A happiness test of human capital theory

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Abstract: This paper tests whether there are wider considerations for undertaking than just income enhancements and improved working conditions. Hence, the investigation here is to ascertain whether there is a happiness premium to education over and above any human capital benefits? A novel feature of the paper is the extended methodological discussion which results from the finding of omitted dynamics. This complicates the analysis, and means that standard FE methods are not wholly appropriate. The discussion details the options available, and offers advice for happiness research where there are omitted dynamics. The empirical results are broadly supportive of human capital theory, and suggest a substantial 'structural break' regarding gender.

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A HAPPINESS TEST OF HUMAN CAPITAL THEORY

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1 Introduction

"Happiness and education are, properly, intimately connected. Happiness should be an aim of education, and a good education should contribute significantly to personal and collective happiness" (Noddings 2003, p.1).

This paper presents an empirical investigation into the impact of education on happiness or life satisfaction: an important subject for a systematic assessment of the happiness of young people. It builds on the dominant human capital theory and considers happiness as a broad measurable indicator of the concept of utility. As such, the analysis supports the claims of experts in the field, for example Van Praag and Ferrer-i-Carbonell (2007), that utility, when defined as satisfaction is adequately measurable, useful for economic analysis and enriches the discipline's methodology. One way this can be done is via using self-reported 'happiness' data to test conventional economic theories and this is done here with a test of human capital theory. Thus, this study is a systematic assessment is developed of the utility (as life satisfaction) of young people in the UK through the prism of education. *Prima facie,* education appears an especially relevant area for an investigation into the happiness of young people in the UK, particularly if young people have been increasing their investments in education (which, as the next subsection indicates, they have been over the past two decades (the span of the dataset used here)). Whether there are wider benefits to education than just its impact on income is, in essence, the happiness test of the human capital theory.

The major issue for this study is an empirical investigation of the impact of education on happiness. However, in the literature the relationship is also analysed in another way: what do individuals need to be taught in order to be happy? This latter issue is discussed very briefly here as part of the introduction to the main focus of this paper. In the opening quote the key word is 'should', and one of the central arguments of Noddings (2003) is that the way the current curricula is set up does not promote happiness, and may even contribute to unhappiness. That education should involve itself with happiness is not a recent belief: Watson (1930), for example, also put forward the notion that an aim of education should be to increase the happiness of the students. Within economics, Layard (2005) makes frequent arguments regarding the role education can play in helping people to both achieve happiness directly and increase their capacity for happiness. For example, he asserts that "happiness depends on your inner life as much as on your outer circumstances. Through education and practice, it is possible to improve your inner life – to accept yourself better and to feel more for others" (p.230). He frequently mentions the need for a 'moral education' throughout his *Happiness* book, and provides a list of things that he asserts would provide 'education of the spirit':

> Understanding and managing your feelings (including anger and rivalry); loving and serving others (including practical exercises and learning about role models); the appreciation of beauty; causes and cures of illness, including mental illness, drugs and alcohol; love, family and parenting; work and money; understanding the media and preserving your own values; understanding others and how to socialise; political participation; philosophical and religious ideas (p.201-2).

Clearly Layard is not talking about education as it currently exists, but a dedicated 'happiness' education programme, and as such this contrasts with the dominant human capital approach where education is typically viewed exclusively as an investment in future labour market earnings, better working conditions and a more fulfilling job.

Adam Smith, in the first chapter of Book 2 of *The Wealth of Nations,* discussed human capital, recognising its positive externalities for society and how it 'can be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which, though it costs a certain expense, repays the expense with a profit." (p.335, 1778 [1776]). Human Capital theory was popularised by the "Chicago School", particularly Gary Becker (1964). Its basic postulate is that education or training raises the productivity of workers through increased knowledge and skills, and this raises workers' future lifetime earning with the causation being explicitly through higher productivity.

Many subsequent studies, some making use of a Mincer (1974) equation have investigated the rate of return from education and/or training, and "rates of return are used to explain the behaviour of individuals in seeking different levels and types of education" (Psacharopoulos and Patrinos 2004, p.3).

Adnett and Davies (2002) succinctly summarise:

> Orthodox economics emphasises investment benefits that reflect the impact of schooling on future productivity and therefore on wages. Specifically the dominant human capital approach claims a causal link between absolute, rather than relative, investments in schooling and earning power through the influence of knowledge and skills on productivity (p.197).

There are competing theories to Human Capital theory, where investments in education and training improve productivity and therefore income. Spence (1973) asserts that education acts as a signalling device, informing employers about an individual's potential productivity. Thurow (1975) argues that productivity is job specific rather than employee specific, and education may represent an indication on the amount of training, a business cost, that is needed. A more recent debate about Human Capital theory has its roots in these competing hypotheses, with Goldin and Katz's (2008) book *The Race Between Education and*

Technology assessing the demand and supply impact of human capital investments on economic growth over the twentieth century in the USA. A review of this book suggests a stronger role for human capital for economic growth than that argued for by Goldin and Katz (Acemoglu and Autor, 2012).

Elsewhere, arguments are made that human capital theory is incomplete in assessing the benefits of education. For example Belfield (2000) asserts that:

> Human capital returns are typically addressed in terms of earnings, yet added to that there should be consideration of the social and external benefits of education: if these are substantial, as well as education having a consumption value, many individuals may be undertaking education without their needing it to fully augment their human capital. (p.26)

This echoes a consideration in the economics happiness literature, which may be a motto for the claims of a revolution in economics of the happiness studies: "that economists… are used to thinking, possibly incorrectly, of pecuniary factors as providing most of life's well-being" (Blanchflower and Oswald 2004, p.1373). The argument made in this investigation is that education is an area ripe for testing whether there are wider considerations than just income enhancements and improved working conditions, and the work of the remaining sections of this paper are dedicated to just that. Is there a happiness premium to education over and above any human capital benefits?

Human capital theory precludes wider utility benefits to education, such as: less risky and stimulating employment (although this is sometimes incorporated into the theory if not the empirical analysis associated with human capital theory); improved ability to contribute to, and participate in, socio-political processes; enhanced ability to appreciate cultural goods;

increased longevity and other health benefits; subjective well-being; and ‘eudaimonia’.[3] The latter is an Aristotelian concept of happiness which literally means ‘good spirit’ and in the psychology literature means human flourishing. In practice, we use responses to the life satisfaction question to encompass all of these benefits. Within psychology, where the semantics of happiness is sometimes discussed, this is perhaps somewhat controversial, but this study will follow the more all-encompassing notion of happiness as utility found within the ‘economics of happiness’ area.[4] That these wider benefits may exist is a possibility recently stated in a brief review which acknowledged that “the return to education may be much wider than the private financial returns that is the focus of so much of the economics literature” (Dickson and Harmon 2011, p.1119).

This paper is organised as follows. Section 1.1 provides contextual information. The following section, 2, critically assesses the literature that links education and happiness. Section 3 discusses the data, the methodological issues and empirical strategy for the happiness tests of human capital theory. Section 4 displays and discusses the results, while section 5 concludes. Further methodological discussion follows the conclusion, in a small subsection.

1.1 Context of the analysis

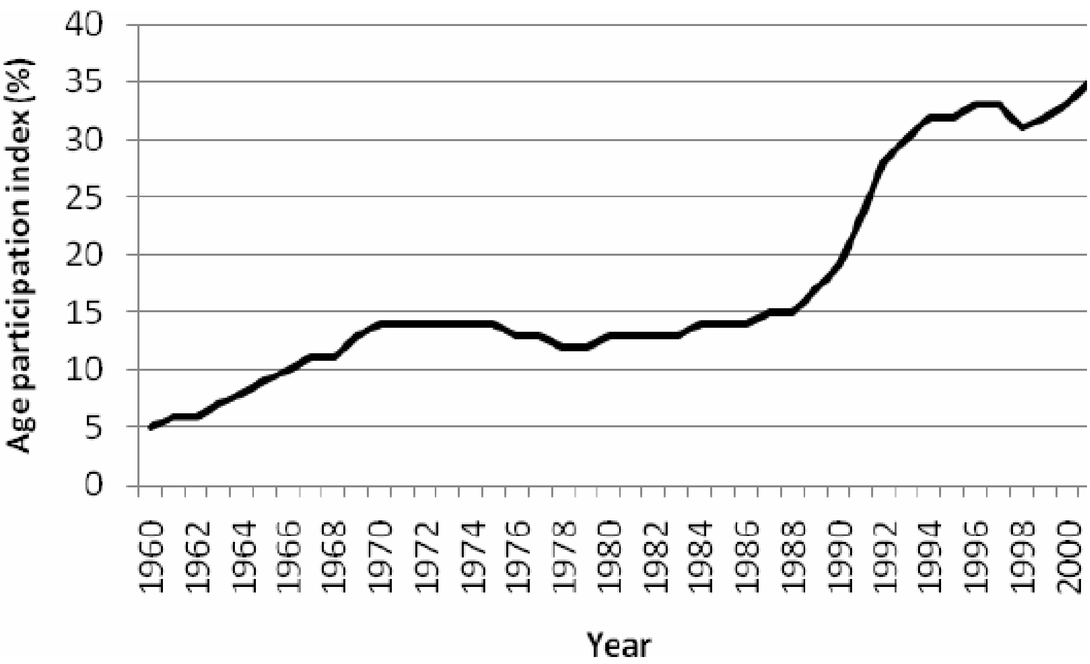
The context of the investigation is one of increasing participation in Higher Education, a highly relevant category of education for the age group under investigation in this analysis, in the UK. An increase that has prevailed since, at least, Wilson’s “White Heat” of the 1960s, with subsequent remarkable changes in participation as the following figure demonstrates.

[3]The references for such assertions come from Noddings (2003), Layard (2005) and other studies referenced throughout the chapter.

