CENTRE FOR ECONOMIC RESEARCH

WORKING PAPER SERIES

2004

The Economic Consequences of being Left-handed: Some Sinister Results

Kevin Denny and Vincent O'Sullivan, University College Dublin

WP04/22

July 2004

DEPARTMENT OF ECONOMICS
UNIVERSITY COLLEGE DUBLIN
BELFIELD DUBLIN 4

The economic consequences of being left-handed : some sinister results[•]

Kevin Denny ‡†

Vincent O' Sullivan †

‡ Department of Economics
† Institute for the Study of Social Change

University College Dublin

2.0 July 2nd 2004

Abstract

This paper provides the first estimates of the effects of handedness on hourly earnings using data on a sample of 33 year olds in the United Kingdom. Augmenting a conventional earnings equation with indicators of left handedness shows there is a well determined positive effect on male earnings with non-manual workers enjoying a slightly larger premium once we allow for non random selection into occupation. This is not consistent with the view that left-handers in general are in some sense handicapped either being innately or through experiencing a world geared towards right-handers. It is consistent with the popular notion of left-handers having particular talents such as enhanced creativity. The results for females however reveal the opposite, left-handed females are paid significantly less.

Keywords: earnings, brain, left-handed

[•] Corresponding author: Kevin.denny@ucd.ie tel: 353 1 716 4613. fax: 353 1 716 1108. Address: Economics Department, University College Dublin, Belfield, Dublin 4.Ireland. The first author is also affiliated to the Institute for Fiscal Studies, London. This paper forms part of the Policy Evaluation Program at the Institute for the Study of Social Change (ISSC) at UCD. Our thanks to participants at the IRCHSS funded UCD/QUB labour market workshop, CAM at the University of Copenhagen and Chris McManus for comments. Permission to use the NCDS given by the ESRC Data-archive at Essex is gratefully acknowledged.

1 Introduction

In the canonical model of the determinants of an individual's earnings associated principally associated with Becker, Mincer and many other human capital theorists, earnings are determined by a relatively small number of variables notably education and a quadratic function of years of work experience.

However it has long been the practise to augment the empirical models with a variety of covariates. Some of these are fairly uncontroversial such as controls for region or year while others raise deeper theoretical implications. The use of years of completed education linearly fits in with the standard Mincer derivation of the model but is counterintuitive to many particular in other social sciences where the use of credentials seems more natural. While there is evidence of some non-linearities (or "sheepskin effects" e.g. Hungerford and Solon (1997)) the linearity assumption provides a surprisingly good fit to the data (e.g. Krueger and Lindahl 2001) .

Arguably the most distinctive extension of the basic human capital framework is the inclusion of measures of ability (invariably cognitive) in the earnings equation (e.g. Griliches 1977). It is not difficult to justify the inclusion of such measures; one would expect "smart" people to earn more other things being equal. Moreover one would expect it to have implications for the estimated coefficient on schooling, invariably the parameter of interest in such models, since they are typically strongly correlated. However an ability measure is fundamentally different from the other variables. While earnings, experience, education are essentially unambiguous and can in principle be measured, "ability" is not. Measures of cognitive ability are based on psychometric instruments that essentially assume the existence of some general ability (the famous "g") and seek to measure it based on a set of a priori criteria such as content validity, test/re-test reliability[1]. The measures themselves have no cardinal interpretation: one cannot say A is "twice as intelligent" as B. The existence of such an ability cannot be proved and the use and interpretation of these tests is widely debated as much of the literature following Herrnstein and Murray's (1994) monograph *The Bell Curve* showed (e.g. Fischer *et al*(1996), Arrow, Bowles & Durlauf(2000)).

