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Education, Training and the Take-up of Preventative Health Care

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Centre for Research on the Wider Benefits of Learning

EDUCATION, TRAINING AND THE TAKE-UP OF PREVENTATIVE HEALTH CARE

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The Centre for Research on the Wider Benefits of Learning (WBL) was established in 1999 by the then Department for Education and Employment, now the Department for Education and Skills (DfES). The Centre's task is to investigate the social benefits that learning brings to individual learners and to society as a whole. The views expressed in this work are those of the authors and do not necessarily reflect the views of the Department for Education and Skills. All errors and omissions are those of the authors.

Executive Summary

1. This paper reports estimates of the effects of education on the take-up of preventative health services. In particular we focus on the uptake of screening for cervical cancer as the outcome, as an example of preventative activity.

2. Relationships between education and take up of preventative health services are not simple and depend, among other factors, on the nature of the health condition, the existence of public programmes on prevention, and social inclusion. We therefore focus on one preventative health service so that our results are clearer and easier to interpret.

3. The analysis aims to form part of an assessment of the potential benefits of education in terms of possible cost savings via health service utilisation.

4. There is a tendency in the field of public health to associate lower uptake of preventative care with low social class or poverty or low education. Whether the association is with class, education or income seems to be of little importance. This project aims to provide theoretical grounds and empirical analysis for the effects of education, as distinct from poverty or low social class, on preventative health care.

5. Data for this project come from the British Household Panel Survey (BHPS). There are three particular strengths of these data: (i) the panel structure; (ii) detailed information on education and training; and (iii) richness of control variables. These data allow us to consider educational effects in the levels, as well as changes in the levels, of uptake of smear tests.

6. This document lays out the theoretical framework and a general model for estimating educational effects on the demand for preventative health care. Education is operationalised in terms of prior learning and in terms of continuing adult learning. The effects of prior learning are modelled to predict the number of smear tests in 11 years and the effects of continuing adult learning to predict the uptake of smear tests each year. For each of these models, we describe the estimation strategy, offer some methodological considerations, and present empirical results.

7. Results using the model to predict uptake of screening in 11 years show that prior learning, measured by highest educational qualifications on completion of full-time education, is positively associated with the uptake of screening.

8. We find a threshold in the effect of education. Women with educational qualifications at Level 2 or above have a higher probability of having three or more screenings in 11 years than women with qualifications below Level 2. Estimated parameters indicate that the effects of Level 3 or Level 4 and above are similar to the effects of having Level 2 qualifications. This finding is relevant to current policies that aim to increase qualifications to Level 2.

9. The effect of educational qualifications on the uptake of screening remains statistically significant even after the inclusion of health controls, personal factors, confounding variables and factors that may channel any educational effects. We estimate that women with educational qualifications above Level 2 have a 5.7 percentage point higher probability of having more than two cervical smear tests in 11 years. They also have a 2.8 percentage point lower probability of not having any test in 11 years.

10. It is likely that the effect of prior learning represents a selection bias but it is noteworthy that the difference remains even after controlling for parental SES and that women's income and SES do not pick up the same selection bias effect. Therefore, we conclude that education is the dominant socio-economic determinant and one deserving of greater policy and research focus in the practice and study of the take-up of preventative care.

11. Using a model to predict changes in the levels of uptake of screening we find that doing adult learning, measured as an indicator of whether women had re-entered full-time education, or had taken any education, training schemes or courses as part of current and past employment, or were enrolled in any government training schemes, the Open University or correspondence courses, is associated with a 2.2 percentage point increase in the probability of utilising screening. This result holds after the inclusion of screening histories, health controls, socio-demographic and economic variables, time-invariant unobservable factors, period and regional effects.

12. Lack of information on time-varying elements that may affect education and uptake of health services, such as self-efficacy and motivation, imply that the associations found here may not reflect effects of education. Nevertheless, different tests for sensitivity indicate that educational associations with preventative health care are robust.

13. We estimate the benefits of adult learning in terms of cancer prevention. For each additional 100,000 women in adult learning we expect between 116 and 152 cases of cancer prevented.

14. We take the finding of the relation between adult learning and uptake of screening to mean that adult learning may have important extra benefits for society. However, because of the estimation problems described we cannot be sure that this is a genuine effect. A true assessment of causality can be obtained by conducting randomised control trials. We acknowledge that there are ethical and practical issues in relation to randomised control trials. We do not discuss them here. However, in the absence of this evidence, this paper does not claim causality of reported effects.

15. More specifically in terms of the problem of encouraging participation in cervical screening we find important differences in the uptake even of free universally provided National Health Service (NHS) services. Barriers to

uptake are not about income but are educational, cultural and social, including factors such as lack of awareness, time constraints and health behaviours. A comprehensive approach is needed to improve women's access in the UK. This approach requires the informed and subtle targeting of women by age, social class, and education. Improving access to screening services can be achieved through programmes that raise women's awareness and agency but also by improvements to general educational provision.

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Introduction

WBL has carried out a series of studies into the complex relationships between health and education/learning (Hammond, 2002; Feinstein, 2002; Feinstein and Hammond, 2004).[1] In this strand of research, this particular project analyses the specific issue of health service utilisation and considers how this is affected by education and learning.

It is well known that education, measured by years of education or highest qualification attained, is positively associated with health, measured as lower mortality or lower morbidity. The well educated experience better health than the poorly educated, as indicated by high levels of perceived health and physical functioning and lower levels of morbidity, mortality and disability. Several authors have reviewed the evidence and conclude that these associations are explained in part, at least, by effects of education on health (Grossman and Kaestner, 1997; Ross and Mirowsky, 1999). Hammond (2002) reviews the mutual effects of learning and health, with a strong emphasis on the factors that mediate the relationship between these variables. This project takes the research a step further by analysing differences in the take-up of preventative health resources by individuals of different educational backgrounds.

The project utilises data from the British Household Panel Survey (BHPS). There are three particular strengths of these data. Firstly, the panel structure of the data allows us to measure the effects of explanatory variables on the levels of service utilisation as well as on changes in the levels of service utilisation. Secondly, the BHPS contains detailed information on educational qualifications and training. Hence, we are able to quantify both the impact of levels of education, and of changes in education in adulthood, on the outcome variable. Finally, the data contain a rich set of control variables which we can incorporate into the model.

This report focuses on the socio-economic determinants of the take-up of preventative health care as a way of assessing causes of differences in the demand for preventative services. It places particular emphasis on the role of education. There are strong theoretical grounds for the view that education may be an important influence on the uptake of preventative health care and so a strong mediator of health inequalities. Therefore, the outcome that we analyse in this paper (cervical screening) is intended as an example of the wider issue of the demand for preventative health services, which we see as a health behaviour, although it is also important in its own right. Education can enhance the demand for preventative health care and hence reduce the cost of future treatments due to ill heath.

In relation to education we describe the channels for an association between education and service utilisation for preventative reasons. If we had access to appropriately rich data it might be possible to estimate this set of structural equations and evaluate the

[1] It is important to distinguish between learning and education. The former is a psychological process that can take place in any context whereas the latter is more socially and culturally bound and takes place in institutions (Hammond, 2002). Different degrees of formality and informality also play a role in the distinction between learning and education.

precise effects of education on each type of utilisation through each channel. That is not feasible currently. What we propose to estimate is the reduced form. This term (from econometrics) refers to the overall or averaged out set of relationships.

For example, if those with high education demand a greater quantity of preventative health service resource than do those with low levels of education, this may be the result of awareness and health knowledge and/or social inclusion. The positive effect of education on health service utilisation may be the combination of both effects. However, we are not able to quantify the strength of each channel.

1.1 Policy relevance

This project is embedded in a contemporaneous concern regarding health provision in Britain. One of the top priorities of the British government has been to provide and to secure access to high quality health services for the population. Wanless (2002 & 2004) suggests that the government's strategy is based on improvements to the supply of health services and on reductions in the demand for health care.

The supply for health services can be improved by increasing the productivity of National Health Service (NHS) staff, improved buildings and with the introduction of new technologies. At the same time, reductions in the demand for health care should be induced by preventative measures such as health promotion initiatives (Wanless, 2004). Thus, the NHS should be seen not only as a curative service but also as a prevention service to promote the health of the nation. This highlights the personal responsibility of the individual to look after their own health as far as possible. Part of the individual responsibility is to take advantage of the national health provision, including preventative care.

In a recent article in the Guardian (23 October 2003) the government announced that all women aged between 25 and 50 in England will be offered screening for cervical cancer every three years instead of the previous five years in an effort to further reduce the impact of the disease, which killed 927 women in England during the previous year.

The article mentioned that the government accepted recommendations from scientists working for the charity Cancer Research UK for consistency in the frequency of smear tests, which varied across regions from every three to every five years. Melanie Johnson, the public health minister at the time, told a conference on cancer that the government would help to fund the changes by making £7.2m available over two years.

The aim of this project is to inform a cutting edge policy issue. We hypothesise that socio-economic factors influence women's demand for preventative health services. We therefore investigate the effects of education, as well as other variables, on the probability that women undertake a smear test when they should. Public policy should aim to stimulate women's demand for this and other forms of preventative health care. We propose that education is one of the factors that affects this demand.

1.2 Organisation of the report

This report is organised as follows: Section 0 describes the theoretical framework for the relationship between education and the uptake of preventative health care. In this section we also review the determinants of the demand for preventative health care placing particular emphasis on the role of education and the channels for the transmission of educational effects.

Section 3 explains the methodology for the analysis. In particular, section 3.1 proposes a general model for estimating purposes, section 3.2 describes the structure of the data, the possibility to explore the effects of prior learning on the number of smear tests taken in 11 years (in section 3.3) and of continuing adult learning on changes in the levels of screening uptake (in section 3.4).

Results from these two sets of analyses are presented in section 4, for prior learning, and in section 0, for continuing adult learning. These sections also contain post-estimation estimations such as marginal effects and sensitivity analysis. The conclusions are in section 6.

2. The relationship between education and preventative health services

2.1 Education and health

The interrelation between health and learning comprises three main components (Hammond, 2002). First, better health enables individuals to continue in education for longer. In our current context this is a kind of reverse causality, backwards from health to learning. Second, external factors such as family background, parental income and/or social context can affect both health and education (confounding bias). Finally, increases in education can result in health improvements through the channels discussed below. In econometric terms, the first two of these relations can induce a selection bias in the estimation of education effects; individuals predisposed to better health are likely to also achieve higher levels of education. The last relationship is the *causal* relationship of interest, education resulting in improvements of health.

2.2 Health service utilisation

We are concerned here, however, not with health per se but with health service utilisation. This introduces a number of complexities and it is important, first, to consider the main elements of health service utilisation:

(i) a preventative element which is manifested through the use of health services for preventative reasons (e.g. regular check-ups);

(ii) a responsive element, characterised by individuals' use of health facilities in response to diseases, pains, accidents, or in general poor health conditions which usually limit daily activities;

(iii) a care element such as when vulnerable groups (children, pregnant women, elderly) utilise health services to monitor their health condition.

These different forms of take-up are important in different ways and the differences between them can highlight the point that from a cost-benefit perspective it is not the case that all forms of utilisation of health resources are socially sub-optimal. Preventative health should lead to savings in the long-run by decreasing the likelihood of subsequent treatment due to ill health conditions. Even responsive treatment will be beneficial in terms of quality-adjusted life years (QALYs) and other quality of life terms.

2.3 The demand for health

Early work on the demand for health was undertaken by Grossman (1972)[2]. His model affords insights into the demand for medical care and also into the determination of health itself. In Grossman's model, individuals inherit an amount of health stock that can depreciate or increase over time depending on the choices of individuals. Health investment comes from health-promoting activities, such as exercise and a balanced diet. Depreciation of the stock of health follows with age, but also by means of the consumption of health-damaging goods such as tobacco, alcohol, drugs.

In the Grossman model, individuals generate utility directly by means of having and maintaining a good health status but also indirectly by increasing their productivity in the labour market (Wagstaff, 1986). The Grossman model follows an individual level approach wherein choices are made to maximise discounted lifetime utility subject to a number of monetary and health technology constraints. A number of research projects, both empirical and theoretical, have followed this approach. Others, however, have criticised the individual utility maximisation approach since it fails to recognise the concept of social welfare and it overlooks the balance between market efficiency and fairness, i.e.; all individuals, regardless of their socio-economic status (SES), having access to health services (Davis, 2001; Rice, 2001).

Our analysis examines individual level determinants of the take-up of preventative health care. This approach is consistent with utility maximising individuals in their specific socio-political environment. In this sense, an individual demand for health services in Britain will reflect the unique aspects of the NHS and the broader, contemporary social context.

In general, the choice of individuals to utilise health services can be influenced by a number of factors including the price paid for the services, whether access to private or public health insurance exists, the initial and current health condition of the individual, the geographical proximity to clinics or hospitals, the level of education as

[2] Demand and supply of health services are complex issues since they involve interactions between individuals, private sector and government. Theoretically, the demand for health will be defined as the quantity of services individuals are willing to purchase at each conceivable price. The demand for health, also known as the demand function, is not observable, but what we do observe is the quantity demanded, that is the take-up of health resources.

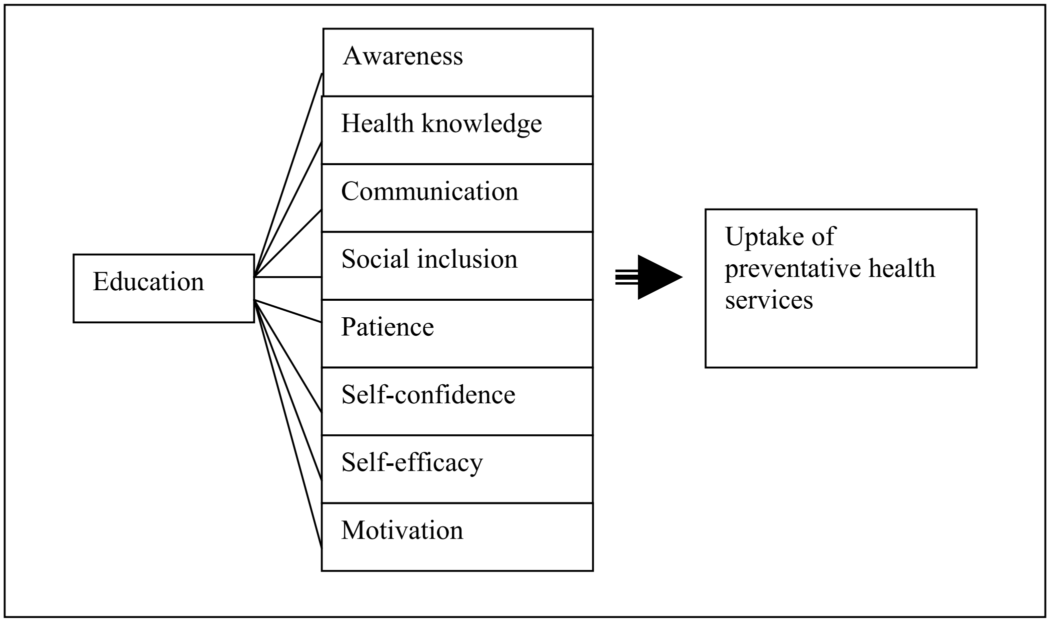
well as knowledge about health related issues, and their age and sex, income and occupation, current social context as well as social background. We focus here on the role of education and continuing learning and do so by laying out a theoretical framework for the association between education and the uptake of preventative medicine.

