Tax_i and Ben_i are the direct taxes and state benefits, respectively, that the household is liable for.

The potential impact of HE on the productivity, and hence wages, of (male) workers is discussed extensively in the existing literature (e.g. Chevalier *et al.*, 2004; Walker and Zhu, 2003). HE can affect female labour supply through either higher demand for skilled labour or increased labour supply, because of the higher wage rate that educated women may attract. This impact is exactly the issue of selection into the labour market that has affected previous estimates of female returns to education.

Further, attending HE can affect the level of partner earnings in the family through assor-

[8] We recognise that income is an imperfect measure of living standards. As work by Brewer *et al.* (2017) shows, it might be preferable to use consumption to measure living standards, particularly for individuals on low incomes. However, consumption is difficult to measure and income acts as a good proxy for our context.

tative mating. There is an extensive body of literature showing that people are more likely to partner with somebody who has a similar level of education (Pencavel, 1998; Gustafsson and Worku, 2005; Ermisch *et al.*, 2006; Raaum *et al.*, 2007). In theory, assortative mating could affect the income returns to HE if educated women are more likely to have a partner or more likely to have a partner who works more or has a higher wage, as might be the case if they are more highly educated.

Finally, having a HE qualification can affect the level of taxes a family pays and the benefits they receive. This mechanism works through the progressive nature of the tax and benefit system, which means that both taxes and benefits are a function of the earnings and employment status of the household. Much of the existing literature on returns to education focuses on gross hourly wages, which might be an appropriate metric for measuring the productivity impact of HE; however, when considering the impact on graduates' living standards, it is net measures of income that are more relevant. In doing so, we highlight the role of a progressive tax system in reducing the returns to HE.

We aim to estimate the casual impact of obtaining a HE qualification on these various outcomes, y_{it}. In doing so, we encounter a number of identification problems.

First, we have to deal with endogenous selection into HE. If pursuing or completing HE is correlated with an unobserved characteristic that also influences one of our outcome variables, this will bias our results. Following Blundell *et al.* (2000, 2005) and Bratti *et al.* (2008), we deal with endogenous selection into HE in two ways. First, we restrict our sample to include only those who obtain at least one A level or equivalent. The A-level examinations are essentially a prerequisite to HE, so by focusing on this subsample, we are studying individuals who at least had the prospect of pursuing HE, thereby improving common support.

Second, we use the rich array of background characteristics available in the cohort studies to control for the differences between those who pursue HE and those who do not. In both cohorts, we control for family background (ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood, the type of school the child attended at age 16) and ability (quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS; quintiles on reading, drawing and copying tests at

age 5 and on maths, reading and general ability tests at age 10 in the BCS).

Our estimating equation can be written as

$$y_{it} = \beta HE_i + \theta \boldsymbol{X}_i + \epsilon_{it}, \tag{2}$$

where $\boldsymbol{X}_i$ is a vector of exogenous observed characteristics and HE is a binary treatment variable $HE \in \{0, 1\}$, with $HE = 1$ when an individual has a HE qualification. Our parameter of interest is β, which is the effect of achieving HE on our outcome variable y_{it}.

Estimating equation (1) through ordinary least squares (OLS) yields unbiased estimates β, the average treatment effect (ATE), if conditioning on $\boldsymbol{X}_i$ is sufficient to control for the endogenous choice of the education level. Blundell *et al.* (2000) scrutinise this identification strategy in detail, comparing it to matching, instrumental variables and control function estimates. They find little difference between the methodologies and conclude that the rich array of background characteristics available in the British cohort studies adequately control for the selection into HE.

A further identification problem in estimating the returns to education for women is the issue of selection into the labour market. Unlike educated men who typically have very high employment rates in their 30s and 40s, many women opt out of the labour market. This selection into employment is likely to be endogenous with respect to many outcomes of interest, including earnings and partnership status. This is often cited as a reason for not focusing on women in the existing literature (e.g. Blundell *et al.*, 2005). We deal with this problem by mostly focusing on outcome measures that are defined for all women, such as level of net income or gross earnings (including zeros for individuals out of work), rather than just for employed women. This enables us to use the full sample in our estimation, hence circumventing the selection issues. A similar issue might arise when considering selection into marriage; to avoid this concern, we focus on a measure of partner earnings that includes zeros for those without working partners. This inclusion of zeros to negate selection issues is one of the reasons our analysis is predominantly conducted in levels rather than log-linear specification, as is common in the literature. In order to make our estimates in levels comparable, all earnings and income measures have been put

into 2017 prices.[9] Where possible, we have estimated log-linear specifications and we find that our alternative functional form assumption does not significantly affect the results