Aside from the more technical issues of what these tests actually mean a radically different approach to intelligence has been offered by Howard Gardner who in a series of books starting in the 1980s (eg Gardner 1983) argued for the existence of "multiple intelligences". These include the conventional psychometric concepts of

[1] See Kline (1998) for an introduction.

intelligence (which he labels linguistic and logical-mathematical intelligence) but also include six or seven other types of intelligence including musical, spatial, inter- and intra-personal intelligences[2]. Such a view has proved quite popular particularly in education emphasizing how individuals differ in their talents and may also have tapped in to much of the latent antipathy that exists towards conventional cognitive testing. These "intelligences" do not admit straightforward measurement however and that is probably one reason why it has had little impact on research in labour economics to date.

However it is noticeable that recent work on the returns to schooling (e.g. Carneiro & Heckman 2004) has suggested that economists have over-emphasized the importance of cognitive skills at the expense of other, more behavioural, abilities. In particular, if IQ is relatively stable after around the age of 8 then there is little point in trying to raise it. However it may be possible to improve children's other, more behavioural, skills and the evidence, though limited, is that there are substantial pay-offs to this.

In general economists have steered clear of including psychometric measures in earnings equations partly due to lack of data but also because they lack an appropriate theoretical framework. A smattering of papers in recent years has used psychometric measures in applied economic analysis. For example Buchele(1983) uses the Rotter(1966) index of "locus of control" or externality . This index measures the extent to which individuals believe they are in control of their circumstances or at the mercy of it, or as it is sometimes put, whether it is all down to luck. He finds no effects of externality on a number of outcomes (earnings, occupational status) though some of these, it is, argued determine the locus of control. The identification assumptions in this paper seem rather arbitrary however. Moreover Ray(1984) points out the psychologists (such as Gatz & Good 1978) have shown that Rotter index provides a doubtful measure of locus of control since the component questions essentially force individuals to choose between two outcomes (either the "internal" or the "external" outcomes). However when respondents have the choice of choosing both, many do so, in other words internal or external outcomes (belief that one is on control of circumstances and belief that it is down to luck) are not negatively correlated.

While the use of behavioural variables and/or psychometric measures is unusual it may be starting to become less esoteric: Bowles, Gintis and Osbourne (2001) survey

[2] The last two roughly correspond to the idea of *Emotional Intelligence*. See Goleman(1995).

the growing literature on behavioural determinants of wages[3]. Some of the literature analyses the effects of character traits such as withdrawal and aggression on earnings as well as psychometric indices such as the Rotter scale discussed above. The theoretical context in which they place their results is Schumpeterian in tone: in a dynamic environment where incentives are changing (because of say changes in technology or markets) there will be a reward to the ability to profit from disequilibria. So one can think of the standard human capital model as being about the rewards to working with existing technologies. However where new technologies arise a different set if skills will be rewarded such as the ability to capitalize on new opportunities. They also discuss the benefits to individuals of being able to manipulate other individuals, so called *Machiavellian intelligence* [4].

While the notion that temperament or behavioural characteristics matter for an individual will come as no surprise to psychologists (amongst others) it has been slow to trickle down to economists. The significance of this literature for the present paper is to indicate the limitations of the conventional human capital model.

A notable quite recent development has been the rise of "neuroeconomics" which involves applying neuroscience to the study of economic decisions. For example functional magnetic resonance imaging (fMRI) has been used to see how different parts of the brain are used while a subject plays simple Prisoner Dilemma games and Hyperscanning allows one to simultaneously scan the brains of several individuals involved in some social interactions including competitive ones[5]. Moreover given the plasticity of the brain there is also the possibility that the structure of the brain may respond to economic circumstances. In fact some recent evidence shows that the posterior hippocampus (an area of the brain associated with spatial representation) in the brains of a sample of London taxi drivers is larger on average and this appears to be a *response* to their occupation, that is it is positively correlated with the time spent in the occupation[6].

This paper contributes to work linking the brain with economics by looking at one particular feature of individuals which relates to the brain namely laterality. In particular we ask whether left-handed people are paid more or less than right-handers controlling for the usual variables that appear in a conventional earnings equation. Our

---

[3] A distinct but related set of papers look at the effects of variables such as beauty or stature, e.g. Hamermesh (1994), Blanchflower & Sargent(1998).