2.3.1 Effects of education on health services: the preventative element

Education can enhance the demand for preventative health services for several reasons (see Figure 1). Education has a direct effect on preventative health by raising awareness of the importance of undertaking regular health check-ups and hence the willingness to do so (Harlan, et al. 1991; Simoes, et al., 1999; Hammond, 2002). Education may also improve the ways in which individuals understand information regarding periodical tests, communication with the health practitioner, and the interpretation of results (Sligo and Jameson, 2000; Hammond, 2003).

Education improves accessibility to services if it enhances the inclusion of individuals in society and provides the means and incentive for individuals to know and demand their rights to receive health care from the government. LeGrand (1982) points out that, even with public provision of health services, access is biased towards the better educated groups, who possess superior information about, and greater willingness to claim, their entitlements.

Figure 1: Mediating factors of educational effects



Other mechanisms by which education may affect the take-up of preventative health are efficacy and confidence. Education increases individuals' efficacy – their power to take control of their lives – and self-confidence, empowering them over future choices, including the choice to undertake periodic health tests. Education can also improve access to health services by increasing patience and motivation. Patience enhances demand for preventative health care by lowering the discount rate on future ill heath, hence placing a higher valuation on prevention today than on ill heath tomorrow. Motivated individuals maintain better health through positive attitudes to life and regular health check-ups.

2.3.2 Other determinants of preventative health service utilisation

Other determinants of the demand for preventative health care include age, gender, household income, price, availability of insurance, spatial location of clinics and hospitals, and the quality of services. Variations in service uptake arise from the interactions between supply and demand which depends on preferences, perceptions and prejudices of patients and health care providers (Goddard and Smith, 2001).

Age and gender

Preventative health care can be gender or age specific depending on the health condition. For example, a gender-age differentiation results from the fact that cervical smear tests are generally offered to women between the ages of 20-65. Another gender differentiation is the expected use of clinics and hospitals by women during maternity.

Increasing age reduces physical capabilities, which undermines health and so calls for an increase in the use of health services (Jackson, 2001). But age specific demand for regular check-ups also includes younger groups such as the demands of mothers and babies. After childbirth, the midwife makes daily visits, and then the health visitor monitors the mother's and baby's progress until the baby is six weeks old (NHS, 2001).

Morbidity and risk behaviours

Another dimension of the demand for health services is health condition or morbidity. Certain health conditions must be monitored regularly in order to maintain the patient under medical supervision. Regardless of their age, adult women with a family history of breast cancer are requested by the NHS to undertake periodical breast screening. Other health conditions that require regular monitoring include diabetes, high cholesterol and high blood pressure.

Health behaviours are closely related to health risk factors, which increase the likelihood of developing certain conditions such as cancer. This is a twofold problem. On the one hand, persons who engage in high risk behaviours such as smoking, lack of daily exercise, binge drinking, extreme exposure to UV rays, and drug abuse, are less likely to utilise preventative health care since, in general, they find it harder to comply with recommended guidelines for regular tests or screenings. At the same time, these high risk behaviours are highly associated with risk factors for cancer, accidents and HIV, which indicates that the health of these individuals should be monitored closely.

Income

Research has documented a positive area level relationship between income and access to health resources which is inversely moderated by health. This relationship is known as the 'inverse care law'. This law states that although richer individuals have better health on average they are also better able to use health resources. Therefore, in this conditional sense the provision of care is inversely related to health need! (Hart, 1971, West and Lowe, 1976, and Whitehead, 1988) Wagstaff (2002) mentions that in most OECD countries the poor tend to use health services more than the better-off, and the question arises as to whether the greater utilisation fully meets the greater medical needs of the poor.

In terms of preventative health care, recent evidence from the US, Canada and Australia has shown that women living in income poverty are less likely to take up tests for cervical cancer (Kang and Bloom 1993; Rimer 1999; Katz and Hoffer 1994; Katz et al 1994; Taylor at al 2001; Selvin and Brett 2003). One possible explanation is that provision of preventative health care is costly so women living in poverty are constrained by low income from utilisation of the service. But this result is found in Canada, where insurance coverage is uniform, universal, and requires no patient cost-sharing and in Australia, where Medicare covers 75% of medical costs (Katz and Hoffer 1994; Katz et al 1994; Taylor at al 2001). In the UK, income should not be a barrier for uptake since the NHS offers free universal public provision of tests for cancer. UK evidence suggests that low uptake may be linked to socio-economic status

(SES) (Goddard and Smith, 2001). However, a study using individual level data found that women living in rented housing were less likely to go for screening, but other indicators for SES were not predictive of attendance (Sutton et al., 1994).

Price

In the UK, every individual is covered by the NHS, which is paid for through taxation (National Insurance). Having a screening test does not incur any additional cost and therefore no price variables directly affect the demand for health services in the UK except for transport costs and the opportunity cost of time when utilising the service (Windmeijer and Santos-Silva, 1997; Propper et al., 2001). This opportunity cost is the time spent in care or treatment. Having private medical insurance does not affect either the direct or the opportunity costs of having a cervical smear test, nor the quality of the service. A person in the UK who has private insurance remains covered by the NHS, and still pays the same contribution towards it. Private insurances tend to offer more choice at the elective specialist level, but less at the GP level (Windmeijer and Santos-Silva, 1997), and cervical smear tests are conducted mainly in GP surgeries or in family planning clinics.

Spatial factors

The spatial allocation of hospitals and health care centres also affect the demand for services. From the demand side, the closer the hospital is to a particular neighbourhood, the lower the cost of commuting and the opportunity cost of time, hence a greater demand for services. Geil, et al. (1997) found that distance is a statistically significant predictor of hospitalisation demand in Germany.

Quality of services

The quality of the service provided also plays an important role in the decision of individuals to utilise the service. Low quality services indicated by long waiting times, poorly trained practitioners, or a lack of health technology, decrease willingness to utilise services. For example, Blundell and Windmeijer (2000) use waiting times as a cost when modelling demand for health services in the UK.

2.4 Re-centring the role of education

In the health economics literature, education has been considered in the demand for health equation primarily as a control variable. Past studies have found that the effects of education on the demand for health services are extremely ambiguous:[3] Rosett and Huang (1972) obtained a negative effect on demand; Wagstaff (1986) found a positive impact; Geil et al. (1997) report no overall effects of education on hospitalisation in Germany; Windmeijer and Santos-Silva (1997) found that in the UK people with

[3] This has followed whether education has been measured by years of education or highest qualification attained. To the best of our current knowledge no other aspects of learning have been considered.

higher levels of education visit the doctor less frequently than those with lower levels of education, with the exception of the most highly educated.

For preventative health care, although the NHS offers free universal public provision of tests for cervical cancer little is known about the role of education in service utilisation in the UK. In 2000, Jepson et al. carried out a systematic review to examine factors associated with the uptake of screening programmes using data from several developed nations. For the particular case of cervical screening programmes, they used twelve studies to investigate socio-economic and demographic determinants of service uptake. None of these were in the UK. In another more recent review of inequalities of access to screening, Chiu (2003) mentions that variables shown to have a particular and consistent negative effect on the uptake of screening were low income, low education and age. Once again, studies used by Chiu were based in the US and Canada.

In 2001, Goddard and Smith reviewed the evidence on equity of access to preventative health care in the UK. For cervical screening, most evidence suggests that low uptake is linked to deprivation at an area level and poor SES at an individual level. However, they found that in the study by Sutton, et al. (1994) the association with SES disappeared in a multivariate analysis. This may be because important interactions exist between SES and other variables, particularly education. We return to this issue after presenting our own results.

None of these studies aim to understand the specific effects of education nor the channels through which education can affect the demand for preventative health care. In this report, we provide a theoretical framework together with empirical evidence on the relationship between education and the uptake of screening for cervical cancer, as an example of a preventative activity.

Our research contains three key advantages over past studies. First, although the inverse care ‘law’ is known to exist for income it has not hitherto been established how it operates with respect to education. Second, we consider education not only as a broad measure of years of schooling or highest qualification attained but also in terms of continuing adult learning. Finally, the panel data contain women’s histories of screening which allows one to control more effectively for individual heterogeneity and makes it possible to obtain robust inferences about the population of interest.

3. Method

3.1 A general model

Let us approximate the effects of education on preventative health service utilisation by the function *f*, such that:[4]

$$S_{it} = f(Ed, X, Y, \alpha_i, \lambda_t, \eta_{it}) + e_{it} \qquad (1)$$

where *i* denotes individuals and *t* stands for time. *S* denotes uptake of service, which is a function of education (*Ed*). *X* is a matrix of individual, demographic characteristics such as age, sex, income, and marital status among others. *Y* is a matrix of variables that affect access to services such as social context, distance from the clinic, average waiting times and so on. Individual time invariant fixed effects are denoted by α_i; period heterogeneity that affects all individuals in a particular year, λ_t; time-varying individual heterogeneity in service utilisation such as changes in self-efficacy, η_{it}. Measurement error is captured by e_{it}.

We hypothesized that the main channels for the relationship between health resource utilisation and education are social inclusion, self-efficacy, confidence, motivation and patience (Figure 1 above). The effect of education on the demand for preventative health services estimated by this model will measure the aggregate effect, or combined effect, of education through each of the main channels.[5]

Ideally we could estimate the full system but that would require extremely detailed data. Even the reduced form, though, is difficult to estimate and will depend, among other issues, on the structure of the available data, the measurement of service utilisation, the assumption made about the function *f*( ), information on education and other control variables, and the problem of measuring unobservable heterogeneity. This last issue is particularly serious as it may induce selection bias on the estimate of the effect of education. The next 3 sections (3.2-3.4) confront these challenges for the empirical estimation of the above model.

3.2 The structure of the data and sample selection

The BHPS was designed as an annual survey of each adult (16+) member of a nationally representative sample of more than 5,000 households, making a total of approximately 10,000 individual interviews. The same individuals are re-interviewed in successive waves or sweeps and, if they split off from original households, all adult members of their new households are also interviewed. Children are interviewed once they reach the age of 16; there is also a special survey of 11-15 year old household

[4] It is important to clarify that we will not be estimating a demand-supply system, but rather looking at the determinants of service utilisation or service demanded.

[5] In Section 2.4 of this report we mentioned that in the empirical literature, education has an ambiguous effect on take-up of services. This occurs due to the combined effects that education has on different types of resource take-up. It is important to have a clear understanding of the mechanisms by which education affects resource utilisation to explain this ambiguity.

members from 1994. Thus the sample is broadly representative of the population of Britain as it changed through the 1990s (Taylor et al. 1996).

There are 11 waves in the BHPS. Not all individuals participated continuously in the study. Of the original 10,264 individuals, 35.1% participated in all waves of the survey. Close to 6% only missed one year. Nearly 19% participated only once between 1991 and 2001. The other 40% of the sample have other patterns of participation, twice, three times, and so on. As additional information, 5,532 individuals joined the BHPS after 1991 (some of them children from interviewed household once they reached 16 years and others due to new household formation).

This report focuses on the effects of education on the uptake of screening. It is therefore necessary to restrict the sample to include only adult women who were eligible for screening.[6] According to the NHS (2002), the target age group for invitation to screening is 20-65 years, however since many women are not invited immediately they reach their 20th birthday, inclusion of the 20-24 age group gives a less accurate estimate of coverage of the target age group. The NHS coverage figures are based on women aged 25-65.

The BHPS provides 11 years of information on smear tests (see Appendix I). Our inclusion criterion is women who were eligible for a cervical smear test between 1991 and 2002; that is women aged 25-56 in 1991. Using this age group is important since it provides information on the histories of screening. In order words, each woman in this sub-sample, who was registered with a GP, is eligible for screening and should report whether or not screening occurred when participating in the survey.

Education is operationalised as (i) prior learning and (ii) continuing adult learning. Prior learning is measured by the highest educational qualification attained at the end of full-time education. Continuing adult learning encompasses all education whether formal or informal in the last 11 years, but after the completion of initial full-time continuous education. Therefore, a further sample restriction is to include adult women who have completed full-time education. This gives us a clear cut-off point between prior learning and continuing adult learning.

The panel structure of the data and the operationalisation of education allow us to conduct two sets of analyses. The first set is concerned with predicting the levels of screening uptake of women on the basis of their qualification level. This provides a descriptive assessment of the probability of screening take-up for women with different levels of education. The second set of analyses is concerned with the effects of participation in adult learning in *changing* the probability of take-up of screening. The particular estimation issues for these analyses are discussed below.

[6] Using a sub-sample could potentially bias results due to attrition. Contoyannis, Jones and Rice (2004) show, however, that although the BHPS shows clear evidence of health related attrition, this does not distort the evidence on state dependence and of the socio-economic gradient in health, which is the interest of this report.

3.3 Estimating the effects of prior learning

For the first set of estimates, we utilise the number of smear tests taken by women in 11 years to assess whether prior learning has an effect on the uptake of screening. The specific estimation issues for this analysis are the: (i) definition of the screening variable; (ii) definition of prior learning; (iii) use of *step-wise* estimation; (iv) description of other control variables; (v) estimation method, strategy and techniques used for post-estimation; and (vi) limitations of the analysis. We describe each in turn in the following sub-sections.

3.3.1 The screening variable

Research estimating the socio-demographic predictors of screening mainly utilises retrospective information on cervical screenings (Jepson et al., 2000; Taylor et al., 2001; Selvin and Brett, 2003). Using the panel structure of the BHPS, it is possible to generate a forward looking categorisation for cervical screenings. Starting from 1991, we expect that during the 11 year period covered by the BHPS women would have, on average, three to four cervical smear tests.[7] Since the periodicity of the test depends not only on the NHS regional policies but also on results from previous tests we further assume that women having more than four tests do so in response to medical recommendations. For the purposes of estimating take-up of preventative care this is a positive outcome, even if a bad outcome in health terms. We assume that having fewer than three tests in 11 years implies under-utilisation.

Three categories are generated to summarise 11 years of reported cervical smear tests for women aged 25-56 who always participated in the BHPS. The first group includes women who did not have any smear test in 11 years. The second group consists of women who had one or two smear tests in 11 years and the third group contains all women who had three or more smear tests in 11 years. This categorisation implies that having one or two preventative tests in 11 years is better than having none; and having three or more is better than having one or two. Hence, there is an implicit ordering in the outcome variable.