However, in order to isolate the channels through which HE affects net income, we are also interested in how HE affects women's gross wages separately from labour supply. To do this, we follow Heckman (1979) and Lee (1983) and we control for the selection into the labour market using a control function approach. We estimate a probit model of selection into work. We account for the covariates listed in the wage equation above, as well as the presence of children in the household, the number of children under 5, whether she has a partner and the work status and income of the partner, which we assume affect women's decisions to enter the labour market but are unrelated to their wages (Gronau, 1974; Schultz, 1990). We then include the inverse Mills ratio obtained from the selection equation into the wage equation, which – if we have modelled selection into work correctly – corrects for women's selection into employment. This approach assumes that our excluded instruments (i.e. the presence of children and a partner) affect the decision to work but not the wage rate. This a strong assumption. Having children might affect the wage rate directly, particularly if mothers are only able to work part-time, which might attract lower wages. Thus, these results should only be taken as indicative of the wage returns to HE. They are not, however, the main focus of this paper. These issues are addressed explicitly in the work of Blundell *et al.* (2016).

3 Results

We begin by estimating the impact of women pursuing HE on the net family income that women have at two different in ages in adulthood (ages 33/34 and 42). We do this for each of the two cohorts described above, born in 1958 and 1970, respectively. We define net family income as the labour market earnings of the female cohort member plus the earnings of any cohabiting partner, deducting direct taxes paid and including state benefits and other income received. This measure of net family income gives the level of resources available to the family and so is a good proxy for the standard of living of those in the family – a similar measure is used by Cribb *et al.* (2018) to measure living standards.

[9] Prices have been deflated using CPI.

Table 3: Impact of HE on net family income per week (2017 prices)

	Age 33/34		Age 42	
	Net family income	Log net family income	Net family income	Log net family income
NCDS (1958)				
Any HE	112.75***	0.19***	170.38***	0.22***
	(29.69)	(0.05)	(39.80)	(0.05)
N	874	874	1020	1020
BCS (1970)				
Any HE	123.46***	0.16***	183.18***	0.23***
	(42.15)	(0.06)	(49.02)	(0.05)
N	1038	1038	1101	1101

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an OLS regression of weekly net family income (in 2017 prices) and log net family income on having completed any HE for women who have obtained at least one A level. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS.

Table 3 shows our estimates of the impact of HE on net family income, controlling for a detailed array of background variables that might influence the selection into HE, as discussed in the previous section. We find that HE increased the weekly family income of women born in 1958 by £110 at age 33 and by £160 at age 42. For the cohort born 12 years later, we find very similar results: HE increased income at age 34 by £120 and at age 42 by £180. This translates into around a 20% increase in family income at each age for both cohorts.

In the remainder of the paper, we explore the channels for how HE affects women's family income, looking at how these channels vary over the life cycle and between the different birth cohorts.

3.1 Labour market returns

First, we investigate the impact of HE on women's own labour market earnings. As discussed above, this can be driven by an impact either on women's wages or their labour supply. We begin by showing the overall impact of pursuing HE on women's total gross earnings including earnings from self-employment. These estimates include zero earnings for women not in work and incorporate both the labour supply and the wage effects of pursuing HE. As shown in Table 4, we see that pursuing HE has a large positive and significant effect in gross earnings at age 33 and 42 for both cohorts; but we find that this effect has increased by around 50% between the cohorts born 12 years apart.[10]

Table 4: Impact of HE on weekly gross labour market earnings (2017 prices)

	Age 33/34	Age 42
NCDS (1958)		
Any HE	133.30***	110.32***
	(23.72)	(31.00)
N	874	1020
BCS (1970)		
Any HE	205.36***	152.24***
	(38.59)	(39.33)
N	1038	1101

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an OLS regression of weekly gross labour market earnings including earnings from self-employment (in 2017 prices) on having completed any HE for women who have obtained at least one A level. Controls for family background are ethnicity, region of birth, age parents left education, social class of parents' work, number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS.