[4] Turner and Martinez (1977) find positive returns to this characteristic for high educated individuals and negative returns for those with low education.

[5] For example Montague and Berns(2002), Glimcher (2002).

[6] Maguire *et al* (2000).

reasons for focusing on left-handedness are partly data-driven: aside from other measures of laterality, it is the only such characteristic available in a large dataset with the labour market data necessary for the investigation. Secondly left-handedness has generated a significant body of scientific research and as discussed below there are grounds for arguing that there may be a connection between it and the labour market. In the next section we discuss some of the scientific background to left-handedness and why it might matter in the labour market.

2 Laterality

Laterality is the scientific term for "sidedness", the characteristic of many objects and living things in which there is an asymmetry between one side and the other. The most obvious examples are in the animal kingdom where many species have important asymmetries. While humans and other primates appear symmetric from the front or back their inner organs are arranged asymmetrically and even the left and right side of the face are not quite mirror images. Overt external asymmetry is less common but can be seen for example in the common crab. Laterality is actually quite a fundamental characteristic of nature, for example amino acids and sugars have left- and right- handed versions, as do sub-atomic particles such as electrons. The DNA molecule is perhaps the best example since it is right handed[7].

In terms of biology, especially human, there is a very large literature examining the incidence, causes and correlates of laterality. The form that most people are familiar with is handedness. While most people identify this with whether an individual writes with their left or right hand, researchers stress a continuum of handedness since many people will use different hands for different tasks. Aside from handedness other forms of laterality exist such as footedness as well as eye dominance and the inter-relationship between different literalities is the subject of much scholarly research[8].

The existence of handedness has a long historical tradition with references to it appearing in the works of Socrates and the Old Testament for example. A consistent feature is the association between left-handedness and abnormality and evil. The clearest example is the Latin word for left, *sinister*, and its modern Italian successor, *sinistra*. This association occurs in numerous languages: for example to describe someone as *gauche* is not a compliment. By contrast, to be *dextrous* (literally right handed) is to be physically adept and a key aide or accomplice is likely to be one's "right hand man". The idea of left

[7] That is as one moves along the famous double helix, one turns in a clockwise direction.

handers being clumsy is widespread. The distinguished British psychologist Sir Cyril Burt declared, "Not infrequently the left handed child shows widespread difficulties in almost every form of fine muscular coordination…Awkward in the house and clumsy in their games, they are fumblers and bunglers in almost everything they do"[9]. A benign, or perhaps simplistic, explanation for this could be that left-handers tend to turn in the opposite direction to right-handers (anti-clockwise and clockwise respectively) so they are more likely to bump into people. The former US President (and left-hander), Gerald Ford's reputation for clumsiness is often attributed to this. More scientific evidence comes from a recent study of several species of fish where it was found that population lateralisation is found particularly in gregarious species since there are obvious gains from coordination[10].

The extent to which left-handedness is stigmatised varies from culture to culture and also depends on religion but is virtually universal. Children who wish to write with their left hand have often been forced, sometimes brutally, to use the other hand. Aside from prejudices the world is geared towards the needs of right-handers since the vast majority of people are right handed it is not surprising. The extent to which it is so can be surprising as it often subtle however and most right-handers are oblivious to it. However left-handers are often acutely aware of the disadvantages accruing to their situation although fearing ridicule they have tended to keep it quiet. Many tools and basic pieces of equipment such as corkscrews, knives, surgical instruments, computer keyboards and even the humble pencil are designed for right-handers. Power-tools and firearms are generally designed with right-handers in mind by the location of the key switches and safety catches. It may be the difficulty of left-handers using right handed equipment that has given rise to the idea that they are clumsy. Coren and Previc (1996) show a higher incidence of accidents occurring to left-handers in a sample of US military personnel and Coren(1989) also finds a higher incidence in a sample of university students 'though a recent study in Finland found no such effect[11].