[7] The number of smear tests observed in the data depends on the periodicity of the test as well as on the results from previous tests. According to the NHS (2002), around 85% of Primary Care Trusts invite women for a smear test every three years and 15% have a mixed policy, inviting women every three or five years, depending on their age. Therefore, we expect that women will report, in most cases, one test in every three years. But screening intake also depends on the results of previous screening. Those women who receive inconclusive results are requested to take the test again. For this reason some women have tests in consecutive years.

Table 1: Cervical smear tests by age in the BHPS

Age Group	Number of smear tests in 11 years (percentage)			Marginal
	None	*1-2*	*3+*	
25-35	3.8	22.7	73.5	40.5
36-45	11.9	25.7	62.4	32.4
46-56	23.8	30.3	46.0	27.2
Marginal	11.9	25.7	62.4	

Notes: Data in this table are based on 1,948 women ages 25-56 participants in all waves of the BHPS.

For each female participant in the BHPS we obtain one outcome variable summarising the uptake of screening in 11 years. Of the 1,948 women aged 25-56 participants in all waves of the BHPS, 11.8% reported not having any smear test in 11 years, 25.7% reported having one or two tests and 62.4% reported three or more tests (Table 1). There is a clear gradient with respect to age. Over half of women not having any tests (54.5%) were aged 46-56 in 1991, whereas 47.6% of women aged 25-35 in 1991 had three or more tests.

3.3.2 Definition of qualifications

Prior learning is measured by the highest educational qualifications attained. Educational qualifications in the BHPS are converted to an equivalent NVQ level (see Appendix I). For all women, aged 25-65, participants in the BHPS, we estimate the distribution of initial qualifications. Initial qualifications are defined as those already obtained by women when they are first recorded in the data. Table 2 describes the qualification levels attained by the women in this sample. The percentages with each academic qualification level are reported in column 1, vocational qualifications in column 2. In column 3 we report the percentage with vocational qualifications at each level, considering only women with academic qualification below Level 3. This highlights the distribution for those women for whom vocational qualifications may be particularly valuable. Column 4 reports the distribution of attainments for academic and vocational qualifications combined.

Table 2: Distribution of prior qualifications, in level equivalents, for women 25-65 in the BHPS

LEVEL	Initial Educational Attainment			
	academic	vocational	vocational if academic<3	Total
	Percent			
0	36.6	55.0	57.6	27.4
1	20.9	23.8	23.4	22.0
2	25.1	4.8	5.4	21.9
3	7.3	4.7	5.1	9.4
4	8.8	11.7	8.5	18.0
5	1.3	n.a.	n.a.	1.3
Total Respondents	5,287	5,287	4,366	5,287

Notes: The variable 'other school qualifications' was classified as academic qualification Level 1 and the variable 'other training, professional or higher qualifications' as vocational qualification Level 1. We estimate that 2.9 and 12% of our sub-sample reported one of these qualifications the first time they participated in the BHPS, respectively. Missing values: 111 cases.

Results from Table 2 show that 6 out of 10 women had obtained an academic qualification when they first joined the BHPS whereas only 45% had a vocational qualification. Once we omit women with high academic attainments, the percentage of women with Level 4 vocational qualifications decreases from 12-8.5%. Column 4 shows that slightly less than 30% of women had a qualification above Level 2 when they first joined the BHPS.

3.3.3 Step-wise estimation

We perform step-wise regressions. This process works by estimating the effects of prior learning on the take-up of smear tests in 11 years using controls that are not correlated with education. We then include income and employment variables and analyse how the effect of education on screening changes as a result of adding these controls into the model.

Including these variables in equation (1) requires careful interpretation. Income and employment may be independent sources of effects on preventative care that provide alternative policy levers. However, they may also be channels for the effects of education. Including them in regressions may result in over-controlling and an underestimate of the true effect of education. Some of the benefits of education will be mediated by income, say, so including income in the model will knock out part of this genuine effect of education. Therefore, models with socio-economic variables that are determined subsequently to education do not enable precise estimation of the effect of education.

However, these regressions allow us to assess which socio-economic variables are significant determinants of the uptake of screening. That is, we would like to determine which of the features of SES matters for screening, whether it is income, class, occupation, employment or education. A result showing that education remains a significant determinant of screening, with the other socio-economic variables not being statistically associated, provides evidence that education rather than income or class may be the key predictor of screening. This has important implications for policy that we return to in the conclusions.

3.3.4 Other control variables

Although we have up to 11 years of information for each of the control variables, in this analysis we utilise one observation of the variable per woman. Therefore, we need to adjust each control variable to account for prior effects (the size of the variable in 1991) or average effects (the average of the variable).

Our aim is to estimate the effect of prior education on the uptake of preventative health. Ideally, we would like to control for confounding bias, i.e. factors that affect educational attainments and the uptake of cervical smear tests, in order to establish the causality of education and quantify its effects. The only factor prior to education that is available in the data is parental socio-economic occupation. Parental SES is one of the most important predictors of educational attainment since it contributes directly and indirectly through its effects on intervening variables like hours spent on homework or children's aspirations (Eccles et al., 1993). Parental SES also affects individuals' access to resources and hence participation in cervical screening (Taylor et al., 2001). We expect that the inclusion of parental SES partially controls for confounding bias.

Parental SES is obtained by the Registrar General's Social Classification (RGSC) using information from the main employment. For parental SES we utilise the main employment of the father (or the mother). Under the RGSC individuals are classified according to their occupation as professional, managerial and technical, skilled non-manual, skilled manual, partly skilled occupation, unskilled, armed forces and not applicable for those that have never worked (see Standard Occupational Classification, 1991). For estimation purposes, we re-categorised this variable in five SES categories: SES 1 for professional, SES 2 for managerial and technical, SES 3 for skilled and armed forces, SES 4 for semi-skilled, SES 5 for unskilled, and unclassified.

Age is a main determinant of cervical smear tests (Jepson, et al., 2000; Chiu, 2003). We divide age into three categories to capture a potential non-linearity in the relationship: ages 25-35, 36-45, and 46-56 in 1991. Per capita income was estimated using the McClements (1978) equivalent scale to allow for household size and needs in making income comparisons. Income is measured in quintiles according to per capita household income in 1991. Women's SES is based on their occupation in 1991. The variable for employment was generated as follows: if the woman was not in the labour force for 9 out of 11 years we classified her as 'mainly not working'; if she worked for 10 or 11 years we classified her as 'mainly employed'; and if any other combination was classified as 'both employed and not in the labour force.'

Other control variables in this analysis include health related controls and personal life circumstances. For health related controls we include self-reported health status in 11 years. This can be excellent, good, fair, poor, and very poor. We also estimate the average General Health Questionnaire (GHQ) measure of well-being for 11 years using the Caseness scale.[8] Tobacco smoking is included in the analysis to control for health risk factors. We include an indicator whether women smoke in period 1. Finally we control for personal life circumstances that may affect screening such as having a partner in 1991, having a child by 1991, and the average number of children under the age of five.

In this set of estimations we do not control for ethnicity since we have a small number of women from ethnic origin other than white, only 3.5% of the sample.

3.3.5 Estimation method, estimation strategy, and post-estimation techniques

We employ an ordered probit to estimate the parameters of the model (see Greene 1997 for full specification of the ordered probit model). Parameters are interpreted as increasing or decreasing the likelihood that women belong to each of the ordered categories; having no smear tests, having one or two smear tests, or having more than two smear tests in 11 years.

The estimation strategy is as follows: first we estimate a simple ordered probit model that includes prior educational qualifications as the only predictor of the probability of taking-up none, one or two, or more than two smear tests in 11 years. Then, we include age and parental SES as controls and verify what happens to educational effects. We then perform step-wise regression with the inclusion of socio-economic variables. Finally, we include health controls and domestic life circumstances and describe the results.

In order to assess the mediating effects of prior learning we perform the last estimation for different sub-groups of the population (sensitivity analysis). In other words, prior learning may be an important mediator of the effects of domestic life circumstances or health behaviours in that education may change the relationship between the variable and the outcome.

Finally, we calculate marginal effects to quantify the impact of the explanatory variables on the probability of each outcome (belonging to each category). These represent the change in the probability of belonging to each category that is associated with changes in each explanatory variable, holding all other explanatory variables constant.

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[8] The Caseness scale (Cox, 1987) converts the answers to 12 questions on well-being to a single scale by recoding values 1 and 2 of individual answers to 0, and values 3 and 4 to 1. Then summing and giving a scale running from 0 (the least distressed) to 12 (the most distressed). Questions on well-being include concentration, loss of sleep, feeling capable of making decisions, feeling useful, being constantly under strain, having problems overcoming difficulties, enjoying day-to-day activities, being able to face problems, feeling unhappy or depressed, losing confidence, belief in self-worth and general happiness.

3.3.6 Limitations of the analysis

Analysing the effects of prior learning on the uptake of screening using this methodology has its limitations. This methodology does not utilise the full structure and information of the data. For this reason, the outcome and all explanatory variables are limited to take one value when in fact there are 11 years of information. In terms of equation (1), this implies that we ignore the period when the variable is observed (denoted by the subscript t). The estimation method also ignores the unobserved heterogeneity shown in equation (1), indicated by α_i, λ_t, and η_{it}.

In general, results ignoring the panel structure of the data (by assuming cross-sectional information) limit the scope for inference. For example, the result obtained for the United States by Selvin and Brett (2003) that non-Hispanic white women with a bachelor's degree of higher education have an uptake of cervical screening which is 2.5 times greater than that of women with less than high school, may just reflect unobservable differences between these groups of women. One cannot determine whether education leads to an increase in uptake or whether education is simply acting as a proxy for other individual characteristics. In order to distinguish between these two possible explanations for the role of education one might utilise changes in women's levels of screening as well as changes in educational qualifications.

3.4 Estimating the effects of continuing adult learning

For the second set of estimates, we utilise yearly information on women's cervical screening to assess whether continuing adult learning has an effect on the uptake of cervical screening. The specific estimation issues for this analysis are the: (i) screening variable; (ii) definition of adult learning; (iii) modelling unobserved heterogeneity; (iv) sequencing problem and cycles of smear tests; (v) other control variables; (vi) estimation strategy and techniques used for post-estimation; and (vii) limitations of the analysis. We describe each in turn in the following sub-sections.

3.4.1 The screening variable

Our outcome variable is an indicator of the take-up of cervical screening in year t. This indicator takes the value of '1' if a smear test occurred.

Figure 2: Self-reported screening, NHS provision only

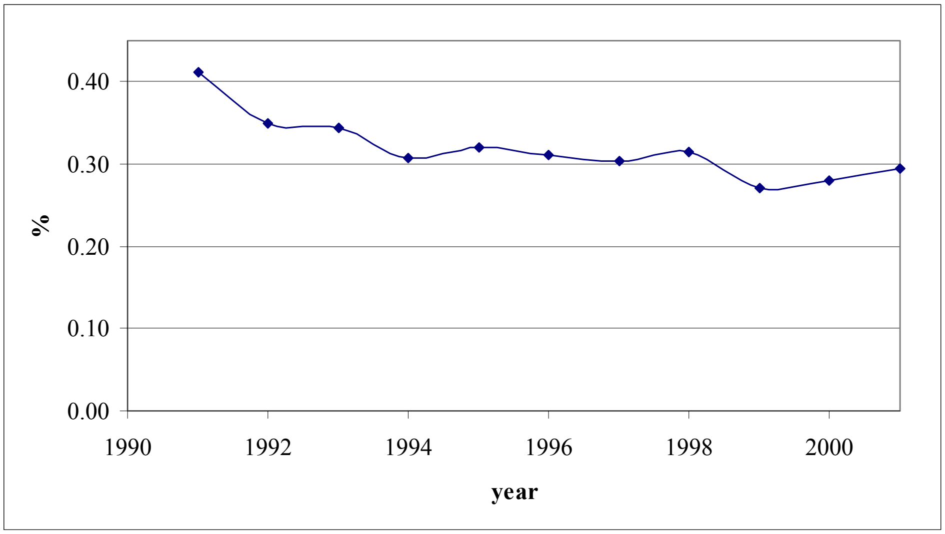

Figure 2 shows the percentage of women who reported having a smear test provided by the NHS from 1991. Due to the 3 year cycle, this figure demonstrates that from 1994 onwards one-third of women have smear tests. Between 1991 and 1994 there is a downwards trend in uptake. This may be explained by the introduction of the computerised call-recall system in the Cancer Screening Programme in 1988 and the 1990 target payments received by GPs for encouraging their patients to be screened (NHS, 2002). That is, after the introduction of these schemes there was a large increase in uptake that then returned to its long-run or steady state level over time[9].

3.4.2 The adult learning variable

Our policy variable for the second analyses is continuing adult learning. This variable takes the value of '1' if during year *t* women re-entered full-time education, or had taken any education, training schemes or courses as part of current and past employment, or were enrolled in any government training schemes, the Open University or correspondence courses.

[9] Including yearly controls should capture these variations in screening.

Figure 3: Participation in training by educational level in the BHPS (%)

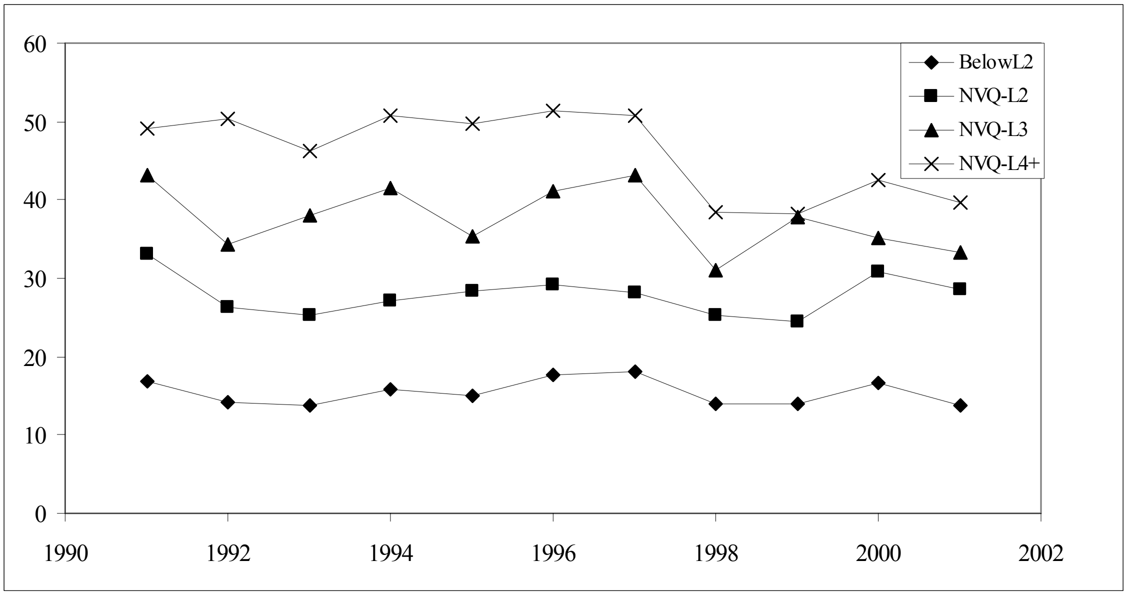

Figure 3 shows how participation in training schemes depends on prior educational attainment, the higher the level, the more participation in training. In 1991, nearly half of the women with educational qualifications Level 4 or above received training or were enrolled into courses or educational schemes. Only 17% of those women with a qualification below Level 2, including those with no qualifications, participated in adult education. In 1998 the BHPS modified the question on training, which may explain why there is a sharp decline in the percentage of participation in training in Figure 3. Since the ordering of training by prior learning is not modified, we do not expect that this drop in the series will affect estimation of parameters.