[4] Though see Clark and Senik (2011) for a recent discussion within economics about whether happiness is the same as flourishing, where similarities between both concepts are found.

The age participation index is a composite measure based on the number of UK-domiciled young entrants to full-time and sandwich undergraduate courses of higher education in Great Britain, expressed as a proportion of the averaged Great Britain 18 to 19 year old population. The chart, Figure 1 ends in the year 2000, and subsequent figures for participation are presented below.

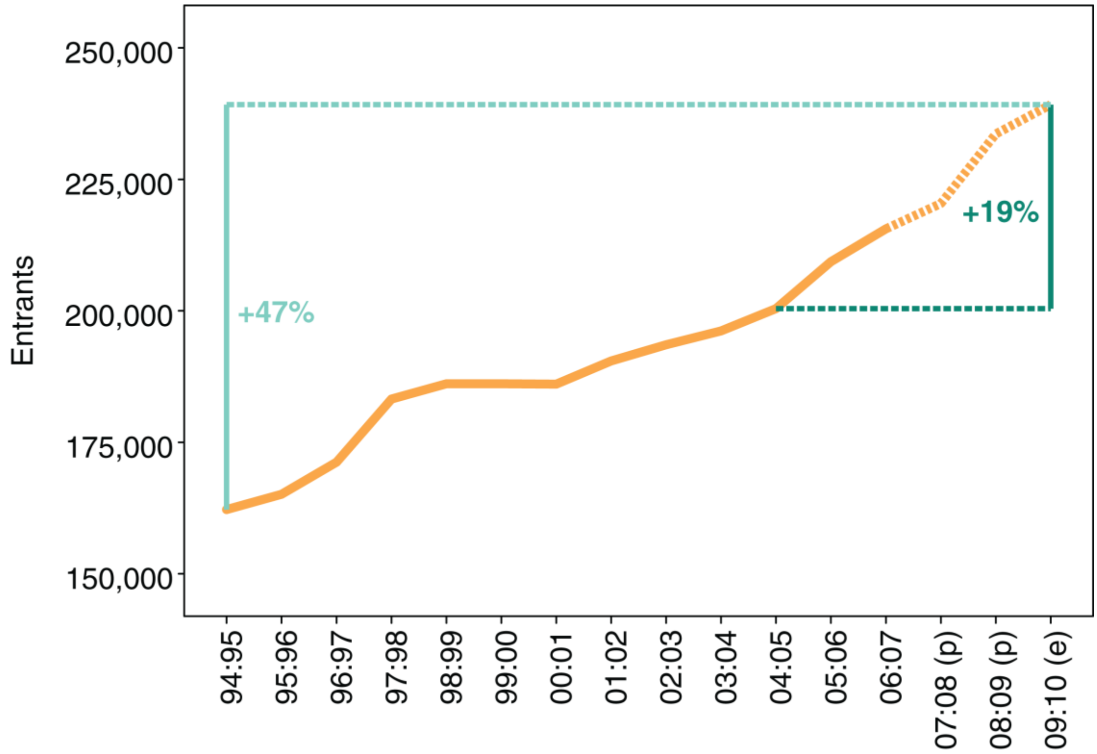
<u>Figure 1 Trends in Higher Education Participation, Great Britain.</u>



(Source: Chowdry et al. 2010).

Osborne et al. (2006) explain that, since the Dearing Report (1997), participation in higher education has been measured in different ways within the countries of the UK. However, the general pattern presented here for England is indicative of the pattern for the UK as a whole. And in England, “the number of young entrants to higher education… has risen by 77,000 (+ 47 per cent) from 162,000 (94:95 cohort) to 239,000 (09:10 cohort, [with this last year being the only one] estimated)" (HEFCE, 2010, p.14). The chart accompanying these figures from the HEFCE report is reproduced in figure 2. The horizontal axis represents academic years, where (p) means projected and (e) means estimated, and the vertical axis is the number of entrants.

Figure 2 Trends in young entrants to higher education (from England)



(Source: HEFCE 2010)

Further statistics are available from the Higher Education Statistics Agency (www.hesa.org.uk) and the following table taken from their website demonstrates the increase since 2000 in the number of students at UK institutions (as well as the increase in qualifications awarded). The years identified in table 1 represent most of the years used in the later empirical analysis of section 3 and 4, which investigates 1996 onwards.

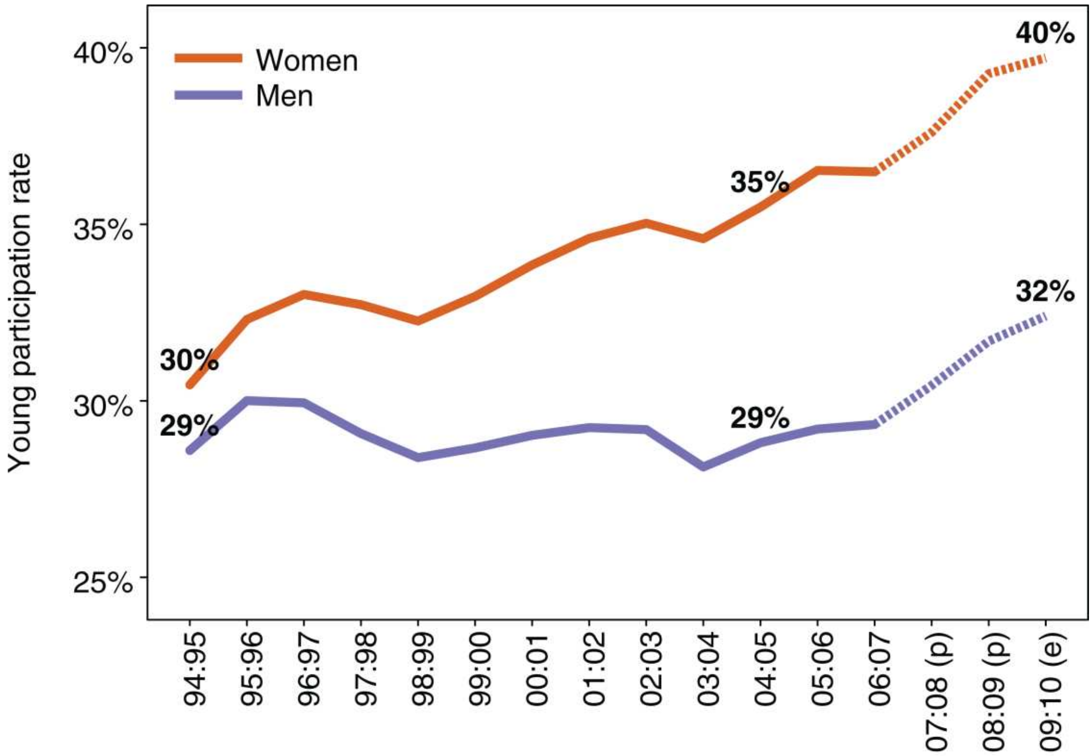
Table 1 students of, and graduates (qualifiers) from UK higher education institutions.

Students and qualifications obtained 2000/01 to 2009/10		
Academic year	**All Students**	**Qualifiers**
2009/10	2,493,415	716,940
2008/09	2,396,050	674,,415
2007/08	2,306,105	676,460
2006/07	2,304,700	651,060
2005/06	2,281,235	640,850
2004/05	2,236,265	633,045
2003/04	2,200,175	595,640
2002/03	2,131,110	557,790
2001/02	2,042,580	521,500
2000/01	1,948,135	504,410

Walker and Zhu (2008) record that: ‘the proportion of graduates in the UK labour force has risen from 9% to more than 13% over the 15 years to 2006” (p.695).

This increase of participation in HE over the past decade and a half exhibits a gender divide, as figure 3, a chart reproduced from The HEFCE report, illustrates. As with figure 2, the last three years being either projected or estimated.

Figure 3 Trends in young participation by gender 1994-2010



(Source: HEFCE 2010)

This gender divide may, for the analysis of this investigation, indicate differences in the impact of increased education on well-being, both through employment and more generally. This is investigated in the later empirical analysis, and an inspection of the data used highlights changes in participation and gender over time. The British Household Panel Survey (BHPS) has information on the highest qualification that the individuals have achieved, and many of the happiness regressions that use this data collapse this large number of education categories into high, medium and low (broadly) defined, respectively, as: degree or above; A-levels and GCSE/O-levels and nursing qualifications; and low education (being either no qualifications or qualifications considered less than O-levels). Table 2 contains person-year figures and percentages of these education composites for individuals aged 20 to 29 in the British Household Panel Survey by gender. Note well that in this table individuals who are in the BHPS more than once will be in the table more than once. Thus the table gives the broad pattern, by gender, of observations in the dataset.

Table 2 Levels of education by gender, (BHPS 1991-2008)

	Overall	Male	Female
High education	14755 (41.68 %)	6988 (42.39 %)	7767 (41.06 %)
Medium education	15482 (43.73 %)	6969 (42.27 %)	8513 (45.00 %)
Low education	5164 (14.59 %)	2528 (15.34 %)	2636 (13.94 %)
Overall	35401 (100 %)	16485 (100 %)	18916 (100 %)

For the ‘high’ education category, there are more males than females in the early waves of the BHPS data, though from wave 9, i.e. 1999, there are more females than males in that category. This matches the statistics for participation by gender above (recall that having a degree is in the high education category.) For medium levels of education females are, in every wave, more prevalent than males, and for low education there is no one gender dominating since, for this level of education, both genders appear to be (in most waves) almost equally represented.