The incidence of left-handedness in the population remains a subject of both topical and scientific interest. The incidence varies across culture, sex and over time. Typically 10% of the population would be classified (or classify themselves) as left handed with a somewhat higher incidence amongst males. There is a lower incidence in eastern cultures, which may reflect greater cultural antipathy to left-handers. Some

---

[8] For example Bourassa, McManus and Bryden(1996)
[9] Quoted in Coren(1993) p 244.
[10] See Bizazza *et al* (2000)
[11] Pekkarinen, Salminen and Järvelin(2003).

ingenious analysis of paintings and sculptures suggest that this incidence hasn't changed much over the last 5000 years (Coren and Porac 1977) though there is evidence that it has risen in the twentieth century[12]. This may well reflect that left-handed children were often forced to write with their right hand, a practice which is, thankfully, becoming less common. Going further back in time, anthropological evidence suggests that right dominance is over a million years old, preceding *homo sapiens*.

The scientific literature on laterality is quite large and only a few aspects will be touched on here[13]. One issue that should be mentioned is the debate on the causes of left-handedness since this has direct implications for how it might influence earnings. There are a variety of possible explanations for left-handedness. It is well known that left-handedness partly runs in families which suggests a possible genetic basis. Bryden, Roy, McManus and Bulman-Fleming (1997) discuss several genetic models of inheritability of handedness 'though others such as Coren(1992) are sceptical of a genetic explanation. Note that there is general acceptance that right-handedness is genetically determined but the issue is what switches individuals on to the left-handed "track".

One of the earliest theories of handedness is the argument associated with Bakan (e.g. Bakan, Dibb and Reed 1973) that birth stress plays a key role. The argument is that if during birth there is damage to the left side of the skull then this may be sufficient to cause an individual to switch from being a right-hander since the left hemisphere is normally responsible for the right hand and vice versa. Damage to the right side would have no effect except in the small number of left-handed individuals. Curiously, the conclusion that left-handers are, in effect, brain damaged, is not very popular with that population themselves. If true, it would imply that left-handedness is a marker for the presence of neurological impairment and this is consistent with evidence on various other conditions which have a higher incidence amongst left-handers. Perhaps more importantly it is difficult to reconcile this theory with the wide variation in obstetric practice over time (and societies).

Why might laterality in general and handedness in particular matter for economic outcomes such as earnings? There are several ways of approaching this and we have no fixed views on this at this point since this is the first study of this topic that we are aware of.

There are two basic reasons for thinking that left-handedness may be associated with bad outcomes in life; *environmental*: the world is geared towards left-handers, or *biological*: left-handedness causes people to be less able. The environmental theory is

[12] See McManus(2003) figures 9.1 and 9.2.

based on a long tradition of historical and scientific evidence that left-handers experience prejudice but also practical difficulties largely because they are a small minority and many aspects of the environment are constructed to suite right-handers. This could account for the higher incidence of accidents they experience as discussed above.

The biological argument comes in several forms and is ambiguous in its prediction. Firstly there are numerous findings that left-handedness is associated with various undesirable outcomes such as low cognitive ability (e.g. Hardyck, Petrinovich, & Goldman 1976, McManus & Mascie-Taylor 1983) as well as a host of unusual and sometimes pathological conditions. For example a higher incidence of left handedness is found amongst groups with a history of alcoholism, autism, being an architect, blondness, criminality, depression, homosexuality, schizophrenia and psychosis to mention but a few[14]. One theory then is that left-handedness is a marker for the presence of other pathologies in the individual which have been caused by some other means such as the "birth stress" idea of Bakan discussed above. In effect then, if we observe a negative relationship between left-handedness and earnings it is not causal but points to the existence of some other underlying condition.