3.4.3 Modelling unobserved heterogeneity

The panel structure of the data allows us to control for some of the unobserved heterogeneity which we described in equation (1) as α_i, λ_t, and η_{it}. The first type of unobserved heterogeneity, α_i, is individual time-invariant. An example of this type of heterogeneity is stable personality traits, which, regardless of the year of the interview, will be the same for each individual. This will be the case if, for example, sanguine personality type women take-up more smear tests than phlegmatic personality type women (Keirsey & Bates, 1978). Time-invariant unobserved heterogeneity can be dealt with in the empirical model using fixed or random effects. Fixed effects estimation absorbs the effect of time-invariant heterogeneity with the inclusion of individual intercepts in the model. This is statistically equivalent to an analysis in changes rather than levels. Essentially, the effect of individual time-invariant heterogeneity is cancelled out in this approach because time-invariant factors do not easily explain changes.

Random effects estimation models this heterogeneity as a random disturbance. This assumes that the unobserved time-invariant heterogeneity is not related to the decision to engage in adult learning. For this outcome the assumption of random effects is a strong one. Mundlak (1978) proposed that the correlation between the explanatory variables and the unobserved time-invariant heterogeneity can be explicitly modelled and dealt with in the estimation. The approach is to incorporate the average value of our time-dependent variable (adult learning) in the estimation. This takes out the bias on the estimate of the adult learning caused by correlation of adult learning participation and unobserved time-invariant heterogeneity.

The decision of whether to use fixed or random effects is not straightforward when dealing with non-experimental data, as in our case[10]. In this paper we adopt both approaches, but mainly focus on random effects. This is because the dependent variable is binary. The fixed effects model necessarily uses a transformation of the variables to obtain deviations from each individual's average and to difference out any time-invariant heterogeneity (Hsiao, 2003). This estimation can only be performed for women who take up screening at all and who do not report having a smear test every year. In other words, it drops women who never had a test and women who reported a test in each year.

Note that, for the fixed effect estimation a conditional logit model is preferred, for random effects, probit. These probit and logit specifications are appropriate when the dependent variable is a binary indicator as here (see Wooldridge, 2002 for details on the estimation of these models).

The second type of unobservable heterogeneity is cross-sectional individual-invariant factors, λ_t, which affect equally all individual observations in one period but not in others. An example of this type of heterogeneity will be the introduction of a national policy that may affect uptake of screening in Britain. It is relatively straightforward to model this heterogeneity by introducing one indicator variable for each period in the panel data.

The last type of heterogeneity that we consider is individual time-varying heterogeneity, η_{it}. An example of this type of unobservable variable is motivation or self-efficacy, features of the individual that may contain stable elements but also elements which can be assumed to change over time. In these data there are no measurements of these variables, so we have no other option than to assume that the effect of the unobserved individual time-varying heterogeneity has the property of a random variable. Therefore, we do not model explicitly this time-varying heterogeneity but assume that it is incorporated in the error term. We explain the implications of ignoring this type of heterogeneity below in the section on the limitations of the model.

[10] For further details about when to use fixed versus random effects see Woodridge (2002) and Hsiao (2003).

3.4.4 The sequencing problem and the cycles of smear tests

Another issue to address is the sequencing of the events of adult learning on the uptake of screening and the implications of this for estimation of effects. Women reported whether adult learning and screening occurred within the year previous to the interview. However, we do not know whether adult learning within that year happened before uptake of screening or vice versa. One way to approach this issue is by estimating whether adult learning in the previous period had an effect on the current uptake of screening. Using past adult learning as a predictor of current screening in this way, however, assumes that adult learning has lasting wider effects on individuals' health choices. We are forced to choose between alternative debatable assumptions and approach the problem by estimating both models and using the range of estimates provided to assess the likely education effect.

As mentioned in footnote 7, most women are invited to have a cervical screening every three years. Using the data, we find a pattern of screening which corroborates the three year cycle of screening. But screening intake also depends on the results of previous screening. Those women who receive inconclusive results are requested to take the test again. For this reason some women have tests in consecutive years. Given that we do not have information on results from previous tests, it is difficult to differentiate between a routine check-up and a follow-up test in response to previous results. One way to partially deal with this issue is to include the lagged variable for screening in the analysis. In the econometric literature, when past values of the outcome variable are included as predictor, the model is said to be 'dynamic'. Hence, we refer here to a dynamic random effects model.

Another way to deal with the lack of information on smear tests results is to perform the analysis without the inclusion of extreme cases, for example women who had five or more tests in 11 years. The expected maximum number of tests in 11 years under the current guidelines would be four tests, but if a test is repeated then women will have over four tests in 11 years. In fact, we find some women with four consecutive tests in 11 years. Therefore, another sensitivity analysis is to perform the estimation for women who have always been in their three year cycle and compare their determinants of screening to those women who have never had a smear test. Both of these analyses are performed in section 5.1.1.

3.4.5 Other control variables

We include in these estimations some of the controls utilised for the case of prior learning, i.e. age, parental SES, self-reported health status, GHQ measure of well-being, smoking, household income, current SES, employment, having a partner in 1991, and information on the number of children. We allow some of these controls to change over time. We include ethnicity as a proxy for cultural barriers to uptake (Simoes et al. 1999). Four categories for ethnicity are white, black (mainly African and Caribbean), Asian (just include Pakistani, Indian, Bangladeshi, and Chinese) and other ethnic origin as a separate category.

Supply side information includes waiting times and regional variation in service delivery. Waiting times can be very long, especially for specialists and for NHS procedures (Martin and Smith, 1999). One way to control for differences in waiting times is to use the information given by patients during the NHS patients survey programme 2002 regarding appointments with their GP. In this survey, patients provided information on the usual number of days that they have to wait until they can get an appointment with the GP of their preference. If the answer is over 2 days, the NHS considers it to be a problem. The NHS then calculates the percentage of individuals who reported a problem, where a higher percentage indicates a greater level of problems. The total national reported problem was 71%. We create an indicator variable by region specifying whether the region exceeded the national average. Individuals living in the following regions expect waiting times higher than the average for England: inner and outer London, South East, East Anglia, Merseyside, South Yorkshire, Tyne and Wear, and other regions in the north of England.

Provision of services differs by region. For most of the 1990s, when the BHPS took place, there were eight NHS Regional Offices (West Midlands, Eastern, Northern and Yorkshire, North West, Trent, South West, South East and London). From the beginning of 2002, the eight NHS Regional Offices have been replaced by 28 new strategic health authorities (NHS, 2002)[11]. The empirical model utilises indicator variables for NHS Regional Offices.

Finally, women not registered with their local GP or family planning clinic will not receive a recall from the NHS. This information is unavailable in the BHPS. However, it is feasible that moving location is one reason for non-registration and so we control for this in the analysis.

3.4.6 Estimation strategy and post-estimation techniques

The estimation strategy is as follows: first we estimate a model ignoring the cyclical structure of cervical screening, introducing prior learning and adult learning as two of our main explanatory variables, together with health controls, time constraints, other socio-economic determinants and demographic characteristics. We describe the results from this model and from a model that includes lagged values of adult learning. Results from the latter are important to assess the sequencing of the estimated effect of adult learning on cervical screening mentioned in section 3.4.4. These models are each estimated using first a random effects probit model and secondly a fixed effect logit model (a.k.a. conditional logit model).

Then we introduce past information on screening to predict current screening as explained in section 3.4.4. With this approach our aim is to capture part of the variation in the outcome variable by its past values. In other words, current screening for women who have never had an abnormal test and who take their screening according to the NHS' recommendations will be perfectly predicted by past screening.

[11] NHS (2002) note for internet at http://www.nhs.uk/root/nhsservices/orgs/

These women, however, are not the main group of targeting for policy. We are interested here in women who have never had a test and in women with a low uptake of screening. If sufficient variation exists in the model after the inclusion of past screening we should be able to pin down the explanatory variables that remain significantly associated with screening. As a technical note, in order to derive consistent estimators of this model we need to define initial conditions for screening uptake (Honore, 2002; Wooldridge, 2002). We do so through using the first three years of observations on screening in the BHPS, that is, during 1991, 1992 and 1993.

As for the case of prior learning, we perform sensitivity analysis and calculate marginal effects. Additionally, we utilise marginal effects to calculate the effect of adult learning on cancer prevention. For this, we draw on information from the Cancer Screening Programme on the probability of cancer prevention. We use confidence intervals to estimate the range of cancer prevention.

3.4.7 Limitations of the analysis

There are certain limitations. In particular we are not able to deal with the time-variant selectivity bias in education. There are unobserved and fluctuating individual characteristics that can affect both participation and success in education and access to services, so that any estimated effect on health service utilisation achieved by education may be due to the unobservable effect. Take for instance self-confidence. A person who becomes more self-confident may be more likely to participate in education and also to demand her rights for service utilisation. Hence, self-confidence is a determinant of service utilisation and its omission will bias the estimate of the effect of education. Changes in patience, self-efficacy and motivation may also contribute to confounding bias of this kind.

One way to deal with selection bias is by utilising instrumental variables, i.e. factors that explain education but that do not explain service utilisation. Family background is well known to influence individuals' education and may be unlikely to determine adult outcomes. Blundell et al. (2001) provides one example of the use of family background as an instrument for education in a wage equation. However, the exclusion restriction (the effect of the instrument on the outcome) may be even less acceptable in an equation for health service utilisation than in that context. Family background may be a central element of social inclusion, and hence health service use. We remain unable to perform instrumental variable estimation in this report. The strength of the conclusions must be tempered by recognition of the possibility of time-varying selection bias.

3.5 Summary of methods

In the last 3 sections, we described the different methods used for the two sets of analyses of the relationship between education and the take-up of cervical smear tests. Figure 4 summarises these methods. For each model we describe the outcome variable; the main policy variable; the control variable used in the estimation; whether the estimation method uses cross-sectional or panel data techniques for analysis; the estimation method; and the other statistical techniques utilised such as estimation of marginal effects, *step-wise* methodology, and sensitivity analysis. The numbers in the final two rows indicate the order in which the different models are estimated.

Figure 4: Summary of methods utilised in empirical analysis

	Screening & Prior Learning	Screening & Adult Learning	Screening, Adult Learning & Screening Histories
Outcome variable	=0 if "no smear tests in 11 years" =1 if "1 or 2 smear tests in 11 years" =2 if "3 or more tests in 11 years"	=0 if "no smear test in year t" =1 if "smear test in year t"	=0 if "no smear test in year t" =1 if "smear test in year t"
Main policy variable	Highest educational qualifications in NVQ level equivalents	=1 if "adult learning in year t"	=1 if "adult learning in year t"
Other controls	Socio-economic, demographic & health controls	Socio-economic, demographic & health controls; regional & period variation	Socio-economic, demographic & health controls; regional & period variation; past screening; initial conditions for screening
Model assumes data	Cross-sectional	Panel	Panel/dynamic
Estimation method	1. Ordered probit	5. Random effects probit. 6. Fixed effects logit	8. Dynamic random effects probit
Other techniques used	2. Step-wise 3. Sensitivity analysis 4. Marginal effects	7. Sensitivity analysis	9. Sensitivity analysis 10. Marginal effects 11. Expected impact on cancer prevention

4. Determinants of cervical smear tests: the role of prior learning

The simplest model shows the relationship between prior education and the take-up of cervical smear tests without the inclusion of any controls (column 1 in Table 3). Our findings suggest a positive association between prior educational qualifications and cervical screenings. The effect of education is robust to the inclusion of age and parental SES (column 3 in Table 3). Compared to women with no qualifications, estimated parameters for women with educational qualifications Level 2, Level 3 and Level 4 or above are 0.16, 0.19, and 0.20, respectively. Our post-estimation results show equality between these parameters.

Table 3: Ordered probit estimates on NHS cervical smear tests: the raw effect of prior education, age and parental SES

Variable	Education only (1)	Parental SES only (2)	Edu + Parental SES + age (3)	Education L2 + SES + age (4)
Prior education (L1)	0.240		0.057	
	(0.078)***		(0.083)	
Prior education (L2)	0.385		0.164	
	(0.081)***		(0.085)**	
Prior education (L3)	0.435		0.185	0.154
	(0.114)***		(0.121)	(0.059)***
Prior education (L4 or above)	0.364		0.202	
	(0.083)***		(0.088)**	
Initial Age group 36-45			-0.349	-0.353
			(0.067)***	(0.067)***
Initial Age group 46-55			-0.776	-0.783
			(0.073)***	(0.072)***
Parental SES 2		0.043	0.092	0.088
		(0.128)	(0.132)	(0.131)
Parental SES 3nm		-0.132	-0.062	-0.068
		(0.134)	(0.139)	(0.138)
Parental SES 3m		-0.091	0.079	0.066
		(0.123)	(0.131)	(0.129)
Parental SES 4		-0.221	0.004	-0.013
		(0.140)	(0.150)	(0.147)
Parental SES 5		-0.140	0.082	0.061
		(0.192)	(0.208)	(0.205)
Parental SES unclassified		-0.487	-0.296	-0.311
		(0.163)***	(0.169)*	(0.168)*
Joint significance parental SES (P-value)		*0.002*	*0.061*	*0.057*
$\mu 1$	-0.924	-1.267	-1.422	-1.462
	(0.058)	(0.117)	(0.142)	(0.133)
$\mu 2$	-0.038	-0.386	-0.485	-0.526
	(0.054)	(0.115)	(0.141)	(0.132)

Data: Adult women in BHPS, one observation per woman who participated in all waves of the BHPS, 1,843 women ages 25-56 in 1991.

Notes: Using column (3) we test the Null hypothesis that L2=L3=L4; $\chi^2 = 0.18$ not rejecting the Null. Standard errors in parenthesis. Asterisks, (*), (**) or (***), indicate significant at 10, 5 and 1% level, respectively.