Breaking down the composite high education category is possible. Overall, individuals (aged 20-29) who have a degree as their highest qualification (one aspect of the ‘high’ education category) – BHPS data 1991-2008 – are as follows:

Table 3 Highest qualification being a degree, by gender, 20-29 year olds in the BHPS

FIRST Degree	Female	Male	Total
No	16,258 (44.7%)	14,487 (39.9%)	30,745 (84.6%)
Yes	3,066 (8.4%)	2,520 (6.9%)	5,586 (17.3%)
Total	19,324	17,007	36,331

There is a split in the gender ratio over time, with males and females having a similar share of degrees until wave 9 (i.e. 1999), after which the female share is approximately 60%.[5]

Walker and Zhu (2008) succinctly summarise this increase in participation in higher education: "UK official statistics… suggest that close to 40% of young men and close to 50% of young women are now entering university in the UK… a sharp change in a very short period of time." (p.695-6).[6] Using data, again from HESA, the next table demonstrates the split between gender as well as mode of study for the latest available year (as of February 2012). At undergraduate level there are more female students than male for both full and part-time study, whereas for post graduates there are more males studying full-time and females studying part-time.

[5] Again, this is consistent with the analysis and statistics above, but it could be an artefact of the BHPS itself: in wave 9 the number of Scottish (and, less importantly given the funding regimes, Welsh) individuals in the survey increased approximately fourfold. Thus the increase in females having a degree from wave 9 onwards could just reflect the additional data in the BHPS from wave 9 onwards. However, this turns out not to be the case: restricting the sample to England maintains this change in the ratio of the genders achieving degrees.

[6] These figures are higher than those measured by HEFCE as part of the young participation rate and displayed in figure 3

Table 4. Students by level, type of attendance, and gender in the UK.

HE Students in 2009/10 by mode (FT or PT), level (UG or PG) and gender			
	Undergraduate	**Postgraduate**	**Total**
Full-time Female	737,125	146,980	884,105
Full-time Male	596,775	151,275	748,050
Full-time Total	1,333,900	298,255	1,632,155
Part-time Female	364,740	163,340	528,080
Part-time Male	216,070	117,105	333,175
Part-time Total	580,810	280,450	861,260
Total Female	1,101,865	310,320	1,412,185
Total Male	812,845	268,380	1,081,225
Total	1,914,710	578,705	2,493,415

(source www.hesa.ac.uk)

The HESA data demonstrate that approximately one-sixth of students in the UK are classed as mature students, that is, entering higher education for the first time aged at least 21, a figure that is increasing over time. A recent UCAS report states that "the number of mature students applying to higher education goes up year on year, with a 12.1% increase in applications in 2010 over 2009" (2011 p.6). This is important to note for empirical analysis, due to the possibility of education being 'quasi' fixed after a certain age of individuals and thus not useful for 'within' or fixed effects econometric analysis: if individuals in their twenties do not change their levels of education much, then fixed effects estimation techniques are not available to us. Later this issue is discussed in relation to the actual data used in the subsequent analysis.

In summary, it is apparent that young people in the UK have been increasing their investments in human capital through increased participation in post-compulsory education. Within this context, the discussion of the introduction offers reasons why this may also have an impact on utility over and above the normal human capital outcomes. Against the background of increasing participation in higher levels of education, seemingly systematic differences in participation by gender, the methodology of ‘happiness economics’ suggests two main hypotheses:

Hypothesis 1: There are wider utility or ‘happiness’ benefits to pursuing education than those predicted by human capital theory.

Hypothesis 2: Males and females have different utility ‘pay offs’ from investments in human capital, independent of their economic returns to education.

Before discussing the data, and the most appropriate model specification to test these hypotheses, the next section provides a critical review of the limited literature that investigates education and happiness.

2 Critical literature review: education and happiness

This section critically reviews the literature that has as its focus, in part or in whole, the relationship between education and happiness. The initial discussion here is on this relationship for all age groups, and then moves on to young people. In general, these assessments find no consistent effect of education on happiness. Layard concludes that “education appears to have only a small direct impact on happiness, though it does raise happiness indirectly through its impact on people’s ability to earn, for example” (Layard 2005, p.62). Other studies find no significant effect or a hump-shaped effect, whereby a ‘medium’ level of education is associated with more happiness than a ‘high’ or ‘low’ level. Many studies assess the impact of education on happiness via a dummy variable (or a series of dummy variables), as a control variable in an attempt to exclude its impact on the variables of interest.

Helliwell (2003), for example, using three waves of the World Values Survey, finds no direct effect of different levels of education on subjective well-being. He goes on to suggest that "the inference to be drawn is presumably that the individual well-being benefits of education flow primarily through their well-documented effects on participation, health, perceived trust, and higher incomes" (p.351).

Using the third and fourth waves of the same dataset, Castriota (2006) also investigates the effect of education on happiness, These waves cover more than 118,000 people living in 81 countries between 1995 and 2000. Castriota finds, via multinomial ordered logit, that for an individual's subjective well-being "education level seems to reduce the weight people attach to GDP per capita" (p.11). In other words, more education may mean less reliance on income (which he proxies with GDP per capita) for happiness. Similar to some of the potential benefits listed above, he offers the following as an explanation: individuals with high levels of education have, on average, higher job satisfaction and a more stimulating cultural life and therefore consider less important the consumption level they can achieve.[7] Alternatively, he argues that if "a person has a very repetitive job and limited consumption of cultural goods, life becomes more material goods-dependent" (p.12). A weakness of the data used is its use of GDP per capita as a proxy for income. A more useful analysis would have used personal income, because the self-declared income decile is provided. That the survey is not a panel is also limiting in terms of its analysis and results.

As a side issue to the main analysis here, it has been noted that there is a difference in the impact of education on happiness that, like income, may depend upon the level of development of the particular economy. The literature suggests that the more developed an economy is the less powerful association education has with happiness. For example

[7]Though job satisfaction is a function of income, and so consumption too.

Inglehart (1990) asserts that education, in less developed countries, where it meets basic needs has a strong impact on subjective well-being. Whilst the evidence suggests that "the positive relation with education appears to be eroding in richer countries" (Hartog and Oosterbeek, 1997 p. 5). This, perhaps, suggests a limited impact of education on happiness in the UK and may link to the general finding that rates of return to education decrease with the level of development.

Veenhoven (1996), in a survey of satisfaction research makes the claim that, for the Netherlands, "good education is seen as required for a good life, but the highly educated appear slightly less satisfied with life in comparison to their less educated counterparts" (p.4) and that "studies in rich nations show even slightly negative correlations with level of education" (p.15). He speculates that it could be due to a lack of jobs at that level of education, and that any advantages that one might gain from education fade. Some studies, discussed below, account for this by the aspirations or expectations-increasing nature of education (which, it is argued, aids adaptation to positive experiences thus limiting their impact on individual happiness).

Also for the Netherlands, Hartog and Oosterbeek (1997) investigate "some new evidence of "other" returns to schooling" (p.245) in an empirical study that uses seven dummy variables to account for different categories of education (from elementary to university) and investigates, directly, the impact of education and happiness on Dutch individuals aged 53, as these individuals have been followed since 1952 in the Brabant dataset they employ. They also find that happiness is parabolic with respect to education, peaking for those individuals with higher level secondary schooling (which is the non-vocational category which precedes university education) . Most educational categories compared with their base of lower vocational education are associated with an increase in happiness. The addition of social controls, for example family background in terms of education and occupation (while not being statistically significant), lower the size of the coefficients on the various education categories. Presumably this is a standard omitted variable bias argument: those from better social backgrounds receive more education and are happier. Additional controls – health, marital status, labour market status, and gender –push the coefficients on education closer together indicating that different levels of education have similar ‘happiness’ returns when these controls are included. There is a contention that education can increase well-being in excess of the impact on income and job satisfaction (and other controls) and is often thought to be about resulting choice and freedom. A well-specified happiness function can assess this contention if subjective well-being responses can be said to capture such notions amongst other wider aspects of utility (see section 4 below).

A recent working paper has attempted to add to, what the authors assert are, the “very few studies [that] investigate the impact of education on SWB [subjective well-being] despite its importance” (Yakovlev and Daniels-Leguizamon 2011, p.2). Using a United States well-being composite that is based on over 30 different questions about overall life evaluation, physical health, working environment, health-related behaviour (e.g. do you smoke?) and basic access to clean water, and medicine among other things, they find education to have a strong positive effect for the highly educated, but not for the moderately educated. Here the dependent variable is state-wide average well-being, and education is measured by either the percentage of survey respondents with a high school degree only (secondary education) or the percentage of survey respondents with bachelor degree or higher (higher education). They estimate their models by both OLS, and a 3 stage least squares procedure to account for potential bias that might arise through interdependence of some of the variables. The investigation is cross-section only, and the authors acknowledge that "as newer Gallup-Healthways data becomes available in the future, it would be useful to see if the cross-sectional relationships found in this study also hold true over time" (p.18) This analysis, therefore, suffers from not being able to take into account unobserved heterogeneity which fixed effects (and more waves) would ordinarily account for. That the empirical analysis is state-wide, the authors argue, mitigates this problem somewhat, however this also creates others. The aggregation of data to US state level is motivated by trying to assess social spillovers, and the regression estimated is a composite of a composite (state-wide average well-being, which is itself a composite variable regressed on other composites (state-wide average income, the broad state-wide education measures mentioned above etc). The authors do not comment on the appropriateness (or otherwise) of using the well-being composite as the dependent variable and a measure of health (much considered in the creation of the well-being index) as an independent variable. The authors repeat claims about the project's plans for an unprecedented twenty-five years of data but use just the first year of its operation, 2008. This reduces its usefulness compared to other happiness research. The authors also incorrectly claim that:

> Existing "happiness" research relies primarily on the international survey data, which suffers from significant problems such as the difficulty of comparing the survey results across different cultures (languages) and the omitted variable bias. This study attempts to circumvent these problems by examining what determines self-reported happiness or subjective well-being (SWB) within a rather homogenous culture and institutional environment such as the one in the United States (p.17).