We also find that in both cohorts the returns are higher earlier in women's careers. This

[10]To allow comparison with the prior literature, which often shows results in logs, these results are also shown for log gross earnings in the Appendix, in Table A3 for women and Table A4 for men. The increase in returns between the cohorts is not present in the log specifications largely because, as discussed below, this appears to be driven by a labour supply effect not picked up by log specifications in which out-of-work individuals are excluded due to zero earnings.

has important implications for studies measuring the returns to education at specific ages (i.e. focusing on an age in the early 30s might overstate the lifetime earnings returns for women). In the following, we break down this impact on gross earnings into the effect on labour supply and wages.[11]

Table 5 explores the labour supply impact, showing the average marginal effect of HE on the probability of being in work, and being in full-time (FT) work, estimated from a probit model – controlling for the same covariates discussed above.[12] We find that having a HE qualification significantly increases the probability that a women is in work at age 33/34 by around 8% in both cohorts. HE also increases the probability of working full-time particularly for the 1970 cohort. There is no significant effect, however, on the labour supply at age 42. In Table A5 in the Appendix, we explore one of the possible explanations for this differential effect across the life cycle. We show that HE reduces the probability that a woman has children by age 34 by around 4%–8% (this effect is insignificant in the NCDS), but there is no impact on the propensity to have had children by their early 40s.[13] This provides some evidence that pursuing HE causes women to delay child-rearing to later in life and, as is discussed extensively in the literature (e.g. Bloom *et al.*, 2009), women often leave work, or start working fewer hours, after having children.

[11] Wages are only defined for those in employment so those out-of-work and in self-employment are excluded from this analysis

[12] Being in work, includes self-employed individuals. However, full-time work is only defined for those out of work or with data on hours worked (which excludes self-employed individuals)

[13] This is perhaps surprising, given the large raw differences in fertility we see between those who pursue HE and those who do not. This implies that the large raw differences in fertility between the two groups are likely to be caused by factors correlated with HE, such as family background.

Table 5: Impact of HE on employment

	Age 33/34		Age 42	
	In work	In FT work	In work	In FT work
NCDS (1958)				
Any HE	0.079**	0.019	0.013	-0.027
	(0.032)	(0.039)	(0.026)	(0.039)
N	871	658	1017	841
BCS (1970)				
Any HE	0.081***	0.054	0.034	-0.016
	(0.029)	(0.038)	(0.025)	(0.037)
N	1037	770	1076	952

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the average marginal effects on having completed any HE from a probit of being in employment (including self-employment) and in full-time work. The sample includes women who have obtained at least one A level. Sample sizes are smaller than before due to individuals being dropped when certain variables perfectly predict the outcome. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS. The sample size decreases in the FT specifications as information on hours is missing for some individuals. Sample sizes vary due to the perfect fit of some individuals in the probit specification.

The second way in which the pursuit of HE can affect female earnings is through a direct impact on wages. However, as discussed, the estimation of the impact on hourly wages using simple regression techniques might be biased, as hourly wages are only observed for women who are in work, which is a selected sample of the population. Instead, we employ a Heckman selection model to control for the selection into the labour market, as set out in Section 2.

Table 6 shows the results using OLS and this selection model. We find that having a HE qualification increases women's wages in both cohorts, but the effect is smaller in the recent cohort. HE increases women's wages by around 40% for the 1958 cohort and by around 30% for the 1970 cohort. In both cohorts, this effect is stable across the life cycle.

While the presence of children and partner earnings are strongly significant in the first stage,

the coefficient on the inverse Mills ratio is only significant for age 42 in the BCS. This suggests that there is little selection in the labour market based on the controls included in our Heckman selection model. Indeed, we see a very small difference in the coefficient between the OLS and the Heckman specifications. This is supported by the fact that our estimates are similar to those found in the existing literature (Dearden, 1999; Harkness and Machin, 1999; Walker and Zhu, 2001; Dearden *et al.*, 2004; Bratti *et al.*, 2008).