So far, so bad for the southpaw. Is there an upside? There is evidence that left-handedness has some advantages. Benbow(1996) finds a higher incidence of left-handers among the extremely intellectually precocious looking at those in the .01% of students (i.e. the top 1 in 10,000) taking the American Scholastic Aptitude Test . However given the small numbers this is unlikely to have much effect on the conditional mean of the earnings distribution. Part of the folklore of left-handedness is that they are more creative. This is usually supported by pointing to selected individuals like Leonardo Da Vinci who was left-handed or Einstein (who was not but is widely believed to be). Is there more systematic evidence for this relationship? A number of other papers find evidence that creativity is higher amongst left-handers e.g. Newland (1981) and Coren (1995). The latter paper makes the interesting finding that creativity (specifically "divergent thinking") is associated with left-handedness in males only[15]. If there is such an advantage it could be either inherited or as a response to a more difficult environment which forces them to be more creative. However, like a lot of findings in the laterality literature, whether this one is true more generally is still an open question.

---

[13] The books by Coren (1993) and McManus(2003) provide accessible introductions to the area.
[14] See Coren (1993), chapter 9. The list is not definitive since there are various conditions omitted and some of these associations are disputed.
[15] In certain games, like tennis, there can be an advantage to being left handed since one's right handed opponent may find it more difficult to predict one's play.

A second possibility relates to brain structure. The main connection between the two hemispheres of the brain is a thick band called the *corpus callosum* ; this contains millions of nerves that allow the two hemispheres to "speak" to each other. Witelson (1985) found that it is significantly larger in left-handers (by about 11%). This could imply that the two hemispheres in a left-handers brain are better integrated in processing information. It is also possible that the larger corpus callosum is a response to the left-handers brain having to work harder.

There is one further argument which often arises in casual conversation 'though we are unaware of any research on this. Let us assume that both left-handers and right-handers each possess a certain set of abilities associated with their particular neurological configuration. However given their minority status left-handers will also need to invest effort in acquiring additional skills which are naturally possessed by right-handers. It follows then they may over-compensate for their handicap. Whether this "advantage of being disadvantaged" is empirically important is very hard to say.

Finally there is the question of the specialization of the two hemispheres and more generally the localization of particular functions in the brain. This idea started in the early nineteenth century with the idea of *phrenology*: the doctrine that characteristics of an individual's personality could be traced to various bumps on the skull. While this is now known to be psuedo-sciente it had the merit of popularising the idea of localization. Later research showed for example that language is largely located in the left hemisphere and also that the left side of the body is controlled by the right hemisphere and vice versa. Subsequent work has shown that *to some extent* the left hemisphere is specialized for verbal, analytical, abstract thinking while the right hemisphere specializes for non-verbal (visual/spatial), holistic, intuitive thinking. However much popular writing on the brain has grossly distorted the extent of specialization so that one hears of "left brained" and "right brained" people, the latter being invariably more creative, artistic or emotional. There are even books which promise to help one re-activate one's supposedly under-utilised right hemisphere[16].

One feature that is understood however is that language is less specialized for left-handers being located in the left hemisphere: about 70% of individuals compared to about 97% of right-handers[17]. This has led to speculation that left-handers brains are wired somewhat differently on average and this variation may sometimes convey an advantage. If one thinks of the brain of consisting of a set of specialized modules then if a particular

[16] For example Edwards (1989).

[17] The evidence suggests that *footedness* rather than handedness better predicts language lateralisation, Elias & Bryden(1998).

module, say for speech production, is unusually located beside another module than this could enhance some activity which requires both of them. Clearly such variation could convey disadvantage in some circumstances. This does not imply that they will typically be advantaged rather that they will be more variation[18].

So while one can think of several potential channels through which an individual's labour market success is affected by their handedness the direction is unclear. If environmental effects matter, especially the extent to which work places and equipment is geared towards right-handers, than one would expect these effects to be greater (more negative) amongst manual workers than non-manuals. It might be argued that the inclusion of laterality in an earnings equation is *ad hoc* since it lacks a strong theoretical foundation. If so, the same argument applies to the inclusion of controls like marital status or number of children which are increasingly common. The idea that features of the brain should influence one's experiences in economic and social life, 'though currently untested, is hardly controversial.

---

[18] This theory of *random cerebral variation* is due to McManus (2003) p229.