This ignores much valuable work discussed above that has been undertaken using the German Socio-Economic Panel and the BHPS, both covering relatively homogenous cultures (perhaps more so than the United States), and both datasets can challenge the grand 'unprecedented' claims this paper makes regarding the data set it uses. There is also no comment regarding the presence or otherwise of heteroscedasticity. The main conclusion from this paper is state-level, and as such is not comparable with the other estimates discussed in this study, which are based on individual-level data. The authors use their results to speculate that the positive effect of education is due to private non-monetary returns, although they are unable to test this due to the aggregate nature of their data.[8] Such a test is what, in part, the analysis here attempts.

Before these studies within economics, similar investigations took place within the field of educational psychology. Historical empirical studies suggest that the impact of education on happiness is positive, with Gurin et al. (1960) finding that those with more education were happier than those with less, and Bradburn and Caplovitz (1965) also asserting that happiness is positively correlated with education. More support for this association comes from Cantril's well-known 'ladder' study (1965), where individuals are asked to rank their subjective opinion of their life as a rung on a ladder: the top rung being (10) the best possible life quality imaginable, and the bottom of the ladder (0) representing the worst possible life quality imaginable. Here education is strongly correlated with the higher rungs of the ladder, i.e. it is strongly correlated with positive responses regarding the best possible life for the respondent (the top of the ladder). Education is seen as helping to achieve an improved satisfaction with life, and an aid to help realise both aims and potential. Gurin et al. posit that "education, like youth, seems to be associated with the investment of greater aspirations and expectations in life – an investment which brings greater gratification" (1960, p.51).

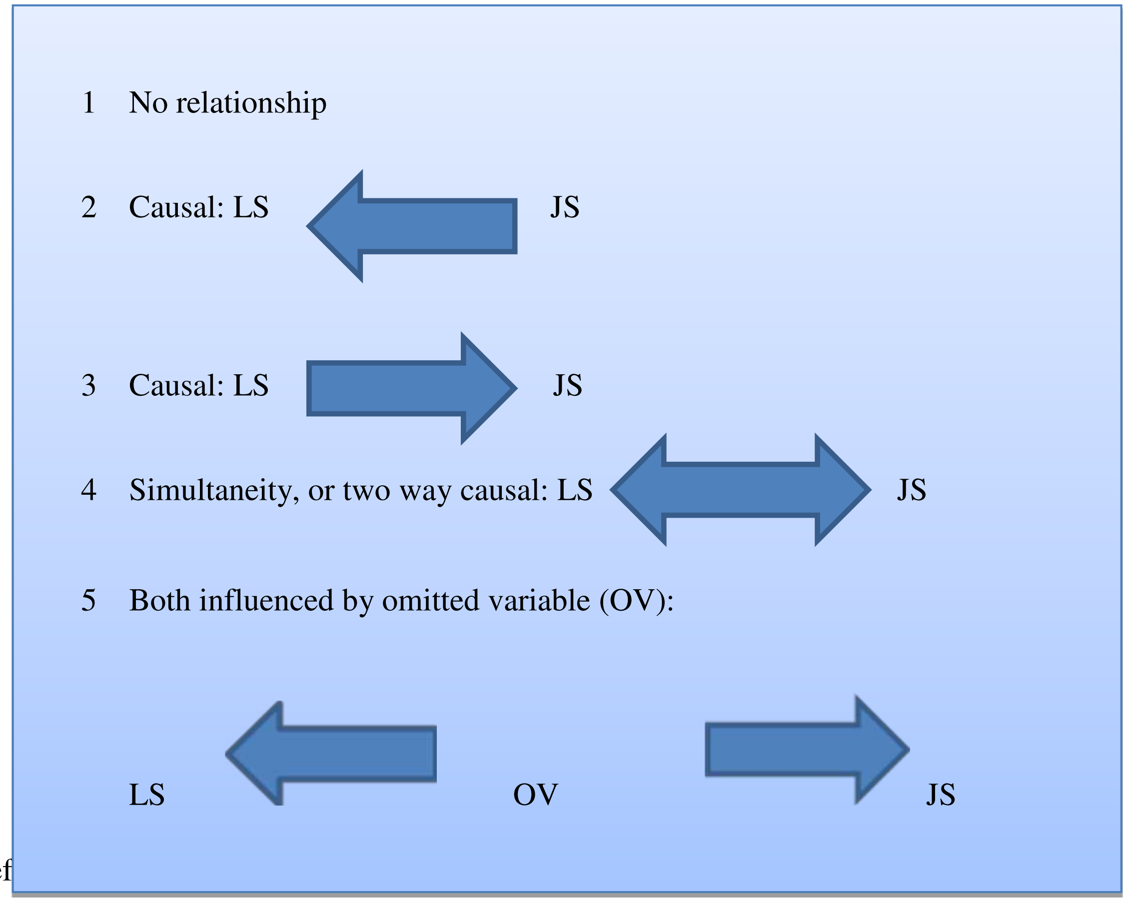
As intimated earlier, the claim that greater aspirations can help bring greater gratification is controversial amongst economists. Recall that increased aspirations resulting from increased income is one of the explanations put forward for the Easterlin paradox; over time as incomes

[8] One solution they could adopt is to control for state-level crime or public goods.

increase happiness does not despite the cross-section correlation between income and well-being. The aspiration raising property of education may be a cause of unhappiness if these aspirations cannot be met, which is suggestive of a mitigating effect of (relatively high) education on happiness. Thus, a high level of education might be problematic with regard to life satisfaction. If a graduate subsequently attains a graduate level job – whatever that is – are they happier than a graduate who does not? In other words, is someone's job commensurate with their education and what are the consequences for happiness? An opposing argument suggesting that relatively more education (higher qualifications) may lead to more happiness comes from the notion that education itself may have positional good properties. Individuals with different levels of educational attainment are possibly indicative of education being, at least in part, a positional good, where there may be status benefits to having achieved a certain credential or qualification. As discussed throughout the happiness literature, relative concerns (for example income and status) are potentially important. How one ranks in terms of educational qualifications may have an impact on an individual's well-being. Similarly how other individuals perform may also impact on an individual's well-being. This possibility that education has positional good properties is important for a study of the impact of education on happiness, since happiness has a relative element. As well as discussing the potential positional good properties of education Adnett and Davies (2002) offer three specific ways that education can benefit an individual (and, by extension, increase their well-being). These are as follows: higher levels of future consumption; participation benefits in terms of ability to enjoy the opportunities for wider social-cultural interaction; and benefits associated with greater socio-political participation. Again, if we believe that the overall subjective well-being measure captures these aspects (and the other, complementary benefits mentioned earlier) we can use the methods of the empirical 'happiness' literature to assess such a possibility. In this study this is undertaken for young people.

The test of human capital theory in section 3 involves using job satisfaction as a proxy for working conditions, this is partly undertaken for pragmatic reasons of data availability. Sometimes an argument is made for job satisfaction as a likely channel for increased education to impact on happiness. Increased education, leading to increased productivity may improve job satisfaction. Much literature suggests that happy people are more satisfied in their jobs (for example Clark 1997; Judge and Illies 2004; Boehm and Lyubomirsky 2008), and some of this literature argues that there are issues of causation: happiness promotes productivity and career success rather than productivity and career success promoting happiness. It has been argued that the channel this works through is the psychologist's notion of 'positive affect' .Boehm and Lyubomirsky (2008), review cross-section data to establish a correlation between job satisfaction and happiness, and panel data to indicate causation from happiness to job satisfaction. The authors suggest that happy people are more "approach-orientated", "more likely to enter novel situations, interact with other people and pursue new goals" and are "particularly well suited to experience success" (p.2). The causation "that happiness may be a precursor and determinant of career success" (Boehm and Lyubomirsky 2008 p.1) is an important consideration for the empirical analysis below, suggesting as it does alternative relationships between productivity (if measured as increased career success) and happiness. Georgellis and Lange (2012) investigate the relationship between job and life satisfaction, and assert more than once that it is a highly complex and nuanced relationship. They discuss, three particular theories of the relationship: segmentation (where there is no evidence of a correlation); compensation (negative correlation); and spillover (positive correlation). They find, using the European Values Survey, individuals belonging to each category with the 'spillover' category being the case for the majority of employees. The sign of the relationship can thus lead to various ideas about the relationship between life and job satisfaction. Also important is the nature of the correlation, and figure 4 presents some possibilities for an association between life and job satisfaction. The nature of the relationship has methodological implications, and these are discussed in the next section. For clarity, before the methodological discussion, the main point about pathway 5 is that life satisfaction and job satisfaction do not stand in any causal relationship to one another. Rather, they are correlated, but only because they are both determined by some omitted, underlying variable(s).

Figure 4 Potential relationships between life satisfaction and job satisfaction



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specifically is critically discussed. Blanchflower and Oswald (2000), in their study of young people, find, via pooled cross section analysis, an age divide in the effects of education. Individuals aged under 30 who are classed as highly-educated (i.e. left education when they are more than 18 years of age) experience higher reported well-being, however the highly educated who are over 30 experienced a small negative time trend over the same time period. The data in the study cover the years 1972-1992. However, the main reason for the increase in well-being amongst the young over this time period is found away from education: the rise in satisfaction of young unmarried individuals, and the authors suggest that:

> it may be that young men and women have benefited from society's recently increased tolerance of those living outside marriage, and from their consequent ability to live in less formal relationships. While this is not an explanation, it suggests that the ultimate answer is somehow connected to the role of family life and personal freedom (p.18).

This is similar to the conclusion from a study within the psychology literature that addresses transitions to adulthood and psychological distress: “education may protect against psychological distress through the knock-on effect of delaying the timing of life transitions and of giving young people greater choice over the course their lives will take” (Sacker and Cable, 2009 p.11). However, it should be noted that Blanchflower (2011) updates the study mentioned above with new waves of the same data and finds that the time trend does not continue. This may indicate habituation with the ability to live in less formal relationships (and so forth) or the time trend might have been an artefact of the data.