Table 6: Impact of HE on hourly wage

	Age 33/34	Age 42
NCDS (1958) - OLS		
Any HE	0.345***	0.329***
	(0.0410)	(0.0484)
NCDS (1958) - Heckman		
Any HE	0.332***	0.331***
	(0.0411)	(0.0468)
N	874	988
BCS (1970) - OLS		
Any HE	0.216***	0.242***
	(0.0496)	(0.0494)
BCS (1970) - Heckman		
Any HE	0.218***	0.250***
	(0.0490)	(0.0484)
N	1038	1101

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an OLS regression of log hourly wages (in 2017 prices) on having completed any HE for women who have obtained at least one A level. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS. Estimates are corrected using the Heckman selection model. The selection equation includes the above controls and the presence of children, the number of children under 5, the presence of a partner and the work status and earnings of the partner.

The larger impact of HE on women's gross earnings in the more recent cohort appears to be driven by slight larger employment effects (and impacts on FT work) more than off-setting diminished wage returns. It could also be the labour supply effects have larger consequences in the more recent cohort as female wages have risen across the board, or due to increased productivity of self-employment which is not captured here. The result of larger impacts earlier in women's careers is clearly driven by the greater labour supply effects at these ages.

3.2 Marriage market returns

The second channel through which HE can affect a woman's net family income is through the earnings of a partner living in the household. In this section, we look at how HE affects whether a woman has a partner, who a woman's partner is, and what this means for their household income and standard of living. Many studies have found significant evidence of assortative mating – that is, more highly educated women are more likely to have a partner who is also highly educated (Pencavel, 1998; Gustafsson and Worku, 2005; Ermisch *et al.*, 2006; Raaum *et al.*, 2007). Therefore, given that we know highly educated men (and women) are likely to have higher earnings, we might expect that HE has a causal impact on the earnings of a woman's partner.

Table 7 shows the impact of a woman pursuing HE on the future earnings of her partner. This includes zero earnings if there is no partner in the household or if the partner is unemployed. For both cohorts, we see a positive effect of HE on partner earnings and that this increases later in women's lives - the opposite trend to women's own earnings. For both cohorts, HE increases partner earnings by around £100 per week (2017 prices) at age 42. For women born in 1958 this is a similar magnitude to the impact of HE on their own earnings. This highlights the importance of partner earnings for the overall returns to HE.

Table 7: Impact of HE on partner earnings per week (2017 prices)

	Age 33/34	Age 42
NCDS (1958)		
Any HE	65.30*	112.91**
	(37.23)	(45.81)
N	874	1020
BCS (1970)		
Any HE	41.29	100.53**
	(36.40)	(48.75)
N	1038	1101

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an OLS regression of weekly partner's gross labour market earnings including earnings from self-employment (in 2017 prices) on having completed any HE for women who have obtained at least one A level. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS.

There are a number of factors that might be driving the impact of HE on the earnings of a woman's partner. HE could increase the probability of having a partner, increase the probability of having a partner who is in work or increase the prospective earnings of any partner. Table 8 explores these effects in more detail.

In line with the existing literature, we find significant evidence that HE increases the probability of having a partner with a HE qualification in both ages and cohorts. To the extent that highly educated men have higher wages than less educated men, we would expect this to feed through to an impact on partner earnings. At age 42, having a HE qualification also increases the probability of having a partner (albeit this is only marginally significant) and having a partner who is in work. This effect on partner labour supply is likely to explain the bigger impact of HE at older ages, as shown in Table 7.

Table 8: Impact of HE on partnering

	Age 33/34			Age 42		
	Has partner	Partner in work	Partner with HE	Has partner	Partner in work	Partner with HE
NCDS (1958)						
Any	-0.017	0.001	0.195***	0.054*	0.089**	0.242***
HE	(0.033)	(0.035)	(0.036)	(0.028)	(0.035)	(0.033)
N	874	874	874	1017	1020	1017
BCS (1970)						
Any HE	-0.013	0.009	0.214***	0.049	0.079**	0.204***
	(0.034)	(0.036)	(0.037)	(0.030)	(0.031)	(0.035)
N	1037	1037	1032	1101	1101	1101

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the average marginal effects on having completed any HE from a probit of having a partner, partner being employed (including self-employment) and having a partner with a HE qualification. The sample includes women who have obtained at least one A level. Sample sizes can be smaller than before due to individuals being dropped when certain variables perfectly predict the outcome. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS.