Categories for comparison: for education either 'no qualifications' or 'below Level 2'; for age 'ages 25-35'; for parental SES 'SES 1 = professionals'.

In column 3 in Table 3, we observe that women with very low levels of qualifications (Level 1) do not differ from women without qualifications in terms of their uptake of smear check-ups. For this reason, we estimate a model in column 4 where we differentiate between women with educational qualifications at Level 2 or above and women with below Level 2 qualifications. For the rest of the analysis we utilise Level 2 qualifications as the cut-off point. This threshold level of qualifications is pertinent to current policy on education.

We find that women's use of cervical screenings does not differ with parental SES, except for women whose parents could not be classified according to the Registrar General's Social Classification (column 2 in Table 3). Nevertheless, parental SES is a jointly significant determinant of cervical smear tests even with the inclusion of prior education and age. However, most of the explanation of variance explained by parental SES is due to the difference between those whose SES is unclassified and those in other groups. This may reflect the effects of growing up in families in poverty, where fathers were unemployed or in prison. There is no difference in screening probability explained by differences in SES groups for those classified.

This is surprising. It is possible that the effect remains because parental SES is not well measured. To assess this possibility we performed three simple validity tests (Table 4). It is well established in the literature that parental SES has a relationship with educational qualifications. We find that women whose parents belong to the lowest SES are less likely to achieve qualifications above Level 2 than women whose parents are professionals. Also, parental SES is positively related to current household income in that children whose parents are in the lowest SES group have lower household income than those whose parents are in SES 1. Finally, children of low SES parents are more likely themselves to be in a low SES group. These findings were already established in the literature but are confirmed in our own analysis as illustrated in Table 4. These results indicate that parental SES is well measured in these data.

Table 4: Estimates of the effect of parental SES on different outcomes

Variable	Education Level 2+	Income	SES 4 or 5
	Probit Model	Linear Model	Probit Model
Parental SES 2	-0.585 (0.161)***	-0.140 (0.066)**	0.298 (0.184)
Parental SES 3nm	-0.866 (0.165)***	-0.163 (0.065)**	0.406 (0.189)**
Parental SES 3m	-1.209 (0.157)***	-0.303 (0.061)***	0.745 (0.177)***
Parental SES 4	-1.445 (0.171)***	-0.360 (0.068)***	0.833 (0.190)***
Parental SES 5	-1.485 (0.219)***	-0.448 (0.096)***	0.730 (0.237)***
Parental SES unclassified	-1.305 (0.195)***	-0.355 (0.082)***	0.829 (0.215)***

Data: Adult women in BHPS, one observation per woman who participated in all waves of the BHPS, 1,843 women ages 25-56 in 1991.

Notes: Standard errors in parenthesis. Asterisks, (*), (**) or (***), indicate significant at 10, 5 and 1 percentage level, respectively.

Categories for comparison: for parental SES 'SES 1 = professionals'.

The finding that education affects on screening are not alternated when parental SES is included suggests, then, that the education channel is robust to the inclusion of controls for confounding variables. Prior education is positively related to the uptake of cervical screenings even when controlling for parental SES (a confounding factor) and age (cohort-specific factors).

We stress that we have not eliminated all possible confounding factors. However, the introduction of parental SES does not substantively alter the estimate of the effect of education.

Prior education and socio-economic channels

To test the mechanisms for the potential education effect, we utilise socio-economic variables, such as income, employment, and occupation which could channel the effect of prior education on the uptake of preventative health care. The reasoning behind these channels is as follows: achieving high educational qualifications leads to better jobs opportunities and higher income. It also determines individuals' position in the social class structure. Income provides monetary resources to purchase preventative health care whereas social class and employment could influence access to the service. Hence, part of the effect of education on preventative health care could be channelled via income or social status. In the context of universal provision of preventative health, income may not be as important as class but may still proxy for other unobservable features of the personality or the context that influences uptake.

Column 1 in Table 5 presents estimation results of uptake of cervical smear tests by women's SES in 1991 without the inclusion of any controls. Each socio-economic group is compared to the highest SES group, i.e. professionals. Women from low occupational social class (SES 3 manual, partly skilled and unskilled) are less likely to take three or more cervical tests in 11 years than women in SES 1. As we expect the uptake of cervical tests does not differ by income (column 2 in Table 5). In fact, the income groups are not even jointly significant. This is presumably due to the universal public provision of the service but it is still informative that income does not pick up selection bias.

We follow the model presented in column 4 in Table 3 to determine how much of the 0.154 percentage point estimate of the relationship between education and cervical smear tests is accounted for by SES, income and employment and whether it remains statistically significant. SES accounts for much of the reduction of the effect of education. The percentage point estimate of education is reduced by 21%-0.122 just with the inclusion of SES. However, none of the SES variables are significantly different to the highest SES nor they are jointly significant (column 3 in Table 5). The inclusion of household income measure in quintiles further reduces the percentage point estimate by a further 5.7%-0.110 (column 4 in Table 5).

The employment variable is not a significant determinant of cervical smear tests. Finally, the effect of education remains significant at 10% after controlling for SES, income, and employment. The raw effect of education is reduced by 29% with the inclusion of socio-economic controls (from 0.154-0.110).

Table 5: Ordered probit estimates on NHS cervical smear tests: socio-economic channels and education

Controls	Variable	(1)	(2)	(3)	(4)	(5)
Education	Prior Education			0.122	0.115	0.110
	L2+			(0.066)*	(0.066)*	(0.067)*
SES	SES 2	-0.332		-0.145	-0.142	-0.143
		(0.225)		(0.236)	(0.235)	(0.235)
	SES 3 non manual	-0.300		-0.072	-0.063	-0.048
		(0.223)		(0.235)	(0.236)	(0.236)
	SES 3 manual	-0.486		-0.216	-0.197	-0.190
		(0.236)**		(0.250)	(0.251)	(0.251)
	SES 4	-0.473		-0.253	-0.226	-0.213
		(0.227)**		(0.243)	(0.245)	(0.247)
	SES 5	-0.473		-0.253	-0.221	-0.215
		(0.227)**		(0.258)	(0.259)	(0.259)
Joint significance SES (P-value)		*0.009*		*0.254*	*0.395*	*0.344*
Income	Income (quintile 4)		-0.012		0.065	0.072
			(0.089)		(0.094)	(0.094)
	Income (quintile 3)		-0.109		-0.031	-0.023
			(0.087)		(0.095)	(0.096)
	Income (quintile 2)		-0.101		-0.059	-0.043
			(0.090)		(0.097)	(0.097)
	Income (lowest		-0.095		-0.045	-0.003
	quintile)		(0.090)		(0.103)	(0.104)
Joint significance income (P-value)			*0.583*		*0.695*	*0.763*
Employment	Employed and not					-0.001
	in work in 11 yrs.					(0.095)
	Mainly employed in					0.135
	11 yrs.					(0.093)
$\mu 1$		-1.532	-1.224	-1.633	-1.634	-1.541
		(0.219)	(0.070)	(0.259)	(0.263)	(0.277)
$\mu 2$		-0.663	-0.350	-0.703	-0.703	-0.608
		(0.218)	(0.065)	(0.258)	(0.262)	(0.276)
Log likelihood		-1642.8	-1688.8	-1568.0	-1566.8	-1564.3

Data: Adult women in BHPS, one observation per woman who participated in all waves of the BHPS, 1,843 women ages 25-56 in 1991.

Notes: Estimations in columns (3) to (5) control for age and parental SES as defined in Table 3.

Standard errors in parenthesis. Asterisks, (*), (**) or (***), indicate significant at 10, 5 and 1% level, respectively.
Categories for comparison: for SES 'SES 1'; for income 'highest quintile'; for employment 'mainly not in the labour force'; for education 'below Level 2'.

To summarise, we find that none of the women belonging to income quintiles one to four differ from women belonging to the highest income quintile in terms of their probabilities to have future smear tests. We find that women belonging to the three lowest SES groups differ from women belonging to the highest SES group in terms of their uptake of screening. This effect, however, disappears with the inclusion of education. These results indicate that, when dealing with uptake of screening, there is something about education that allows it to remain as a predictor of the differences in service uptake.

There are two explanations for these results, which are not exclusive. First, selection bias in the uptake of preventative health is introduced through education but not through occupational class, income or employment. Second, part of the effect of education is channelled through income, employment and class, but education retains a significant effect on the uptake of cervical screening. This second explanation indicates the possibility that education can increase preventative medicine through increasing knowledge, agency, awareness, and inclusion. It does not preclude the possibility of confounding factors that promote education and cervical smear tests, such as self-efficacy, motivation, and self-confidence.

Education, health related controls and domestic life circumstances

The second set of controls includes health related variables such as health status and well-being, health behaviours such as smoking, and domestic life circumstances such as marital status or children. We wouldn't expect the effect of education on the uptake of preventative health care to be influenced by the inclusion of self-reported health because we not expect take-up of screening to be strongly influenced by health status. Other health related variables (such as smoking) may affect the role of education. This is mainly because education could have an effect both on health behaviours, reducing the likelihood of smoking, and also on screening.

Domestic life circumstances could motivate the uptake of screening regardless of education. However, education may be an important mediator for the effect of domestic life circumstances. For instance, women with children may be more likely to care for their health so that they can care for their children, i.e. being healthy for others. Education works as a mediator if it changes this relationship. In other words, the increased uptake of screening for women with children is greater for those with more as opposed to less education. We utilise sub-samples of women based on age and personal life circumstances to analyse this role of education.

The results are given in Table 6. The first column gives results for all women, the second for women with children, the third for younger women, the fourth for women who had a partner in 1991, and the fifth for women who smoke.

Similar to the results found by Selvin and Brett (2003), the inclusion of self-reported health and the GHQ measure of well-being as health related controls do not affect women's uptake of cervical screening (Table 6). Furthermore, the inclusion of health related controls and personal life circumstances only marginally reduce the point estimate of education found in column 4 in Table 3 from 0.154-0.149; a 3.3% reduction. Self-reported health and subjective well-being are not statistical significant determinants of smear tests in any of the different model specifications shown in Table 6.

We find a persistent negative association of tobacco smoking and cervical screening both in the full model in column 1 in Table 6 and in the different sub-samples, except for on young women. This is consistent with US research that suggests that persons who engage in 'high risk behaviours' (such as smoking) are less likely to follow recommended guidelines for cervical screening (Selvin and Brett). Furthermore we find that the effect of education on smears is particularly high among smokers (column 5 in Table 6). Education does affect women's attitudes towards their own health including smoking behaviours and compliance with medical instructions (Hammond, 2003). The finding that among the high risk group there is a positive association between education and uptake of cervical smear screening has relevance for those who wish to tackle health inequalities.

We use three variables to account for family life circumstances that could impact on the take-up of cervical tests regardless of educational background. The first variable identifies women who had a child in 1991, the second identifies women who had a partner in 1991, and the third is the number of children between ages 0-5 living at home. This latest variable could constitute a time constraint in the take-up of services. Results from column 1 in Table 6 suggest that both having a child and a partner are significant determinants of preventative health activity.

Table 6: Ordered probit estimates of NHS cervical smear tests: health controls and different life circumstances

Variable	Health controls + life circ. (1)	Women with children (2)	Women ages 25-45 in 1991 (3)	Women had a partner (4)	High risk group (5)
Model described in Column 4 in Table 3. Education L2+	0.154 (0.056)***	0.173 (0.065)***	0.199 (0.072)***	0.171 (0.065)***	0.230 (0.106)**
Initial Education L2 or above	0.149 (0.061)**	0.149 (0.066)**	0.181 (0.074)**	0.139 (0.066)**	0.228 (0.109)**
Avg. Health Status in 11 yrs.	0.013 (0.041)	0.026 (0.045)	0.001 (0.049)	-0.008 (0.045)	0.006 (0.068)
Average well-being, GHQ.	0.009 (0.016)	-0.007 (0.017)	0.026 (0.019)	0.014 (0.017)	0.040 (0.027)
Smoke in period 1	-0.114 (0.063)*	-0.161 (0.069)**	-0.101 (0.075)	-0.158 (0.069)**	n.a.
Had a child in period 1	0.172 (0.105)*	n.a.	0.267 (0.129)**	0.065 (0.119)	0.021 (0.136)
Partner (1 if ever had or lived with partner in period 1)	0.220 (0.081)***	n.a.	0.153 (0.104)	n.a.	0.041 (0.190)
Total number of children under 5 in 11 yrs.	-0.031 (0.033)	-0.030 (0.033)	-0.083 (0.044)*	-0.040 (0.036)	-0.001 (0.054)
μ1	-1.182 (0.176)	-1.497 (0.189)	-1.136 (0.209)	-1.593 (0.176)	-1.274 (0.371)
μ2	-0.243 (0.177)	-0.533 (0.190)	-0.116 (0.208)	-0.634 (0.177)	-0.411 (0.371)
Log likelihood	-1586.1	-1297.1	-1057.1	-1334.1	-495.7
Number of Observations	1843	1493	1357	1548	557

Data: Adult women in BHPS, full sample and different sub-samples.

Notes: All estimations include controls for age and parental SES.
Standard errors in parenthesis. Asterisks, (*), (**) or (***), indicate significant at 10, 5 and 1% level, respectively.

Categories for comparison: for education 'below Level 2'.

Across four different sub-samples education has an effect on the uptake of cervical smear tests in 11 years. We find that education has a significant effect on the take-up of cervical smear tests for young women. Similarly, education significantly impacts on the uptake of smear tests for women with children, women who had had a partner in 1991, and women who smoke.

Unreported in Table 6, we also find the following results:

(iv) a raw relationship exists between education and cervical screening for women with children and women who do not smoke, but this relationship disappears with the inclusion of age and parental SES as controls;

(v) for women aged 45-56 in 1991 and for women who did not have a partner in 1991 we find no association between education and smear tests.

Reported and unreported results indicate a degree of heterogeneity in the population. We see that effects of education on cervical screening vary according to domestic life circumstances and health related behaviours. Using the panel structure of the data and introducing adult learning in our analysis we will be able to address more effectively the heterogeneity in the data.

Marginal effects on uptake of cervical screening – size of effects

We use upper and lower bound estimates for our calculation of the marginal effect of education, i.e. the effect of education on the probability of taking smear tests in 11 years. The lower bound comes from the model that contains socio-economic controls, health related variables and domestic life circumstances (column 1 in Table 6). We calculate the upper bound from the model in column 4 in Table 3 that only controls for age and parental SES. These two marginal effects provide a range for the effect of prior education (Table 7). Level 2 or above education increases the probability that women have more than two tests in 11 years by between 5.7 and 5.9 percentage points. This implies that for women with education the probability of having 3 or more tests in 11 years could increase up to 67.1% from the baseline of 61.3%. Level 2 or above also decreases the probability of not having any tests in 11 years between 2.9 and 2.8 percentage points, bringing down this probability to 9.5% from the baseline of 12.4%.