One study has investigated the contributory factors to happiness for university students (Chan et al., 2005). It utilises primary data from a questionnaire given to economics students at the University of Western Australia, which, as the authors admit, is limited: the sample size is 745 students, which drops to 640 for the regression analysis and is drawn mainly from the first year. The study uses the pattern of age responses in the raw data to incorrectly claim that their U-shape pattern is consistent with the findings of Blanchflower and Oswald (2004). This is a misunderstanding of the U-shape which is created from the estimated age and age squared coefficients of a regression, and not simply a plot of raw data. Indeed as Chan et al comment, after ordered probit analysis “it appears that neither age nor year of study have much of an impact on students' level of happiness" (2005, p.11). That the individuals in the study are aged between 18 and 22, and form such a small segment of the U-shape, should perhaps alert the authors not to expect much impact from age on the level of happiness nor to expect replication of the whole U-shape.

The next section discusses the data and the important methodological issues surrounding our use of 'happiness economics' to test the hypotheses, presented earlier.

3 Data discussion and methodology

This section discusses, initially, the relevant data from the BHPS and the equations that will be utilised to test both hypotheses. The discussion then turns to the important methodological issues, carefully establishing the preferred way to perform the tests given the data.

Many studies use the broad composite measures of educational attainment – high, medium, and low – as dummy variables in a typical multivariate regression to account for education. In contrast, the analysis here uses the years of schooling an individual has undertaken as the main education variable, created through the information the BHPS has on the highest qualification an individual has achieved. This measure allows for more variety, and more 'intra-person' change: by construction, individuals change their 'years of schooling' more frequently than they move into another broad composite category.[9] The gaps in the table below are explained by the creation of the variable from qualifications achieved. Twelve years of schooling, for example, would represent the first year of A-levels being completed.

[9]Note well that this is a comparison between 'high', 'medium' and 'low' conceptions of education and years of schooling created from highest educational qualification. More than one highest educational category is in each of the broad composites, hence there is more intra-person variety with the 'years of schooling' measure.

Without making assumptions that may well be incorrect we cannot account for such possibilities.

Table 5 Years of schooling for individuals in the twenties age range by gender. BHPS 1996-2007

Years of Schooling	Female		Male		Total	
10	59	(0.4%)	49	(0.5%)	108	(0.5%)
11	3,875	(30.7%)	3,400	(31.0%)	7,275	(30.8%)
13	2,860	(22.7%)	2,554	(23.2%)	5,414	(22.9%)
15	83	(0.7%)	6	(0.1%)	89	(0.4%)
16	5,396	(42.8%)	4,672	(42.6%)	10,068	(42.7%)
19	320	(2.5%)	291	(2.7%)	611	(2.6%)
Total	12,593		10,972		23,565	

An investigation of this breakdown over time (not shown) shows that before wave 9 (i.e. 1999) more males than females have 16 years of schooling, which is approximately equivalent to having a degree as the highest qualification. This trend reverses from 1999 onwards when females become more prevalent than males as graduates, a finding consistent with the discussion in Section 1.

Investigating hypothesis 1 requires using the happiness data to test if there are wider benefits to education than those identified by orthodox human capital theory. This test is undertaken in three stages using slightly different happiness functions. Firstly, a standard happiness regression will be estimated without any human capital elements (i.e. wage or job conditions proxy). Secondly, this will be re-estimated but including log wage. This will be a test of a strict reading of human capital theory where income is the only postulated benefit from investments in human capital. And thirdly, a subsequent estimate also includes job satisfaction allowing for a more inclusive version of human capital theory where the benefits may include better working conditions and a more interesting job, proxied by a job satisfaction variable: satisfaction with work itself. Table 6 gives the gender breakdown for 'satisfaction with work itself' is as follows (based on the waves (mentioned above) where the life satisfaction question is asked). The labelling of the responses is the same as that in the BHPS, not every option is labelled.

Table 6: Job satisfaction by gender, twenties age range BHPS 1996-2007

Job satisfaction: work itself	Female		Male		Total
1 (not satisfied at all)	158	(1.7%)	161	(1.9%)	319 (1.8%)
2	264	(2.9%)	280	(3.2%)	544 (3.1%)
3	640	(7.0%)	624	(7.2%)	1,264 (7.1%)
4 (not satisfied/dissatisfied	692	(7.6%)	884	(10.2%)	1,576 (8.9%)
5	2,022	(22.1%)	1,991	(23.0%)	4,013 (22.6%)
6	3,910	(42.8%)	3,514	(40.6%)	7,424 (41.7%)
7 (completely satisfied)	1,458	(16.0%)	1,202	(13.9%)	2,660 (15.0%)
Total	9,144		8,656		17,800

There is no substantial change in the pattern by gender over time, although a limited case could be made for women being, on average, more satisfied at work (not shown). The table above shows the overall responses, in all waves. A chi-squared test of equal distributions gives a test statistic of 56.8 which, at 6 degrees of freedom, rejects comfortably rejects the null of equal distributions.[10] For the population as a whole, the normal finding is that women are more satisfied at work (Clark 2005; Boeri and Garibaldi 2009). The broadly parabolic response to the job satisfaction questions is similar to the responses to the life satisfaction questions. A correlation between happiness and this job satisfaction measure for the whole sample reveals an approximately 20-30% association: overall the correlation coefficient is

[10] The Kolmogorov-Smirnov two sample test supports the conclusion obtained by the Pearson chi-squared test of association, with a p-value of 0.000. The differences between the genders are statistically significant.

0.267; for males is 0.293; and for females 0.240. Further comments on any relationship between job satisfaction and life satisfaction are made below. A simple t-test to investigate whether the males and females give different responses to the job satisfaction question cannot reject the null of no difference between the mean response of males and females at conventional levels of significance. Inspecting the data further (not shown) there appears to be no notable pattern of job satisfaction and years of schooling.

The equations to be estimated, then, are as follows:

- Estimate 1 $LS_{it} = \beta_{0it} + \beta_1 education_{it} + X\beta'_{it} + \varepsilon_{it}$
- Estimate 2 $LS_{it} = \beta_{0it} + \beta_1 education_{it} + \beta_{2i} \ln wage_{it} + X\beta'_{it} + \varepsilon_{it}$
- Estimate 3 $LS_{it} = \beta_{0it} + \beta_1 education_{it} + \beta_2 \ln wage_{it} + \beta_3 jobsatisfaction_{it} + X\beta'_{it} + \varepsilon_{it}$

Where LS_{it} is the response of individual *i* at time *t* to the life satisfaction question, education which is captured by years of schooling of individual *i* at time *t*, log wage which is based on labour income of individual *i* at time *t*, and job satisfaction which is the response regarding satisfaction with 'work itself' of individual *i* at time *t*. $X\beta'$ represents a vector of control variables where X is a 1×k vector of control variables and β' is a k×1 vector coefficients to be estimated.[11] The happiness function is thus specified to include variables deemed important by human capital theory: labour market income; better working conditions; and a more fulfilling job. Human Capital theory is about future labour market earnings, however since future income is not known, the empirical work only makes use of current income, another pragmatic decision. To the extent that lifetime income is not captured by current income then

[11] These controls are standard in well-being regressions, and include marital status, health, age dummies, wave dummies and region dummies (see section 5.3 for more details).

not all of the human capital income benefits are captured by the wage variable.[12] Also, because future income may not be accurately captured by current wage, this particular aspect of human capital theory may be partially captured by the education variable when log wage is included in the happiness function. This is an upwards bias for the education variable, thus making it harder to disprove the argument of wider 'happiness' benefits theory than permitted by HCT. Any conclusions drawn from the results need to reflect this potential bias.

Data is not available in the BHPS on the quality of working conditions and how fulfilling a particular job is, so a proxy is used. The proxy used is, as briefly mentioned above, an individual's assessment with his or her satisfaction with 'work itself'. This is a pragmatic choice given the dataset. That it is also subjective is perhaps potentially problematic: individuals may have some tendency to score themselves in a similar way not necessarily connected with the specific question asked. If fixed effects estimation techniques are used, this individual anchoring concern is mitigated somewhat: in other words we can control for any unobserved traits an individual may have in responding to such questions with the fixed effect itself (if these traits do not change over time). Within the economic literature, empirical studies carry out similar estimations with life satisfaction as the dependent variable, and job satisfaction as one of the independent variables (for example Georgellis and Lange 2012, and also discussed above). This is okay if the source of potential endogeneity is omitted variables rather than simultaneity. In other words, if the correlation is as displayed by (5) and not (4) in figure 4. This is returned to later on when the model specification is discussed, but in summary, current income and satisfaction with work itself, will be right hand side variables along with the standard set of controls, in the happiness literature.

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[12]Although this only matters if the current income – future income correlation differs by education.

The coefficients of special interest are those on education, income and job satisfaction. If there is a statistically significant relationship between happiness and education after the inclusion of log wage, and then after the inclusion of job satisfaction too, then the hypothesis is supported. If not, then the hypothesis is not supported. Looking at the changes in the coefficient for education particularly we can deduce information about the likely impact of increased education.

Frequently, there are limitations with data for an empirical investigation into education. In particular, with the BHPS there is no clear information on how individuals financed their education (or how they were financed) and the associated costs, which may be important. Differing loan and grant regimes could have an impact; in England different fee regimes too. A crude check would be to split the dataset in three (after restricting the sample to England), reflecting the different English student finance regimes, or to check for structural breaks in the results. For degree holders this would be (mostly) whether they started their degree in a no fee environment i.e. before 1998; between 1998 and 2003, the £1,000 fee environment; and 2004 onwards the £3,000 fee environment. This has been attempted, but does not reveal anything of interest (output omitted).