3.3 Impact of taxes and benefits

Finally, we consider the role of the tax and benefit system. Table 9 shows the impact on HE of the amount of direct taxes paid by the woman's family and the amount of state benefits received.

Acquiring an HE qualification increases women's household income, and as a result of the progressive tax system in place in Britain this has direct impact on their tax liability. We show that acquiring an HE qualification has a positive and significant impact of tax liability at both ages and in both birth cohorts.

The impact on benefit income is less straightforward, however. Given that having a HE qualification increases the likelihood that women are in work and increases the earnings of the household, we would expect HE to reduce the level of benefit income received. However, as shown in Table 1, the women in our comparison group (those with at least one A level) also have high employment rates. As a result, even the sample who did not pursue HE will receive

relatively little out-of-work benefit income. Instead, the primary source of benefit income for this sample is in-work benefits, such as Child Tax Credit and Working Tax Credit (or Working Family Tax Credit as it was called in 1999), which are largest for women who have low wages and have children. However, in-work benefits were much less generous and were claimed by far fewer people in the early 1990s (when the 1958 cohort was aged 33) and these benefits were rapidly expanded between 1999 and 2003 (Dilnot and McCrae, 1999).

As a result, we find that in the early cohort – when there were smaller in-work benefits and there was less of an effect of HE on fertility (as shown in Table A5 in the Appendix) – pursuing HE had little impact on the level of benefits received. However, in the cohort born in 1970 (i.e. with larger in-work benefits), we do find a significant negative impact of HE on benefit income.

The overall result is that when we take into account the tax and benefit system, the estimates of the returns to education are reduced because highly educated women have higher household earnings and so pay more tax and receive less in benefit income. This effect became stronger between these cohorts, in part likely because of the expansion of in-work benefits.

Table 9: Impact of HE on taxes and benefits per week (2017 price)

	Age 33/34		Age 42	
	Taxes	Benefits	Taxes	Benefits
NCDS (1958)				
Any HE	71.11***	-3.22	62.67***	1.05
	(17.49)	(2.72)	(17.63)	(4.78)
N	874	874	1020	1020
BCS (1970)				
Any HE	82.30***	-34.03***	66.90*	-13.11**
	(16.82)	(10.81)	(38.90)	(5.16)
N	1038	1038	1101	1101

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an OLS regression of weekly taxes paid and benefits received (in 2017 prices) on having completed any HE for women who have obtained at least one A level. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS.

4 Conclusion

Across the globe, women are participating in HE in ever increasing numbers. There have been attempts to explain these trends by describing the costs and benefits of pursuing HE (e.g. Becker *et al.*, 2010). However, defining the value of these costs and benefit remains an open issue. In this context, by focusing on the wage and earnings returns, we can miss many of the important effects of HE. In this paper, we shed new light on the issue by considering multiple impacts of HE on women's outcomes in later life in a unified framework, and we translate these into an impact on net family incomes, a widely used proxy for living standards.

We show that the benefits of HE are not confined to boosting the productivity and wages of

graduates. HE also significantly increases the probability a women is in work and the number of hours they work, further boosting labour market returns. HE also increases the probability of a woman having a partner who also has a HE qualification, and therefore the partner is typically more likely to work and earn more. However, focusing on gross earnings returns overstates the private benefits of HE, as higher-earning graduates pay more in tax and receive fewer benefits. By incorporating all of these factors, we present a much more complete picture of the role HE can play.

The returns to HE can also vary over the life cycle. We show that while HE increases net family income by around 20% for women in their early 30s and early 40s, the mechanisms change over time. For women in their early 30s, the impact of HE on income primarily comes through their own labour market earnings, but by age 40 the importance of the impact on partners' earnings has increased, likely because at this age women have an increased propensity to work part-time. It appears that, by increasing the average education level of partners, HE provides some insurance for women taking time out of the labour market after having children.

By comparing two different cohorts of women, we are also in a unique position to explore how these effects have changed over time. We find that the impact of HE on women's wages declines slightly between those born in 1958 and 1970, but this is more than compensated by an increased in the impact on labour supply. The role of partners' earnings remains an important channel of returns, particularly at older ages. Finally, the tax and benefit system has become more progressive, acting to reduce the net returns to HE.