Table 7: Marginal effect of different explanatory variables on smear tests

Variable	Zero smear tests in 11 yrs.	1 or 2 tests in 11 yrs.	More than 2 tests in 11 yrs.
Prior Education L2 or above	-2.88 to -2.76	-2.98 to -2.93	5.69 to 5.86
Initial Age group 36-45	7.26	6.75	-14.01
Initial Age group 46-55	18.24	12.56	-30.80
Parental SES 2	-1.76	-1.96	3.72
Parental SES 3 non manual	1.12	1.15	-2.27
Parental SES 3 manual	-1.29	-1.41	2.70
Parental SES 4	-0.14	-0.14	0.28
Parental SES 5	-1.55	-1.77	3.32
Parental SES unclassified	4.60	4.04	-8.64
Avg. Health Status in 11 yrs.	-0.24	-0.26	0.50
Average well-being, GHQ.	-0.18	-0.19	0.37
Smoke in period 1	2.18	2.22	-4.40
Had a child in period 1	-3.39	-3.26	6.66
Partner (1 if ever had or lived with partner in period 1)	-4.46	-4.08	8.54
Total # of children under 5 in 11 yrs.	0.59	0.62	-1.21
MARGINAL PROBABILITY(1)	*12.4%*	*26.3%*	*61.3%*

Notes: Text in bold indicates that the variable was significant determinant of smear tests in the ordered probit, full model presented in column 1 of Table 6.

Marginal effect for education is also calculated using the estimated parameter of education from column 4 of Table 3.

Categories for comparison: for education 'below Level 2'; for age 'age group 25-35'; for SES 'highest SES'; for income 'highest income'; for employment 'mainly out of the labour force'.
(1) Marginal probability refers to the predicted probability that each of the outcome occurs.

Several other interesting results are worth mentioning from these estimations. Age is the most important determinant of cervical smear tests. The probability of taking additional tests decreases as women age. The marginal effects on Table 7 indicate that women between ages 45-56 are 18.2 percentage points more likely not to have any smear test in 11 years and nearly 30 percentage points less likely to have more than two tests in 11 years than younger women (ages 25-35). Women aged 36-45 are 7.3 percentage points more likely not to have any test in 11 years and 14 percentage points less likely to have more than two tests in 11 years than younger women (ages 25-35).

Although the point estimate of the occupational status variables are not statistically significant, their marginal effects show the expected gradient. Compared to women whose parents belong to the highest SES group, the probability of not having a test in 11 years increases for women in the lowest SES group. Similarly, the probability of having two or more tests decreases for women of low SES parents.

High risk behaviour women are 4.4 percentage points less likely to have more than two tests in 11 years and 2.2 percentage points more likely not to have any screening in 11 years. Women who had a child in 1991 are 6.6 percentage points more likely to take more than two tests and 3.4 percentage points less likely not to take any test in 11 years than women who have not had a child. Similarly, women who had a partner by 1991 are 8.5 percentage points more likely of having more than two tests in 11 years and 4.5 percentage points less likely of not having any test than women who had not have a partner in 1991.

To summarise, we find that education has an effect on the uptake of cervical smear tests. We find that the effect of education remains statistically significant at 10% even after the inclusion of socio-economic and demographic controls.

5. Predictors of cervical screening: the role of continuing adult learning

Results from the model that uses yearly information on women's cervical screening, continuing adult learning and other socio-economic and demographic controls are presented in Table 8. Interpretation of the adult learning parameters in this table (and in general for all parameters) differs from previous tables. Under these models, the significant parameter for adult learning indicates that, in any given year, doing adult learning is associated with a change in the probability of taking a smear test for that individual. The estimated parameter from these models indicates differences within individuals, i.e. whether doing adult learning is associated with changes in the likelihood of that individual having a smear test.

Table 8: Probability model estimates of cervical smear tests, women aged 25-55 in 1991. NHS provision only

Variable	Random effects PROBIT		Conditional LOGIT	
	parameter	s.d.	Parameter	s.d.
Constant	-0.572	(0.240)**		
Education L2+	0.031	(0.032)		
Adult Learning	0.062	(0.026)**	0.088	(0.043)**
Age group 35-45	-0.125	(0.028)***		
Age group 45-65	-0.299	(0.034)***		
Ethnic (Black)	0.206	(0.130)		
Ethnic (Asian)	-0.244	(0.106)**		
Ethnic (other)	-0.235	(0.171)		
Health Status (excellent – very bad)	0.068	(0.014)***	0.115	(0.026)***
GQH Caseness	0.003	(0.004)	0.004	(0.006)
Smoke (1 yes)	0.072	(0.045)	0.061	(0.094)
Partner in Period 1	0.058	(0.038)		
Children U5 (1 yes)	-0.009	(0.031)	-0.111	(0.057)*
Children U5-18 (1 yes)	0.023	(0.027)	0.017	(0.055)
Eq HH Income	-0.015	(0.021)	-0.003	(0.035)
Employed full-time	-0.015	(0.034)	-0.141	(0.071)**
Employed part-time	0.030	(0.031)	-0.004	(0.063)
SES 4-5 (1 yes)	0.005	(0.030)		
Moved residence (1 yes)	0.100	(0.035)***	0.109	(0.060)*
Long waiting times	-0.111	(0.048)**	-0.211	(0.303)
Auxiliary equation				
Average (adult learning)	0.130	(0.062)**		
Average (HH income)	0.024	(0.035)		
Average (health status)	-0.021	(0.022)		
Average (GHQ Caseness)	0.010	(0.008)		
Average (# cigarettes)	-0.006	(0.003)**		
Controls				
Parental SES	YES			
NHS Reg. Offices[1]	YES	F=23.4***	YES	F=4.82
Time dummies[1]	YES	F=40.7***	YES	F=158***

Data: All women adults in BHPS, age 25-55. The random effects probit model includes 2,507 women and 21,865 observations. The conditional logit includes 2,046 women and 19,147 observations.

Notes: Asterisks, (***), (**), or (*) indicate significant at 1, 5 and 10% level, respectively. Categories for comparison: for education 'below Level 2'; for adult learning 'none'; for ethnicity 'white'; for employment 'unemployed'.

Conditional logit model is only estimated for women with more than 2 years of observations with at least one screening. Women with 11 screenings are omitted.
(1) For NHS regional offices and for times dummies we present an F-statistic, which tests the hypothesis that all parameters estimated are equal to zero. Asterisks here represent a significant rejection of the null hypothesis.

Results for the effects of continuing adult learning on screening using the random effects probit and the conditional logit models indicate that doing adult learning is associated with a higher probability of having a test (Table 8). The random effect probit model also incorporates the average enrolment in adult learning for each individual as a control for the correlation between individual time-invariant heterogeneity and the explanatory variables. This variable is significantly associated with screening, indicating that not only changes but also the level of adult learning is associated with screening.[12] Notice that in the second model we analyse the results with respect to changes in the odds, whereas in the first model analysis is in respect to the average probability.

Many results from Table 8 are compatible with our analysis in Section 4 and with previous research in this area. In particular, age is an important determinant of screening, with uptake decreasing with age.[13] Cultural barriers to uptake are captured by the significant parameter of ethnicity on the probability of having a screening; Asian women are less likely to take up screening than white women. Ethnicity and the other variables that do not change over time – prior education, having a partner in 1991 and the SES background of parents – are not included in the conditional logit estimation.

Other results provide new evidence. For this model, in which we estimate determinants of the probability of uptake of cervical screening regardless of screening history, self-reported health is a significant determinant of screening, with deteriorating health status being associated with an increase in uptake.[14] One possible explanation is that the association is driven by the fact that cervical tests are performed mainly at the GP's clinic or medical centre. That is, there is nothing about women's perceptions of their health that triggers their uptake of preventative medicine. But rather, women with poor health tend to visit the GP more often and hence have a higher probability of taking the smear test in one of their frequent visits to the GP. Also, since we are not controlling for previous smear tests, then those who are having very frequent tests on medical advice might report poor health. Perhaps if the location for the test differed, at it does for breast cancer screening, these results could be different also.

Change in smoking behaviour is not associated with the uptake of screening, but the average number of cigarettes smoked is negatively associated with screening, as it was in our previous model. We reconcile this apparent contradiction as follows. Women who smoke more are less likely to have smear tests than women who smoke less or do not smoke at all. However, changes in smoking behaviour, i.e. giving up or taking up smoking does not affect uptake of screening. Although smoking is a proxy variable for high risk behaviour, changes in smoking behaviour do not necessarily imply changes in the same normative direction for other risk behaviours. The smoking variable is problematic for interpretation. Smoking is persistent, hence finding no association may be the result of lack of variability in this variable. Another issue is the reverse causality of screening on smoking behaviour, for example the result of the test might cause women to give up smoking (Scholes et al., 1999). Finally, smoking is

[12] Prior education is not statistically associated with screening, however this result is expected due to collinearity between prior education and adult learning. In this sense, average levels of adult learning may be capturing part of the effect of prior education.

[13] The categorisation of age used in the probit estimation is not included in the conditional logit, but the age effect is captured in the latter model by the inclusion of time dummy variables in the estimation.

[14] The variable for self-reported health entered in the equation as ordinal follows a descriptive analysis of how this variable interacts with uptake of screening.

associated with other explanatory variables in the model such as prior education and social class, which induces collinearity.

The effects for having children under five and full-time employment are statistically significant for the logit but not significant for the probit. For the former, results from the conditional logit suggest that the change from not having children to having children under five decreases the likelihood of taking a smear test. This is somewhat surprising since women with small children often visit GP surgeries. It may be that despite the frequency of their visits, demands on their time are such that they do not have the time to spare for the smear test. For the latter, changes in employment status, specifically becoming employed full-time, is associated with a decrease in the likelihood of having a smear test. This result only holds for the sub-sample of women who had a screening and does not include women who have never had a screening, which in our case is an important group to target for policy.

Finally, changing location is associated with an increase in the probability of screening. This result contradicts evidence from the DoH suggesting that changing location is one of the main barriers faced by the NHS to increase uptake. Women will not be recalled to screening unless they register with a GP in the new location and the medical history has been requested from their former clinic. If women do not register with a GP, recall letters from their old clinic may never reach them. Evidence here suggests the contrary. It suggests that moving location is associated with an increase in the uptake of screening. Maybe, changing location carries a sense of agency, which impacts on the uptake of smear tests.

Controls for time and regional variation are important in this model. Women living in regions where waiting times for the GP are higher than the average for England are less likely to have a smear test (see also Martin and Smith, 1999). For the random effects probit model the variable NHS regional office is used to capture regional differences in service uptake. The F-statistic measures whether the combined effect of these variables is negligible. With 95% confidence we reject the null hypothesis that estimated parameters for NHS regional offices are all equal to zero.

Controls for time dummies have different interpretations in the different models. In the random effects probit model time dummies capture changes that affect uptake in one year but not in others, for instance the effect of a national policy. We see that there is a statistically significant association between take-up of smear tests and this time variable (F=40.7). In addition to this effect, time dummies in the conditional logit capture age effects. We cannot include age and year in this estimation as separate variables. For this reason the F-statistic more than doubles and it is highly significant.

A note on past adult learning

Results in Table 8 show an association between adult learning and the uptake of screening in the same year. However, we do not know whether adult learning or uptake of screening occurred first within that year. Testing a causal relation from adult learning to uptake of screening requires that (i) adult learning occurred prior to screening and (ii) there is a clear understanding on the mechanisms by which adult learning affects individuals' behaviours with respect to preventative medicine. The latter is analysed by Hammond (2003). Adult learning increases self-esteem, self-efficacy and changes who one's friends are which can trigger the uptake of preventative medicine. In order to deal with the former point we propose to utilise adult learning in the previous year as a predictor of uptake of screening in the current year.

The use of past adult learning as a predictor of current screening requires an additional assumption: any effect of adult learning on the uptake of screening persists for at least one year. This means that the mechanisms through which adult learning changes behaviour to increase preventative health are affected or are effective for a long time. Currently, no evidence exists to demonstrate that this may or may not be the case.

Estimating the model again with the inclusion of past adult learning (detailed results not reported here) instead of current adult learning by random effects probit indicates that doing adult learning in the last period is not associated with the uptake of screening in the current period. The model using fixed effects does not show a statistical association between variations in past adult learning with variations in uptake of screening either. This result indicates that the effects of adult learning are likely to be transitory (at best).

The estimated parameters of the model that includes past adult learning also utilises all the explanatory variables shown in Table 8. For the random effects probit model the same variables remain significant, whereas in the conditional logit model full-time employment and the indicator for moving residence lose their significance. Discrepancy between the results show which variables are sensitive to the different specification of the adult learning variable.[15]

5.1.1 Predictors of screening using cycles of screening to determine current uptake

So far our estimates of the probability of screening ignore past information about screening. In reality, past screening is an important predictor of current screening. All women between the ages of 20-64 are eligible for a free cervical smear test every three to five years. Around 85% of Primary Care Trusts invite women every three years and 15% have a mixed policy, inviting women every three or five years, depending on their age. According to the NHS, of the 13.8 million women aged 25-64 eligible for cervical screening in 2001-02, 81.6% had been screened within the previous five years (NHS, 2003).

Failing to incorporate this information in the model is represented in the structure of the residuals in the random effects probit or conditional logit models. Table 9 shows the correlation matrix for the difference between observed uptake of screening and the

[15] The results are available from the authors upon request.

predicted probability of screening (i.e. residuals), using the random effect probit model. There is a high correlation of the residuals between the current year and three years in the past, with a correlation coefficient fluctuating between 0.25 and 0.23. There is also a correlation between current residuals and the last period's which we will address below, but it is clear that there is a low correlation between current residuals and two years in the past.

Table 9: Correlation matrix for residuals of the random effects probit model

	u_t	u_{t-1}	u_{t-2}	u_{t-3}	u_{t-4}	uf_{t-5}	u_{t-6}
u_t	1						
u_{t-1}	0.124	1					
u_{t-2}	0.041	0.137	1				
u_{t-3}	0.247	0.032	0.134	1			
u_{t-4}	0.098	0.247	0.030	0.138	1		
u_{t-5}	0.059	0.103	0.231	0.037	0.131	1	
u_{t-6}	0.143	0.061	0.099	0.227	0.028	0.111	1

Our next representation of the empirical model includes information about past smear tests to predict current uptake. This is because the conditional probability of women taking a smear test is a function of past experience, i.e. when the last test was taken. Excluding this information from the model would make it impossible to derive consistent estimates of the parameters (Hsiao, 2003).

Due to the nature of the cycles for screening our initial conditions include the first three sweeps of the BHPS. Women reporting a smear in 1991 – sweep one of the BHPS – are expected to have the next smear in 1994. But not reporting a smear in 1991 may be due to a smear taken in 1990, hence the next check-up in a three year cycle will be in 1993. For this reason we include as initial conditions reported smears in 1991, 1992 and 1993.