More difficulties arise for empirical work due to the heterogeneous nature of education which cannot be taken into consideration with many datasets, including the BHPS. What kind of A-levels did someone gain? What classification of degree? And what subject? At what institution? These questions which are likely to be important for economic returns to education (and potentially happiness too) cannot be answered with the data available. That some of these conjectures may be important is supported by recent studies (including

Chevalier 2011; Walker and Zhu 2011). For these reasons caution is necessary regarding conclusions from the results for our estimations presented below.

As Piper (2012) demonstrated, there are likely to be dynamics in the residuals when BHPS life satisfaction data is used and, if present, this dynamic information needs to be taken into account. And as that paper also argued, typical fixed effects estimations are not the preferred ones because they do not take into account the dynamic nature of the British life satisfaction data.

Whenever there are omitted dynamics, consideration should be given in the modelling strategy. This is something made possible by recent advances in econometric theory together with corresponding software and user written programmes. The test statistic (obtained from Wooldridge's *xtserial*) demonstrates that serial correlation exists. Indeed, in all of the estimates generated for this study (including many not reported) the null hypothesis of no first-order residual autocorrelation is rejected with a p-value of as 0.0000 (i.e., in practical terms, the null can be rejected with certainty). It is clear that such a firm rejection of the assumption of no autocorrelation needs, somehow, to be modelled. There are different options available to the applied researcher.

Often, with such a result, a dynamic panel model estimated by a difference or system general method of moments (GMM) approach, both implemented within STATA 10 and higher as well as by other programmes like xtabond2, would be used to model the dynamics. These procedures make use of internal instruments to address the endogeneity of lagged values of the dependent variable as well as other potential endogenous variables. Internal instruments taken from inside the model, form a 'system' by using lagged differences to instrument the levels of variables and lagged levels to instrument the differences of variables. This means that there is no need to find instruments from outside the dataset (although use of "external" instruments is not precluded). Whenever dynamic panel modelling is being considered, it must fulfil some criteria. A key criterion for instrument validity is that the differenced residuals demonstrate first-order but not second-order auto-correlation in the first differences. Once a decision has been taken to treat particular variables as potentially endogenous, the over-identifying instruments can be tested for validity. A choice needs to be made regarding the number of instruments (based on the choice of lags to be used). Model diagnostic tests give guidance regarding the exogeneity, and hence the validity of the over-identifying instruments used for estimation. This can be important for estimation purposes, because the decision indicates what lags are available as internal instruments.

All of the diagnostic tests demonstrated that all of the following models fulfilled what was necessary for a good statistical model: the instrumentation demonstrated first order auto-correlation but not second in the first differences; the over identification due to the internal instruments is valid for estimation and considering education – the key independent variable used here –as exogenous or endogenous made no statistical difference; the necessary 'steady state' regarding the key variables is not rejected; in all cases the assumption of exogeneity (where made) is not rejected. (Roodman 2006; Roodman 2009).[13] In terms of statistical integrity, the formulations investigated for education and happiness using dynamic panel modelling were all acceptable. Thus, in terms of instrumentation, exogeneity, endogeneity,

[13] Roodman (2006, p.43) explains: "before using system GMM, ponder the required assumptions. The validity of the additional instruments in system GMM depends on the assumption that changes in the instrumenting variables are uncorrelated with the fixed effects. In particular, they require that throughout the study period, individuals sampled are in a kind of steady-state, in the sense that deviations from long-term values, controlling for covariates, are not systematically related to fixed effects."

and the necessary autocorrelation results, the dynamic models estimated seem to be acceptable. Ordinarily such a discussion would make reference to the specific diagnostics tests and their results. However, in this case, dynamic panel modelling – while statistically appropriate (i.e. the diagnostic tests were supportive) – is not the best way to assess the relationship between education and happiness. Instead another method taking account of the dynamics is preferred and used.

The main reasons for not using the recent methods for dynamic panel modelling largely centre around the interpretation of the coefficients. Recall that here the interpretation of the independent variables relates to their current, contemporaneous effect, and the lagged dependent variable contains the entire history of the independent variables. Thus, in a dynamic panel context, the impact of the education variable (or any other independent variable) reflects current situations and changes from previous information. This is arguably unsuitable for education for two main reasons. Firstly, there is relatively little 'new' information regarding education, and thus information regarding education is likely to be contained in the lagged variable and not the right-hand-side independent education variable. Secondly, the education variable is 'as if it is lagged', i.e. not current or contemporaneous (unlike health, and job status) but instead is backward looking. The years of schooling someone has is itself a historic measure. A key finding of the Piper (2012) is that happiness is largely a contemporaneous phenomenon, with individuals' responses to life satisfaction questions (mainly) reflecting their current situation. This itself is instructive for model choice. Understood in this way, in using dynamic panel analysis we cannot learn much about the education and happiness relationship. The impact of education cannot be measured via difference or system dynamic GMM estimation whether using a single or several education variables. The new information is either potentially quite rare (such that education measures are ‘quasi-fixed’) or something that is itself exogenous or backwards looking, and thus not something that additionally affects current life satisfaction or is captured by current responses to the life satisfaction questions. In contrast, such an approach may be more usefully used for more contemporaneous phenomena such as health and employment (for example). Here the new information is more important, and current. Modelling dynamics is important, yet involves not only statistical tests but also judgement about the method that will be likely to generate the most informative results.

The small coefficient on the lagged dependent variable (established in Piper 2012, and discussed above) is itself also instructive in terms of model choice, and suggests the possibility of modelling the autocorrelation in the error term. Beck and Katz (2011) argue that "for fast dynamics (where the coefficient on the lagged dependent variable is close to zero) it will be hard to distinguish between the lagged dependent variable and the AR1 specifications, or, alternatively, it does not make much difference which specification we use" (p.13). This, coupled with the arguments above about the lagged dependent variable capturing the effects under investigation in this study in a ‘black box’ manner, leads to an alternative estimation procedure; namely, to model the dynamics via the error term and estimate according to the Cochrane-Orcutt method, in which the slope coefficients of the static model are estimated conditional on an AR(1) dynamic in the residuals (Cochrane-Orcutt, 1949). However, as McGuirk and Spanos (2003) note, this method is only valid if and only if the often unrealistic Common Factor (CF) restrictions first proposed by Sargan (1964) hold. This finding in the econometrics literature is often not heeded by applied researchers: “despite additional warnings concerning the unrealistic nature of the CF restrictions… the practice of autocorrelation correction without testing the CF restrictions is still common. In fact, its use may even be on the rise…” (McGuirk and Spanos, 2003, p.3). Testing these restrictions is akin to asking whether the dynamics can be modelled in the residuals. If the CF restrictions hold (tested below), modelling the residual is an alternative approach to dynamic analysis. The discussion above presents reasons why modelling the dynamics via the residual rather than using a dynamic estimator is preferred here (as long as the common factor restrictions hold).

More detailed explanation is required before the results from testing the CF restrictions can be presented. First we explain that the unobserved components model estimated by the Cochrane-Orcutt (or similar) estimator is a restricted version of the dynamic linear regression model. A corollary of this is that the unobserved components model and thus the Cochrane-Orcutt (or similar) estimator are legitimate only if the CFRs cannot be rejected. Using only the continuous variables from Estimate 3 (the model with the most variables included) the unobserved components model is specified as follows:

$$LS_{it} = \alpha + \alpha_2 educ_{it} + \alpha 3 lnwage_{it} + \alpha_4 jobsat_{it} + \varepsilon_{it} \qquad (1)$$

Where $\varepsilon_{it} = \rho\varepsilon_{it-1} + \upsilon_{it}$ (2)

- LS_{it} denotes life satisfaction of individual i at time t

- $\alpha$is the intercept

- $educ_{it}$ represents the education of individual i at time t as measured by years of schooling

- $lnwage_{it}$ is log wage of individual $i$at time t

- $jobsat_{it}$ is the self-reported job satisfaction of individual $i$at time t

- ε_{it} is the disturbance term, with v_{it} as the white noise component.

The model is transformed, as follows:

First step: lag (1) once:

$$LS_{it-1} = \alpha + \alpha_2 educ_{it-1} + \alpha 3 lnwage_{it-1} + \alpha_4 jobsat_{it-1} + \varepsilon_{it-1} \qquad (3)$$

Second step: solve for ε_{it-1}

$$\varepsilon_{it-1} = LS_{it-1} - \alpha - \alpha_2 educ_{it-1} - \alpha 3 lnwage_{it-1} - \alpha_4 jobsat_{it-1} \qquad (4)$$

Third step: substitute (4) into (2)

$$\varepsilon_{it} = \rho(LS_{it-1} - \alpha - \alpha_2 educ_{it-1} - \alpha 3 lnwage_{it-1} - \alpha_4 jobsat_{it-1}) + \upsilon_{it} \qquad (5)$$

$$\varepsilon_{it} = \rho LS_{it-1} - \rho\alpha - \rho\alpha_2 educ_{it-1} - \rho\ \alpha 3 lnwage_{it-1} - \rho\ \alpha_4 jobsat_{it-1} + \upsilon_{it} \qquad (6)$$

Fourth step: substitute (6) into (1)

$$LS_{it} = \alpha + \alpha_2 educ_{it} + \alpha 3 lnwage_{it} + \alpha_4 jobsat_{it} + \rho LS_{it-1} - \rho\alpha - \rho\alpha_2 educ_{it-1}$$

$$-\rho\ \alpha 3 lnwage_{it-1} - \rho\ \alpha_4 jobsat_{it-1} + \upsilon_{it} \qquad (7)$$

Fifth step: collect terms, hence

$$LS_{it} = (1-\rho)\alpha + \alpha_2 educ_{it} + \alpha_3 lnwage_{it} + \alpha_4 jobsat_{it} + \rho LS_{it-1} - \rho\alpha_2 educ_{it-1}$$

$$-\rho\ \alpha 3 lnwage_{it-1} - \rho\ \alpha_4 jobsat_{it-1} + \upsilon_{it} \qquad (8)$$