3 Data

Our analysis is based on the 1958 National Child Development Survey (NCDS). This is a longitudinal study of all persons living in Great Britain who were born between 3rd and 9th of March 1958. The 1958 perinatal mortality survey has been followed by 6 subsequent waves (NCDS 1–6) at age 7, 11, 16, 23, 33 and the most recent, at ages 41-42. NCDS 1-3 comprised of interviews with the child, his parent's, his school and the report of a medical examiner. This data is an exceptionally rich source on child development from birth to early adolescence, child care, medical care, health, physical statistics, home environment, educational progress, parental involvement, cognitive and social growth, family relationships, etc. NCDS 4-6 is based largely on interviews with the cohort member and his partner. They document economic activity, income, training, housing as well as the development of the cohort member's own family.

Due to possible heterogeneity of the effects of laterality across genders (and the problem of modelling labour force participation for women) the analysis is carried out separately for men (full time workers in 1991 only) and women. Only individuals with non-missing observations for all variables used in our study have been included. Tables 1a and 1b shows that the sample used in this analysis is not unlike the overall NCDS sample.

The dependent variable is the natural log of hourly earnings in 1991. The earnings of men and women were derived separately. For the male sample the hourly earnings was derived using usual gross pay, pay period and hours worked per week. Amounts for those who stated they were not economically active were coded to missing, as were observations recording hours worked of outside the range of thirty to eighty hours per week. A trimming of the earnings data at the top and bottom five percentiles took place to eliminate the effects of suspect extreme values. Wages for women were derived similarly with the only differences being the inclusion of working weeks of less than thirty hours to reflect the large numbers of women who work part time.

Three forms of human capital are included in the model: schooling, ability and experience. The age left school variable was calculated from the monthly economic activity information recorded from 1974 to 1981. Respondents reporting school leaving ages of less than sixteen (contrary to the well enforced school leaving age of the time) were dropped from the sample.

The measures of ability were taken at ages 7 (the "maths score" taken from the Problem Arithmetic Test – Pringle et al, 1966) and 11 (verbal and non-verbal ability components from General Ability Test, Douglas 1964). When including ability measures of this kind, economists often try to use ability measures from as early as possible to avoid “contamination” from schooling. It is also desirable to include measures reflecting the different facets of ability where possible. However the scores from the South Gate Reading Test (Southgate, 1962) taken at age seven were not suitable as it is specifically designed to identify weak readers rather than capture reading ability (hence the vast majority of respondents scoring a perfect or near perfect score). In the interest of including ability measures that encapsulate other forms of ability, the verbal and non-verbal scores from the General Ability Test (Douglas, 1964) was included. At age eleven it could be argued that a measure of ability has be contaminated by schooling although most measures of ability regardless of age reported will, to some extent, reflect and be influenced by environmental factors.

We also experimented with using a single measure of ability based on taking a the first principal component from the set of ability measures, the results are essentially the same. The standardisation of the test scores was performed on the entire NCDS sample on all men and women with non-missing values for the individual scores.

Unlike other NCDS studies (e.g. Dearden, 1997), we experimented with a measure of work experience which was calculated by examining the detailed employment history of the cohort member from leaving school until the NCDS5 in 1991. Although this is a study of a single cohort work experience may differ due time spent in education, sickness and unemployment. The effects of experience were incorporated into the model in the usual quadratic form.

In undertaking this study we did not approach the subject with any particular theory of the effects of laterality. However for the male analysis it was felt that it would be sensible to split the sample by manual and non-manual occupation. This was done using the 1991 Socio-economic group classification with personal service workers and farmers being classified alongside the nominally manual categories. All types of employers, managers and professionals were placed in the alternate group along with the various other groups of non-manual workers.

Aside from the level of schooling a number of variables are taken from waves prior to 1991. Information on the type of school attended by the respondent is included. The number of children in the respondent’s family (while growing up) and a dummy indicating whether the respondent was the eldest are included to proxy family size and birth order effects. A number of other variables are taken from the 1991 wave including union membership status, size of employer, marital status and whether the respondent has any children.