In order to take into account the complete history of self-reported screening, the next set of analyses were performed using information from women who participated in all sweeps of the BHPS. Results in Table 10 include (as explanatory variables) having had a cervical smear test during the previous year, three years in the past, and for the initial condition, whether there was a screening in sweeps 1, 2 or 3 of the BHPS. We show that the variables for past screening are highly significant determinants of later screening. In particular, women who had a test 3 years in the past are nearly 20 percentage points more likely to have a test again than women who did not have a test. Table 10 shows that women who had a test the previous year are 11 percentage points more likely to have a test during the following year. This result reflects repeat tests due to the unclear results of a previous test. During this period, and indeed currently, 10% of smear tests do not collect enough cells for the purpose of clinical analysis. This result is likely to disappear with the introduction of liquid based cytology (LBC), which is expected to reduce substantially the percentage of inadequate smear tests.

Although in this model large variation in the current uptake of screening is captured by the lagged values of screening, current adult learning remains associated with uptake. This result indicates that women who did adult learning have a 2.3 percentage point higher probability of having a smear test (see marginal effects in Table 10).

Other determinants of screening are ethnicity, with Asian women having 9.8 percentage points lower probability than white women of having a test; age, with women belonging to the older cohort (45-55) having a lower probability of taking a smear test; self-reported health status, as better health status decreases the probability of screening by 2.9 percentage points; and finally women living in an area with long waiting times have 3 percentage points lower probability of going for a screening.

Table 10: Dynamic random effect probit model estimates of cervical smear tests (including past smear tests), women aged 25-55 in 1991. NHS provision only

Variable	Dynamic RE Probit		Marginal Effects
	parameter	s.d.	Dynamic RE model
Constant	-0.952	(0.255)***	
Education L2+	0.001	(0.031)	0.000
Adult Learning	0.066	(0.036)**	**0.023**
Age group 35-45	0.000	(0.036)	0.000
Age group 45-65	-0.103	(0.043)**	**-0.035**
Ethnic (Black)	-0.080	(0.149)	-0.027
Ethnic (Asian)	-0.286	(0.106)***	**-0.098**
Ethnic (other)	-0.082	(0.181)	-0.028
Health Status (excellent – very bad)	0.086	(0.022)***	**0.029**
GQH Caseness	0.000	(0.005)	0.000
Smoke (1 yes)	0.103	(0.056)*	**0.035**
Partner in Period 1	-0.003	(0.041)	-0.001
Children U5 (1 yes)	0.023	(0.042)	0.008
Children U5-18 (1 yes)	0.007	(0.031)	0.002
Eq HH Income	0.011	(0.030)	0.004
Employed full-time	-0.039	(0.041)	-0.013
Employed part-time	-0.023	(0.038)	-0.008
SES 4-5 (1 yes)	-0.024	(0.035)	-0.008
Moved residence (1 yes)	-0.001	(0.052)	-0.001
Long waiting times	-0.087	(0.048)*	**-0.030**
Past screening			
Screening (t-1)	0.320	(0.029)***	**0.109**
Screening (t-3)	0.571	(0.029)***	**0.196**
Screening (period 1)	0.107	(0.028)***	**0.036**
Screening (period 2)	0.110	(0.028)***	**0.036**
Screening (period 3)	0.069	(0.029)**	**0.023**
Auxiliary equation			
Average (adult learning)	0.053	(0.071)	
Average (HH income)	-0.030	(0.043)	
Average (health status)	-0.091	(0.033)***	
Average (GHQ Caseness)	0.013	(0.010)	
Average (# cigarettes)	-0.007	(0.003)**	
Controls			
Parental SES	YES		
NHS Reg. Offices[1]	YES	F=20.1**	
Time dummies[1]	YES	F=13.7*	

Data: All women adults in BHPS, age 25-55, who participated in all 11 waves of the BHPS: 2,507 women and 21,865 observations.

Notes: Asterisks, (***), (**), or (*) indicate significant at 1, 5 and 10% level, respectively. Those in bold refer to significant marginal effects.

Categories for comparison: for education 'below Level 2'; for adult learning 'none'; for ethnicity 'white'; for employment 'unemployed'.

(1) For NHS regional offices and for times dummies we present an F-statistic, which test the hypothesis that all parameters estimated are equal to zero. Asterisks here represent a significant rejection of the null hypothesis.

The explanatory variables that are correlated with the random effect are average health status and average cigarette consumption. The latter again indicates that high risk behaviour is associated with the unobserved heterogeneity and decreases the probability of having a smear test. For average self-reported health, women who reported poor health status are more likely to have a screening than women who reported excellent health status.

Sensitivity analysis

We mentioned earlier that women's uptake of current screening depends on the results of previous screening. Women who have had more than five tests in 11 years are likely to have done so in response to previous results. In this case, any effect of education on preventative medicine may be seriously modified by the effect of receiving an abnormal test in the past, which may be triggering uptake regardless of educational background or continuing adult learning.[16] For this reason we perform the estimations shown in Table 10 for the sub-sample of women who had fewer than five tests in 11 years.

Results from this sub-sample of women show that prior education is associated with the uptake of screening, with women with educational qualifications at Level 2 or above being more likely than women with below Level 2 to take the smear test by 1.9 percentage points.[17] Continuing adult learning is not statistically associated with screening, but this is due to the high correlation between adult learning and prior education (if prior education is omitted, adult learning is significant). Other determinants of screening for this sub-sample are deteriorating health status, smoking and having a partner. Deteriorating health status is again associated with an increase in screening. We find smoking to be negatively associated with the uptake of screening. Having had a partner by 1991 also increases the probability of screening.

A second sensitivity test deals with the problem of ignoring the reasons for having or not having a cervical screening. For example, a woman may report not having a screening in a particular year since that particular year was not part of this woman's cycle. Other reasons are unwillingness to undertake the test perhaps because a test had never been taken before. Using screening histories, it is possible to obtain a sub-sample of women who have always been in a three-year cycle and compare their determinants of screening to those women who have never had a screening.

For this estimation we find that screening is associated with prior education, age, smoking, having a partner and having children. Again, adult learning is not significant when prior education is included but becomes so if prior education is omitted.

5.1.2 Summary of results

Figure 5 shows the summary of the results for the effects of continuing adult learning on the take-up of cervical screening. For each of the models described above, this figure describes whether the variable for adult learning (AL) is significant and the level of significance (indicated in parenthesis).

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[16] Abnormal results do not mean cervical cancer, but only a risk of cancer. In fact, only 5% of CIN 1 and 30% of CIN 2 and 3 turn into cervical cancer if left untreated. After treatment there is a strong element of prevention. In this case, it is possible that awareness would come from past experience of risk of cancer rather than from learning.

[17] We do not report results from this sensitivity analysis but they are available from the authors upon request.

Figure 5: Summary of results for effects of continuing adult learning on screening

Model	Educational effects
Random Effects	AL significant (5%)
Fixed Effects	AL significant (5%)
Random effects + lagged AL	AL_{t-1} not significant
Fixed effects + lagged AL	AL_{t-1} not significant
Dynamic random effects	AL significant (5%)
Sensitivity: only < 4 tests	AL not significant, prior education significant (5%)
Sensitivity: perfect cycles vs. no uptake	AL not significant, prior education significant (5%)

5.1.3 Expected benefits from increasing adult learning

How are these results translated into expected screening? This question is addressed in Table 11. We assume that 100,000 women are enrolled in adult learning. Using our estimates for marginal effects in Table 10 we calculate a range for the expected increase in cervical screening associated with adult learning. For adult learning, the marginal effect ranges from 1.9-2.5%, so we expect between 1,900-2,500 new screenings.

From all adequate smear tests analysed in 2002, 92.4% were negative, 3.9% showed borderline changes, 2.2% showed mild dyskaryosis, 0.8% moderate dyskaryosis, 0.6% severe dyskaryosis and 0.1% glandular neoplasia suspected of invasive cancer.[18] Using these statistics we estimated that a minimum of 1,756 of the new smears for adult learners will be negative, 76 will show borderline changes, 42 mild dyskaryosis, 15 moderate dyskaryosis, 11 severe dyskaryosis and possibly 2 glandular neoplasia.

Finally, according to the NHS Cancer Screening Programme (2003) cervical screening can prevent 80-90% of cases of cancer in women who attend regularly. Assuming the lower bound percentage for prevention (80%) then we expect between 116-152 cases of cancer prevented for every 100,000 women in adult learning.

Table 11: Expected increase in tests and results for every additional 100,000 women

	Adult Learning
New Tests	(1,900 – 2,500)
Negative result	(1,756 – 2,310)
Borderline changes	(74 – 98)
Mild dyskaryosis	(42 – 55)
Moderate dyskaryosis	(15 – 20)
Severe dyskaryosis	(11 – 15)
Glandular neoplasia	(1.5 – 3)
Number of prevented cancers	(116 – 152)

The above estimations, obviously, do not contain the positive externalities associated with adult education. For example, the measurable benefits of adult learning on the labour market, on lowering risk of depression or a negative association with obesity.

[18] About 10% of smear tests show an inadequate result since there is not enough material to be analysed in the laboratory. For women tested again due to inadequate screening, about 5% result in an inadequate screening again. This makes about 15% inadequate screenings.

6. Conclusions

This report is part of the WBL series that investigates the relationship between education and health. In particular, we focus on the relationship between education and the uptake of health services.

Uptake of health services contains three elements. A preventative element is manifested in the uptake of health services for preventative reasons. A care element is mainly manifested in the use of health services for vulnerable groups, such as children and the elderly. Finally a reactive element is marked by individuals' use of health services in response to a particular condition or morbidity. Our analysis looks only at the preventative element of the demand for health services.

We build a theoretical framework to address the links between learning and the uptake of health services for preventative reasons. Education has a direct effect on preventative health by raising awareness of the importance of undertaking regular health check-ups and the willingness to undertake such check-ups. Certain aspects of education improve the ways in which individuals understand information regarding periodic tests and the interpretation of results. Education improves accessibility to services if it enhances the inclusion of individuals in society and provides the means for individuals to know and demand their perceived rights to receive health care from the government.

Other mechanisms by which education may affect the take-up of preventative health are self-efficacy and confidence. Education increases individuals' self-efficacy – individuals' perceived power to take control of their lives – and self-confidence, empowering them over future choices, including the choice to undertake periodic health tests. Education can also improve access to health services by increasing individuals' patience and motivation. Patience enhances demand for preventative health care by lowering the discount rate on future ill heath, hence placing a higher valuation on prevention today than on ill heath tomorrow. Motivated individuals maintain better health through positive attitudes in life and regular health check-ups.

We utilise data from the BHPS to carry out the empirical investigation. The BHPS contains information on the use of preventative health care. In particular, we utilise an indicator of uptake of cervical smears. The BHPS also contains good information about education and training and other sets of controls that are important in the empirical analysis. The panel structure of the data enables us to address empirical issues that cannot be addressed in cross-sectional data. Moreover we were able to control for unobserved individual heterogeneity by using random and fixed effects models.

Our analysis of the demand for preventative healthcare is divided into two sections. First we explore the relationship between prior education and uptake of cervical screening and then we investigate the relationship between continuing adult learning and uptake of screening.

For the prior learning model we generate an ordered variable indicating whether women have zero, one or two, or more than two cervical smear tests in 11 years. This categorisation implies that having one or two preventative tests in 11 years is better than not having a test; and having three or more is better than having one or two. Hence, there is an implicit ordering in the outcome variable.

We implicitly assume that women having more than four tests do so in response to medical recommendations. In such circumstances having more tests indicates the appropriate uptake of preventative care and so is a positive outcome in terms of our variable. In any case, the proportion having many tests is small and does not alter our findings in any substantial way. For further analysis we categorised women into three age groups: 25-35 years, 36-45 years and 45-56 years. Of 1,843 women aged 25-56 participants in all waves of the BHPS, 12.3% reported not having any smear test in 11 years, 26.4% reported having one or two tests and 61.3% reported three or more tests.

Our main finding is that education is associated with the uptake of cervical screening, even after the inclusion of factors that channel educational effects such as income, SES and occupation. Even though we estimate a significant association of education on the uptake of screening net of parental SES, we do not disregard the possibility that we may be capturing the effect of other unobservable individual characteristics which affect both access to resources and education itself, such as self-confidence, motivation, patience and self-efficacy (Hammond, 2003). A self-confident woman may be more likely to achieve more education and also to demand her rights for service utilisation. Hence, self-confidence may be a determinant of service utilisation and its omission will bias upwards the estimate of the effect of education. However, these factors should also be proxied for or related to parental SES so the non-significance of the SES variables suggests that the associations found between take-up of smear tests and education is picking up a causal effect of education.

Studies analysed by Jepson et al. (2000) show an insignificant relationship between education and the uptake of screening. Our results contradict these findings. An explanation for this may be that the controls included in Jepson et al are themselves mediators of the effects of education, such as income, occupation, poverty or class. An insignificant association between education and service uptake does not mean that education does not matter at all, but simply that after such controls are included the educational effect is knocked out.

In the UK there is a cohort-specific uptake of cervical screening services. We find that age is by far one of the most important determinants of screening. Personal life circumstances are important predictors of the take-up of screening. The positive association between women having a child or a partner and cervical screening suggests that caring for one's own health can be motivated by caring for others. Similar to results in the US, women who smoke are less likely to take-up preventative health care.

However, results from this model do not make full use of the panel structure of the data and hence some interesting questions are not being addressed here. One of these regards the effects of adult learning on the uptake of screening. Also, screening in the UK follows a cycle, and this information has not been properly accounted for in a static model. Finally, some variables change over time, and it is important to assess whether changes in these variables, for instance deteriorating health status, have statistical relationships with the uptake of screening.

For the adult learning model we utilise yearly information on self-reported uptake of screening as our outcome variable. This variable takes the value of '1' for each smear test taken between 1991 and 2001 and '0' otherwise. Hence, our outcome is a categorical variable with 11 years of information. The panel structure of this variable allows us to control for some of the unobserved heterogeneity in the data. In particular, using random effects, we model individual time-invariant heterogeneity and using yearly dummy variables period individual-invariant heterogeneity. We assume that individual time-varying heterogeneity is absorbed in the error term.

First we estimate a model to predict screening, ignoring its cyclical structure. The aim of this model is to estimate the factors that predict screening regardless of whether women had already experienced any screening in the past. Results from this model indicate that adult learning is associated with the uptake of screening. In other words, there is a positive association between women enrolled in adult learning and their uptake of cervical screening. We discuss below the likelihood that the effect is causal. Note, too, the finding that if we look at the effects of adult learning lagged one year we find no effects. This suggests that if the effect is causal then it is temporary. However, one should bear in mind that the definition of adult learning being applied here is extremely general, referring to a great range of different courses, of different durations (from 1 day to 1 year), taken for very different reasons and with very different pedagogies, peer groups and qualifications.