Ignoring the constant term (α) equation (8) has four independently estimated coefficients: ρ, α_2, and $\alpha 3$ and α_4

It is now shown that this is a restricted version of the dynamic linear model of order one (i.e. specified with the first lag of both the dependent variable with each independent variable) (equation 9), which has seven independently estimated coefficients: α_1, α_2, α_3, α_4, α_5, α_6 and α_7 (ignoring the constant term):

$$LS_{it} = \alpha + \alpha_1 LS_{it-1} + \alpha_2 educ_{it} + \alpha_3 lnwage_{it} + \alpha_4 jobsat_{it} + \alpha_5 educ_{it-1} + \alpha_6 lnwage_{it-1} + \alpha_7 jobsat_{it-1} + \varepsilon_{it} \qquad (9)$$

On comparing the dynamic linear regression model (equation 9), i.e. the unrestricted model, the following can be noticed:

- in both (8) and (9), there is one coefficient on LS_{it-1}, which is, respectively, ρ and α_1

- in (8) the coefficient on $educ_{it-1}$ is- $\rho\alpha_2$, the coefficient on- $lnwage_{it-1}$ is-$\rho\alpha_3$, and the coefficient on $jobsat_{it-1}$ is $-\rho\alpha_4$

- in (9) the coefficient on $educ_{it-1}$ is α_5 , the coefficient on - $lnwage_{it-1}$ is α_6, and the coefficient on $jobsat_{it-1}$ is α_7

Hence,- $\rho\alpha_2$ is the negative of the product of the coefficients on LS_{it-1} and $educ_{it-1}$

- $\rho\alpha_3$ is the negative of the product of the coefficients on LS_{it-1} and $lnwage_{it-1}$

- $\rho\alpha_4$ is the negative of the product of the coefficients on LS_{it-1} *and* $jobsat_{it-1}$

Now the dynamic linear regression model (9) can be transformed into (8) if and only if the following restrictions hold: $-\alpha_5 = \alpha_1 * \alpha_2$; $-\alpha_6 = \alpha_1 * \alpha_3$; and $-\alpha_7 = \alpha_1 * \alpha_4$.

These are the common factor restrictions. The CF restrictions must be tested on each continuous variable in the estimate. Bond (2002) tests them jointly, although they can also be tested individually which presents a more demanding test. The common factor restrictions were tested using OLS, fixed effects, and dynamic panel models. In all three cases, as shown below, they hold. The results from the lagged dependent variable also confirm the usefulness of using a dynamic panel model (where appropriate). A comparison of this particular coefficient, the lagged dependent variable, passes the informal test proposed by Bond (2002) for the validity of the dynamic estimator: “a candidate consistent estimator will lie between the OLS and Within Groups estimates, or at least not significantly higher than the former or significantly lower than the latter" (Bond 2002, p.7). The coefficient on the lagged dependent variable obtained by the dynamic panel estimator is below the OLS coefficient (which is biased upwards) and above the coefficient from the FE estimate (which is biased downwards, an effect sometimes called the Nickell (1981) bias). Note that though here the dynamics are modelled in the residuals, this result gives us confidence that the dynamic estimator, when used, gives appropriate results. See Bond (2002) for more information.

Only the fixed effects common factor restrictions are reported here. In each case, the null hypothesis is that the CFR holds as demonstrated in this extraction from Stata (the *nlcom* command).

```
. testnl _b[l_lfsato]*_b[yrsschooling] = -_b[l_yrsschooling]

  (1)  _b[l_lfsato]*_b[yrsschooling] = -_b[l_yrsschooling]

F(1, 5392) =       1.40
            Prob > F =       0.2360

. testnl _b[l_lfsato]*_b[lnwage] = -_b[l_lnwage]

  (1)  _b[l_lfsato]*_b[lnwage] = -_b[l_lnwage]

F(1, 5392) =       0.00
            Prob > F =       0.9692

. testnl _b[l_lfsato]*_b[jbsat6] = -_b[l_jbsat6]

  (1)  _b[l_lfsato]*_b[jbsat6] = -_b[l_jbsat6]

F(1, 5392) =       0.13
            Prob > F =       0.7145
```

That the common factor restrictions cannot be rejected suggests that the dynamics are in the residuals, i.e. in the unobserved rather than in the observed part of the model. This is perhaps unsurprising when the OLS regressions have an R-squared of about 0.1 and one considers the multitude of unobserved aspects that are potentially important for life satisfaction. Indeed, a recent finding is that the amount of fruit and vegetables eaten enters positively and strongly statistically significantly into happiness equations (Blanchflower and Oswald 2011). This, like many other things, just cannot be captured by most life satisfaction regressions (due simply to lack of data). Such elements that are not explicitly modelled enter in the equations via the residuals and some of these may be autocorrelated. As such it is likely that there are unobserved dynamics, which the non-rejection of the CFRs suggests are reflected in the dynamic structure of the residual. Accordingly, an acceptable estimation procedure, and used here, is a fixed effects regression with dynamic residuals (Equation 2).

For fixed effects analysis to be informative, there must be some variation in individuals' investments in education. Education is often thought of as a 'quasi-fixed' variable, not providing much variation beyond the age where people conventionally study and thus not useful for fixed effects estimation. As the initial section of this paper highlighted, this is an old stereotype and recent, successive UK governments have promoted lifelong learning. That the twenties age range is being studied here mitigates this concern somewhat too. Fixed effects estimation, to be useful, requires such 'intra person' change. The standard deviation of 'intra' or 'within person change, while at 0.83 is not large, also supports fixed effects estimation as a valid choice.

Section 2 discussed the interesting issue of the association between job satisfaction and life satisfaction. This remains an open question, and recent research (Georgellis and Lange, 2012) has found some evidence for three different possibilities (no correlation, positive correlation, negative correlation) echoing Lambert (1990) who asserts that these "are treated as competing explanations, even though evidence and logic suggests that all three [possibilities] operate to link work and family" (p.239). A possible line of enquiry here is that of the seemingly unrelated regressions framework (SURs). This is beyond the scope of this paper, but essentially two regressions are run, one for earnings/productivity and one for happiness. These regressions would have specific observables, shared observables, specific unobservables, and general, shared unobservables. The SUR method could use the residuals as part of the estimating procedure to draw inferences about the relationship between education and happiness. It must be remembered that productivity or career success is, however, not the same as job satisfaction. Here, we argue that both happiness and job satisfaction are 'output' variables' and, as such, are more likely to share common observed variables (which will be in the model) and unobserved variables, perhaps like 'positive affect' or being 'approach oriented' as suggested above. As long as these unobserved variables are fixed (or at least slowly moving) issues of endogeneity can be taken care of with thoughtful modelling. This argument is essentially saying that, in figure 4, the pathway is (5) and not (4).This means that it is appropriate that, in practice, we include job satisfaction as a right-hand side variable matching recent published work which asserts that "a complementary approach to examining the job-life satisfaction relationship is to run life satisfaction regressions including job satisfaction as an explanatory variable" (Georgellis and Lange 2012, p.449).

A further potential methodological issue is that the dependent variable is ordinal and not cardinal. This complicates the estimation, particularly if a dynamic estimation method is to be used. However, the analysis here will follow the recent tradition in the economics of happiness literature, particularly following Ferrer-i-Carbonell and Frijters (2004), in making the assumption that the differences between treating life satisfaction as cardinal rather than ordinal do not especially alter the qualitative nature of the results, whereas taking account of the fixed effects does. Thus it is arguably more important to model the fixed effects than to maintain the ordinality of the dependent variable. Here, based on the discussion above, a decision has been to take into account the omitted dynamics and the fixed effects rather than to give priority to the ordinal nature of the dependent variable. The results are as follows.

4 Results

This section records and discusses the results of the 'happiness' tests of human capital theory. To recap, the estimating procedure is to incrementally add log wage (2), and then job satisfaction (3), to the initial estimation of education and standard controls on life satisfaction. Following extensive consideration the preferred model is the autocorrelation corrected linear regression model. The dynamics that are omitted in standard static fixed effects regressions are modelled in the residual. These sets of 3 regressions are performed for everyone employed, and then restricting the sample to each gender. Recall that the restriction that the employed only are investigated is because this is an analysis of the returns to education via human capital theory.

Table 7 displays the results for all young employed individuals.

Table 7 Fixed effects estimates with AR(1) disturbances – life satisfaction and education: human capital tests for the employed only

VARIABLES	(E1) Life Satisfaction	(E2) Life Satisfaction	(E3) Life Satisfaction
Education: years of schooling	**0.03***	**0.03***	**0.02**
	(0.015)	**(0.015)**	**(0.015)**
Log wage		**0.14*****	**0.12*****
		(0.040)	**(0.040)**
Job satisfaction			**0.12*****
			(0.009)
Married	0.08*	0.09*	0.10**
	(0.049)	(0.049)	(0.048)
Separated	0.13	0.15	0.15
	(0.142)	(0.144)	(0.141)
Divorced	0.10	0.10	0.19
	(0.181)	(0.186)	(0.183)
Widowed	-2.43**	-2.42**	-2.10*
	(1.181)	(1.182)	(1.162)
Health: excellent	0.35***	0.34***	0.31***
	(0.038)	(0.038)	(0.037)
Health: good	0.20***	0.19***	0.18***
	(0.031)	(0.031)	(0.031)
age2324	-0.03	-0.03	-0.02
	(0.043)	(0.044)	(0.043)
age2526	-0.00	-0.00	0.01
	(0.063)	(0.063)	(0.062)
age2729	0.01	0.00	0.02
	(0.085)	(0.085)	(0.084)
Wave dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Constant	-0.09	-0.20	-0.17
	(0.205)	(0.204)	(0.202)
Observations	9,994	9,892	9,878
Number of pid	3,627	3,593	3,590

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For the young employed individuals, there is a positive relationship between happiness and education (5% significance), which is mitigated only somewhat when log wage is added (10% significance) and then eliminated entirely when job satisfaction is included (statistically insignificant at conventional levels of significance; p=0.113). For comparison purposes when the third estimate is run without log wage, education is significant at the 10% level, and is about 8% larger. Based on estimations (not reported here) education is a significant determinant of both job satisfaction and log wage.