An understanding of the wider impacts of HE on women's net incomes is vital in order to understand the drivers of women's decisions to pursue HE. We have shown that focusing solely on wage returns misses the important effect of HE on working hours, partnering and tax liabilities, and we have shown that these mechanisms vary in importance over women's life cycles and have changed over time. Further research is required to understand why these mechanisms have changed and what is likely to happen to the cohorts currently entering or considering Higher Education.

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Appendix

Table A1: Descriptives of all women

	Age 33	Age 42
NCDS (1958)		
Employed	0.69	0.79
Of which full-time	0.55	0.56
Of which part-time	0.45	0.43
Gross weekly earnings (£s)	365.71	289.10
Net family income (£s)	466.72	652.06
Lives with partner	0.82	0.81
Has kids	0.77	0.79
Observations	5055	5793
BCS (1970)		
Employed	0.74	0.78
Of which full-time	0.62	0.57
Of which part-time	0.38	0.43
Gross weekly earnings (£s)	445.92	366.68
Net family income (£s)	855.63	976.22
Lives with partner	0.76	0.70
Has kids	0.70	0.71
Observations	4249	5194

Notes: Employment includes self-employed individuals. The part-time and full-time distinction is only defined for employees (not self-employed individuals) for whom we have data on hours worked.

Table A2: Descriptives of men in our data - same criteria for selection

	Age 33	Age 42
NCDS (1958)		
Employed	0.97	0.97
Of which full-time	0.98	0.97
Of which part-time	0.02	0.03
Gross weekly earnings (£s)	655.95	998.39
Net family income (£s)	626.70	989.69
Lives with partner	0.76	0.83
Has kids	0.54	0.73
Observations	980	1018
BCS (1970)		
Employed	0.95	0.95
Of which full-time	0.99	0.97
Of which part-time	0.01	0.03
Gross weekly earnings (£s)	940.80	1123.40
Net family income (£s)	959.64	1145.22
Lives with partner	0.73	0.78
Has kids	0.44	0.62
Observations	868	964

Notes: Employment includes self-employed individuals. The part-time and full-time distinction is only defined for employees (not self-employed individuals) for whom we have data on hours worked.

Table A3: Impact of HE on log gross labour market earnings

	Age 33/34	Age 42
NCDS (1958)		
Any HE	0.345***	0.289***
	(0.0738)	(0.0664)
N	809	842
BCS (1970)		
Any HE	0.356***	0.203***
	(0.0664)	(0.0620)
N	836	951

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an OLS regression of weekly log earned income including income from self-employment (in 2017 prices) on having completed any HE for women who have obtained at least one A level. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS. Those with very low self-employment income (below £10 a week) are excluded from this specification to avoid over sensitivity to these individuals.

Table A4: Impact of HE on log weekly gross labour market earnings and log net income – men

	Age 33/34		Age 42	
	Gross earnings	Net family income	Gross earnings	Net family income
NCDS (1958)				
Any HE	0.145***	0.167***	0.134**	0.209***
	(0.041)	(0.058)	(0.053)	(0.052)
N	854	980	822	1018
BCS (1970)				
Any HE	0.264***	0.209***	0.290***	0.297***
	(0.049)	(0.063)	(0.051)	(0.057)
N	750	868	772	964

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an OLS regressions of log weekly gross earned income including self-employment and log net income (in 2017 prices) on having completed any HE for men who have obtained at least one A level. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS.

Table A5: Impact of HE on having children

	Age 33/34	Age 42
NCDS (1958)		
Any HE	-0.032	0.017
	(0.037)	(0.031)
N	874	1020
BCS (1970)		
Any HE	-0.076**	-0.034
	(0.038)	(0.034)
N	1037	1101

Notes: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$. Standard errors are given in parentheses. The results shown are the coefficient on having completed any HE from an probit regression of an indicator for having children (in 2017 prices) on having completed any HE for women who have obtained at least one A level. Controls for family background are ethnicity, region of birth, the age parents left education, the social class of parents' work, the number of younger and older siblings, whether both natural parents were present in childhood and the type of school the child attended age 16. Controls for ability are quintiles on drawing, copying, reading and maths tests at age 7 and on maths, reading and general ability tests at age 11 in the NCDS and quintiles on reading, drawing and copying tests at age 5 and on maths, reading and general ability tests at age 10 in the BCS.