Other results indicate the importance of cultural barriers for service uptake; this being captured by the negative and significant parameter of ethnicity. Asian women are less likely to take-up screening than white women. We also find that poor self-reported health is associated with greater uptake of screening, although the explanation for this association does not lie with self-reported health per se but rather with the association between poor self-reported health and visits to the GP. Women with poor health status tend to make more visits to the GP or the clinic, which are the places where smear tests take place. We believe that in one of these visits women with poor health status may also be invited for their screening for cervical cancer.

We also find that changing location is associated with the uptake of screening. Finally, we show that having children under five, full-time employment and living in regions where waiting times for the GP are higher than the average for England are each associated with a lower probability of having a smear test. This last result shows the importance of spatial factors, and in some sense a broad measure of quality of services, for service uptake.

Our last set of estimations include past screenings as predictors of current screening. Our aim with this approach is to capture which of the explanatory variables remain statistically associated with screening when past screening is included as predictor. Again, adult learning remains statistically associated with the uptake of screening. For this set of estimations the marginal effect indicates that doing adult learning is associated with 2.2 percentage points increase in the probability of having a smear test.

Other determinants of screening are ethnicity, with Asian women having 9.8 percentage points lower probability than white women of having a test; age, with women belonging to the older cohort (45-55) having a lower probability of taking a smear test; self-reported health status, as better health status decreases the probability of screening by 2.9 percentage points; and finally women living in an area with long waiting times have 3 percentage points lower probability of going for a screening.

Is the significant relationship between adult learning and the probability of having a smear test causal? Our estimate can be thought of as an effect of adult learning under two assumptions. First, that there can be no reverse causality operating (since screening and learning occur simultaneously in our data). One must assume therefore that the association cannot be caused by an effect of screening on participation in learning. This seems to us a reasonable assumption. The second and more problematic possibility is that unobserved time-varying heterogeneity causes both adult learning and screening. Our methods are not robust to this possibility.

However it is worth emphasising that when we translate our results for adult learning into prevention of cervical cancer we find that between 116 and 152 cases of cancer would be prevented for every 100,000 women in adult learning. The number is relatively small because the learning experiences observed were not systematically related to the intention to prevent cancer.

Moreover, the channel for cancer prevention is through take-up of screening and so there are a number of intermediary and low probability events in between learning and cancer prevention. Nevertheless the finding that between 116 and 152 cancers would be prevented per learning episode is quite large in epidemiological terms and, if causal, is remarkable given that the benefit is entirely unexpected and not the cause of learning participation, in other words it is a great added-value or externality.

Furthermore, the only preventative measure assessed here is cervical cancer screening. If there are indeed effects of learning for women on this outcome there are likely to be effects for all on a greater range of preventative measures, in which case the public health benefit may be extremely substantial indeed.

We take this finding to mean that adult learning may have important extra benefits for society. However, because of the estimation problems described we cannot be sure that this is a genuine effect. A true assessment of causality can be obtained by conducting randomised control trials. We acknowledge that there are ethical and practical issues in relation to randomised control trials. We do not discuss them here. However, in the absence of this evidence, this paper does not claim causality of reported effects.

We also find that prior learning has very strong implications for the probability of undertaking smear tests. We find particular differences between women who attained qualifications at Level 2 and above prior to the 11 years history of screening studied here. Again, it is likely that this represents a selection bias but it is noteworthy that the difference remains even after controlling for parental SES and that women's income and SES do not pick up the same selection bias effect. Therefore, we conclude that education is the dominant socio-economic determinant and one deserving of greater policy and research focus in the practice and study of the take-up of preventative care.

More specifically in terms of the problem of encouraging participation in cervical screening we find important differences in the uptake even of free universally provided NHS services. Barriers to uptake are not about income but are educational, cultural and social, including factors such as lack of awareness, time constraints and health behaviours. A comprehensive approach is needed to improve women's access in the UK. This approach requires the informed and subtle targeting of women by age, social class, and education. Improving access to screening services can be achieved through programmes that raise women's awareness and agency but also by improvements to general educational provision.

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7. Appendix I: Description of the British Household Panel Survey

The British Household Panel Survey (BHPS) has been developed to further our understanding of social and economic change at the individual and household level in Britain, to identify, model and forecast such changes, their causes and consequences in relation to a range of socio-economic variables. This appendix describes the main variables on health and education utilised throughout this report.

7.1 Health and take-up of health services in the BHPS

Since 1991 the BHPS has collected information on health and care for all adults living in the participant households. The core data, that is, information provided each year by participants, include personal health conditions, employment constraints due to poor health, visits to the doctor, hospital or clinic use, use of health and welfare services, specialist check-ups, tests and screening, and smoking behaviour. Rotating information, which include topics collected periodically where we do not expect large changes over time, embrace attitudes towards cost and payments for health care.

As mentioned in Section 0, one of our hypotheses is that education can increase individuals' use of health services for preventative reasons. Information on preventative health care in the BHPS includes dental check-up, eye test by an optician, chest or X-ray, cholesterol test, blood pressure, and for women only cervical smear and breast screening. From this list of check-ups, blood pressure, X-rays or cholesterol tests are likely to be the result of a follow-up illness and they are usually requested by the GP. The decision to take any of these check-ups is beyond the individual's choice for preventative health care. Dental care may be the result of symptoms and pains and not necessary related to a regular check-up. Also in the case of dental care, it is difficult to control the extent to which some individuals have healthier teeth and require less visits to the dentist. Therefore, we decided to focus on screening tests for women.

We decided to utilise cervical smears as our outcome rather than breast screenings mainly due to the age distribution of the population that is entitled to receive the service. Cervical screenings are offered to all women aged between 20 and 65 whereas breast screening is offered only to women over 50 (NHSb, 2003). For the age range of cervical smear tests we can investigate more clearly the effects of educational background and adult learning on the probability that women will have the test over the life course. For the case of breast screening, results will be for a specific cohort. In future research we may extend the analysis to breast screening.

7.2 Information on education in the BHPS

All waves produce information on educational background and recent attainments and, in addition, numbers of subjects passed for some school qualifications such as O Levels and A Levels. During the first wave of interviews (in 1991) individuals were asked two main questions about educational background: (i) types of school qualifications and number of subjects passed, e.g. CSE, GCSE, O Level, A Level, among others; and (ii) types of further education qualifications obtained, e.g. City and Guilds Certificates, Ordinary National Certificate and University Certificate, among others. For the second round of interviews, individuals that participated in the first round were only asked for qualifications obtained during the last year (taken to be since the 1st of September 1991). All new respondents in the second (and subsequent waves) round of interviews provide the same information on educational background as respondents in the first wave. In general, there may not always be a match between reported qualifications and reported numbers (for example, where a respondent failed to provide a number).

Double-counting educational attainments is possible as some people would have obtained qualifications reported in the first wave after September 1991 and report such qualifications both in the first and second waves of interviews. This issue may be accentuated through a tendency to report qualifications more than once. According to Taylor et al. (1996) it is quite possible to obtain the same level of qualifications two years running, and no attempt had been made to eliminate this issue. If only the highest level of educational qualifications per year is required, double-counting qualifications is not a problem.

From the second wave onwards, the BHPS includes questions regarding periods of full-time education and qualifications gained since September of the year before the survey is collected (for example, Wave Three was collected in 1993, so individuals were asked for qualifications gained since September 1992). Only Waves Eight to Ten contain information on qualifications gained due to part-time training or courses. These last surveys contain detailed information that links participation in education, training and qualifications.

With respect to training, however, there are some important modifications between waves that are worth mentioning:

- Wave One includes questions on whether participants received work related training or general training but not whether training led to qualifications.

- Waves Two to Seven ask questions directed to work related and general training, but do not collect information on qualifications gained due to training. As mentioned above, these waves only collect information for qualifications gained due to full-time education.

- Waves Eight to Eleven ask participants for qualifications gained due to full-time education. In a different section, respondents reported up to three part-time training schemes or courses that led to qualifications. In these waves, however, we only know participation in training that led to qualifications.

7.2.1 Classification of educational qualifications

Educational qualifications collected in the BHPS are converted to an equivalent NVQ level as shown in Table 12 and Table 13. For some academic qualifications we utilise the number of subjects passed to discern between two different level equivalents. This is the case for A Levels, Scottish Higher Grades, O Levels, GCSE and Scottish O Grades (Table 12). An individual who passes two or more subjects during her A Levels is considered to have an equivalent Level 3, but only one pass is equivalent to Level 2.

Table 12: BHPS academic qualifications to NVQ levels equivalent

BHPS list	Subjects	Level
University or CNAA Higher Degree	n.a.	5
University or CNAA First Degree; University Diploma	n.a.	4
A Levels	2+	3
Scottish Higher Grades	3+	3
Higher School Certificates; Scottish School Leaving Certificate Higher Grade; Scottish Certificate of Sixth Year Studies	any	3
A Levels	1	2
Scottish Higher Grades	1 or 2	2
GCSE grades A-C; O Levels (pre 1975); O Level grades A-C (1975 or later); Scottish O Grades (pass or bands A-C or 1-3)	5+	2
Certificate or Matriculate; CSE grade 1; Scottish School Leaving Certificate Lower Grade; School Scottish Standard Grade Level 1-3	any	2
GCSE grades A-C; O Levels (pre 1975); O Level grades A-C (1975 or later); Scottish O Grades (pass or bands A-C or 1-3)	1 to 4	1
CSE Grades 2-5; O Level grades D-E; GCSE grades D-G; Scottish SCE Ordinary Grade bands D-E or 4-5; Scottish Standard Grade levels 4-7	any	1

Note: When the person reported her degree or qualification (e.g. A Levels) but did not remember the number of subjects, we categorise them to the lowest level equivalent (i.e. Level 2 for A Levels). The code for ‘other school qualifications’ was classified as academic Level 1.

Apart from City and Guilds vocational qualifications, we are not able to discern other vocational qualifications that correspond to different level equivalents (see Table 13). For instance, trade apprenticeship degrees are classified at Level 2 and Level 3 equivalents. We opted to allocate all individuals with these qualifications to the lowest level, i.e. for the case of trade apprenticeship to Level 2. We cannot categorise vocational qualification at Level 5 since we do not have information on Full Professional Qualifications (membership awarded by a professional institution, NVQ Level 5 or PGCE).

Table 13: BHPS vocational qualifications to NVQ levels

BHPS list	Level
Teaching Qualifications; Nursing Qualifications; City & Guilds Certificate (Full Technological/Part III); HNC; HND; BEC/TEC/BTEC Higher Certificate/Diploma. (**From Wave Eight**, NVQ Level 4)	4
Ordinary National Certificate/Diploma; BEC/TEC/BTEC National/General Certificate or Diploma; City & Guilds Certificate (Advanced/Final/Part II). (**From Wave Eight**, NVQ Level 3)	3
City & Guilds Certificate (Craft/Intermediate/Ordinary/Part I); recognised trade apprenticeship. (**From Wave Eight**, NVQ Level 2)	2
Youth Training Certificate; Clerical or Commercial Qualifications. (**From Wave Eight**, NVQ Level 1)	1

Note: The code for 'other technical, professional or higher qualifications' was classified as vocational Level 1.

7.2.2 Classification of continuing adult learning

Sources of information on the extent of participation in adult learning vary according to the definition of adulthood, and more crucially, of learning. Researchers delimit these terms according to availability of information and the structure of datasets. We define an adult learner as a person over 25 years who has completed full-time education who participates in learning activities by re-entering full-time education, taking part in training schemes provided by current and past employment, attending any government training schemes, Open University courses or correspondence courses.

Respondents provided information on qualifications gained each year between 1991 and 2001, but it is not until after 1997 we are able to link qualifications gained due to full-time education and qualifications gained due to part-time courses, training or government schemes. The BHPS does not include information on leisure courses, which would form part of learning through informal institutions.

Data on training in the BHPS has been modified over time, especially with respect to duration of training schemes and whether training leads to qualifications. During the first wave of interviews, employed individuals provided information on training offered by current employer, reasons for undertaking such training and duration of training measured as the total numbers of training days in one year. In a different section of the questionnaire, all individuals, regardless of employment status, provided information on education and training schemes or courses undertaken in one year, other than the ones already mentioned. For this training information was also provided on reasons and duration. Wave Two refined information on duration by including a measurement of training intensity. Here, individuals provided both the number of hours a day in training and total number of days. Again, participation in education and training was collected first for current employment and then for all other training including the one received from past employment. Waves Three to Seven provided more flexibility for individuals to respond on total duration of training. These questionnaires considered different training schemes with different intensities (i.e.; individuals reported an estimation of the total time spent in training either in hours, days, weeks or months). In neither of these waves is it possible to link training to qualifications. The last four waves of the BHPS modified information on training in two respects. First, information was divided into full and part-time education and training. Second, for each period, individuals provided detailed information about the three longest training schemes or courses in one year. For each course, information was given about reasons for training, duration, how fees were paid, and qualifications obtained, if any.

Due to differences in data collection across waves we are not able to distinguish between full-time and part-time training over the whole period. We are not able to distinguish either between work related training from other types of training. Finally, duration of training schemes is an imperfect and not homogenous measure hence we decided not to include this variable in our analysis. In this report, participation in education or training schemes include all courses undertaken within a year as part of current and past employment and includes government training, open university courses, correspondence courses and work experience schemes.

WIDER BENEFITS OF LEARNING RESEARCH REPORT NO.12

Education, Training and the Take-up of Preventative Health Care

This paper reports findings from research using the British Household Panel Survey on the relationship between education and the take-up of screening for cervical cancer, as an example of preventative healthcare activity. Theoretically, education can enhance the demand for preventative health services by raising awareness of the importance of undertaking regular health check-ups and hence the willingness to do so. Education may also improve the ways in which individuals understand information regarding periodical tests, communication with the health practitioner, and the interpretation of results. Furthermore education enhances the inclusion of individuals in society, improves self-efficacy and confidence. All these factors increase service uptake.

Using a model for the effects of prior learning on the uptake of screening, we show that level 2 or above education increases the probability that women have more than two tests in 11 years by between 5.7 and 5.9 percentage points. This result is robust to the inclusion of controls such as income and socio-economic status, demographic information and personal life circumstances. Using discrete panel data techniques, we show that adult learning is statistically associated with an increase in the uptake of screening. The marginal effect indicates that participation in adult learning is associated with an increase in the probability of having a smear test of 2.3 percentage points. This estimate is strongly robust to time-invariant selectivity bias in education. The findings presented in this paper enrich existing evidence on the socio-economic determinants of screening for cervical cancer and enable policy makers to better understand barriers to service uptake.

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