These estimations are performed again restricting the sample to males and then to females. The results are striking.

Table 8 Fixed effects estimates with AR(1) disturbances – life satisfaction and education: human capital tests for young employed males only

VARIABLES	(E1) Life Satisfaction	(E2) Life Satisfaction	(E3) Life Satisfaction
Education: years of schooling	**0.04****	**0.04***	**0.03**
	(0.019)	**(0.019)**	**(0.019)**
Log wage		**0.24*****	**0.19*****
		(0.063)	**(0.062)**
Job satisfaction			**0.12*****
			(0.012)
Married	0.09	0.09	0.11*
	(0.068)	(0.068)	(0.067)
Separated	-0.28	-0.27	-0.30
	(0.233)	(0.237)	(0.233)
Divorced	0.14	0.16	0.38
	(0.372)	(0.372)	(0.366)
Widowed	0.00	0.00	0.00
	(0.000)	(0.000)	(0.000)
Health: excellent	0.29***	0.29***	0.26***
	(0.052)	(0.052)	(0.052)
Health: good	0.17***	0.17***	0.15***
	(0.043)	(0.043)	(0.042)
age2324	-0.10	-0.10*	-0.07
	(0.059)	(0.059)	(0.059)
age2526	-0.03	-0.03	-0.01
	(0.085)	(0.085)	(0.084)
age2729	-0.04	-0.05	-0.03
	(0.115)	(0.115)	(0.113)
Wave dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Constant	-0.36	-0.44	-0.38
	(0.298)	(0.291)	(0.287)
Observations	4,977	4,921	4,913
Number of pid	1,775	1,758	1,755

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The pattern for the young males subsample is the same as that found for the young employed sample as a whole: education and happiness have a positive relationship, mitigated somewhat by income, and completely eliminated by job satisfaction and income. In contrast, for young employed females, table 9, there is no statistically significant relationship between happiness and education.

Table 9 Fixed effects estimates with AR(1) disturbances – life satisfaction and education: human capital tests for young employed females

VARIABLES	(E1) Life Satisfaction	(E2) Life Satisfaction	(E3) Life Satisfaction
Education: years of schooling	**0.01**	**0.01**	**0.02**
	(0.025)	**(0.025)**	**(0.025)**
Log wage		**0.08**	**0.07**
		(0.054)	**(0.053)**
Job satisfaction			**0.12*** **
			(0.014)
Married	0.08	0.08	0.09
	(0.070)	(0.070)	(0.069)
Separated	0.32*	0.33*	0.34*
	(0.184)	(0.185)	(0.182)
Divorced	0.17	0.17	0.23
	(0.217)	(0.225)	(0.221)
Widowed	-2.29*	-2.30*	-2.01*
	(1.230)	(1.234)	(1.214)
Health: excellent	0.40***	0.39***	0.36***
	(0.055)	(0.055)	(0.055)
Health: good	0.23***	0.22***	0.21***
	(0.045)	(0.045)	(0.044)
age2324	0.03	0.03	0.03
	(0.063)	(0.064)	(0.063)
age2526	0.03	0.02	0.03
	(0.092)	(0.093)	(0.091)
age2729	0.08	0.07	0.07
	(0.125)	(0.126)	(0.124)
Wave dummies	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes
Constant	0.07	-0.03	-0.02
	(0.288)	(0.289)	(0.288)
Observations	5,017	4,971	4,965
Number of pid	1,852	1,835	1,835

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Thus there is a clear difference in the results from males and females: gender does appear to matter. Young males do experience happiness benefits from education, which are mitigated somewhat by wages and completely eliminated with the further addition of job satisfaction. This result is consistent with an inclusive reading of human capital theory. For young employed females, there is no statistically significant relationship between happiness and education in these results. Future research could attempt to ascertain reasons for such a gender divide. Note that this difference is not due to sample size: approximately the same number of observations for males and for females are used in these estimates.

5 Concluding remarks

The conclusion of this study has two main thrusts: one methodological; and one arising from the results. Firstly, the methodological conclusion: autocorrelation is often a feature of panel happiness estimations and this needs to be tested for. In the literature it often is not. A user written programme, Wooldridge's *xtserial* was used to test for group-level serial correlation. The estimates of this investigation uniformly demonstrate that first order autocorrelation is present with a p-value of 0.00. Clearly, this consistent result indicates the presence of omitted dynamics that need to be modelled. Applied happiness researchers have a choice about how to model this and, while there are no systematic rules about what is best practice, there are various tests that can aid judgement. A popular panel data 'system' general method of moments estimator, implemented by Roodman's *xtabond2*, is replete with tests regarding its applicability. See Piper (2012) where this method was used to analyse the dynamics of the happiness data. Here, both economic reasoning and statistical testing informed a decision to model the dynamics in the residual and not via a lagged dependent variable. It is crucial that the common factor restrictions hold for this choice to be made. The choice of model needs to be considered both statistically and according to whether it seems appropriate given the investigation. Moreover, the impact of education on life satisfaction is highly likely, when estimated via dynamic panel methods, to be captured in the lagged dependent variable in a black box manner, and this is unhelpful (to say the least) for this study's analysis.

These decisions stem from a relatively nascent area of empirical analysis, and need – for now – to be judged on an individual basis, wherever serial correlation is present. An applied researcher needs to ask both what is statistically appropriate (here, both of these choices were) and whether the results are likely to be informative or not. Above, an argument is made for modelling (serially correlated) happiness data that deals with contemporary phenomena (e.g. health, marital status) analysed via the system GMM model. Yet where any impacts are likely to be captured by a more historic measure, we make a case for using the AR(1) model where the coefficients on the independent variables, when estimated jointly with unobserved dynamics in the residuals, will be more informative. The key message here is that serial correlation is something that needs to be considered, and there are careful choices that need to be made about how.

Secondly, the results are broadly supportive of the human capital theory. Based on this British data, it appears that there are wider happiness benefits to education (after controlling for income but not after also including job satisfaction), but this appears to be a male phenomenon only. For females there appears to be no statistically significant relationship between education and happiness. These gender results are particularly interesting given the trends in participation in the UK (see section 1). Hypothesis 1 does not find much support in this analysis: happiness benefits do seem to exist but only for males, and these disappear when both log wage and job satisfaction are in the model. Recall that there is a possible upward bias with regard to the education variable – the impact of education on future income not captured by current income – and as such this, coupled with our results above, offers further support for human capital theory, and less support for the wider happiness benefits. Hypothesis 2 finds qualified support: there are clear differences in the impact on males and females with regard to happiness and education. Females demonstrate no statistical association, whereas males do (somewhat). This offers evidence suggesting the need for a more systematic assessment of the heterogeneous nature of (or presence of structural breaks within) happiness data.

Future research needs to test for serial correlation, take it seriously if it is found, and consider testing the data for the genders and for different age groups (for example) separately, rather than just subsuming such sources of potential heterogeneity within a dummy variable inserted into an otherwise undifferentiated multivariate regression.

5.1 Further methodological discussion and limitations

It is perhaps unsurprising, but the results here are similar to those obtained via static fixed effects analysis (output omitted). Modelling the residual to take into account of the dynamics does not, here, change the qualitative results. While this may be the case with these estimations a more general finding is that somehow the dynamic nature of the life satisfaction data needs to be considered in the estimation procedure; something that is rarely done in previous published research. This should increase confidence in the validity of happiness regressions.

Modelling the dynamics within the explanatory variables via an estimator that uses the lagged dependent variable while ensuring that the statistical issues are addressed (Roodman 2006; Roodman 2009), changes the results completely.[14] This should not be a surprise given the discussion above, where it was decided that such a method is inappropriate in this case. In

[14] Years of schooling, when an independent variable in a dynamic regression (i.e. refelceting new information), is statistically insignificantly different from zero even when income and job satisfaction are not included in the regression (as in estimate 1).

other areas, the appropriateness (or otherwise) of such a model is often not considered, and researchers often fail to adequately explain what the results mean. A recent example is Fayissa et al. (2011), which investigates the impact of education on health status. The coefficients of the independent variable refer to new information conditional on the entire history of the data. Simple comparisons with static FE are not appropriate.

The results from GMM estimations, along with the non-rejection of the Common Factor restrictions, vindicate the decision to model the dynamics in the residuals. The coefficients for education in the static GMM results are, on average, ten times larger than those on the coefficients for the dynamic GMM results. This supports the argument made above that education is ‘as if it is a lagged variable already’ and that its impact would be captured historically – i.e. cumulatively - and not as ‘new information’ in the specific independent variable itself. Values from the previous years have a low association with current happiness; 90 per cent of the average response to the life satisfaction variables is based on current concerns/situations (Piper 2012). In this context dynamic system GMM modelling is particularly useful, but not when the investigation – as in the present case – centres on a more ‘historic’ variable. In such a circumstance, the correct procedure to model the dynamics that are a feature of life satisfaction data (at least within the BHPS), is to check whether the Common Factor restrictions hold and, if so, to model the dynamics in the residual of a static FE model. Finally, future studies need to address the issue of ‘structural breaks’ (gender, age range) in the impact of education on happiness (and perhaps on other areas too), as well as consider the most appropriate way to take into account the omitted dynamics that life satisfaction data contains.

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