There are several laterality variables contained in the dataset. Laterality has many different dimensions and degrees. The variable used in this study is the parent's opinion of the child's laterality at age 7. In introducing laterality into the model one has to note that the measurement of it is not simple. Researchers in the field will, if possible, construct a *laterality profile* or *inventory* that measures the extent to which one is left dominant or right dominant. This will depend not just on hand use but also on eye and foot use (people have a dominant foot and a dominant eye) and will vary in the number and nature of functions with which they use their hands. A "weak left-hander" might use their left hand for writing but otherwise use their right hand for most other tasks. The data contains measurements of foot and eye dominance and some other measurements of lateral ability (e.g. the speed at which they could pick up matches with either hand) however after some experimentation we found that these other measures had more or less or no predictive power.

There is an argument for using an early record of laterality as they are more likely to be influenced by environmental pressures (such as school or family) as they get older. On the other hand at a very early age a child may not have fully revealed their true handedness. So a disproportionately high number of children at age 7 are recorded (see Table 1A) as being mixed handed. One could simply take this at face value. However over time one finds that mixed-handers "disappear" i.e. they become left or (mostly) right-handers. We make the assumption that the indication at age 7 of mixed handedness is largely measurement error. We considered two ways of dealing with this: either one could impute the handedness of the mixed-handers from data taken at age 11 or we could simply omit them. These two approaches give very similar results but in this paper we present results based on the second strategy. So our laterality variable indicates whether they were left handed at age 7, the omitted category being right handed.

A number of variables determining labour force participation are included for the female sample to facilitate a Heckman two-step scheme for female earnings. Included in these, to capture possible income effects, are dummies indicating the presence of a partner and a working partner are included as is the level partner's wages (coded zero if no partner or no working partner).

4 Results

Descriptive statistics are provided in Tables 1a and 1b. Although missing values reduces the sample size considerably by comparing the first and last columns which show the means for the entire sample and that used in the empirical work. In most cases they are quite similar although for example for both men and women those with children are over-represented relative to the entire sample (67% in the sample and 42% overall for the males).

The basic results for men are included in Table 2. We initially present a series of fairly standard earnings equations of the Mincer type with a small number of additional covariates. In column 1 we omit any controls for ability. The estimated return to schooling is 4.5%. The returns to experience after 10 years are about 3%. The other results are largely as one would expect, positive employer size effects and positive effects from being married and having children. The union coefficient is not statistically significant. The second specification augments this with three measures of cognitive ability, mathematics ability at age 7 and measures of verbal and non-verbal ability at age 11. Other tests are available in the data including maths and comprehension tests at 11 and a test for verbal ability at 7: we found these were largely redundant given the three we used. Including these is fairly predictable: there are positive returns to cognitive ability ‘though the non-verbal coefficient is not significant. The fall in the return to schooling is just over one percentage point, a fall of about 25%. Bowles, Gintis and Osbourne (2001) survey a large number of estimates of the omitted variable for the US and find an average fall of 18%. The addition of the ability controls also has the effect of making the two experience coefficients jointly insignificant (p value = 55%). There is not much variation in experience given that they are all the same age ‘though it was clearly sufficient when ability was not controlled for. Column 3 adds controls for school type (this is the school they were in at age 11) however the results are not noticeably different. In column 4 we introduce controls for hand laterality based on the parents’ knowledge of the child at age 7. The results show a well determined positive effect of being left handed equivalent to almost 7% in terms of hourly wages.

The discussion of the laterality literature in section 3 suggests that since there the effects, if any, may differ between workers. To the extent that the world is geared towards right-handers on would expect this to be primarily a feature of those who work their hands. If left-handers possession some advantage it seems likely to be a cerebral one so one might expect to be particularly evident in non-manual workers. In Table 3, we estimate separate models for manual and non-manual workers. From columns 1 and 2 one can see that laterality continues to have a positive, indeed slightly larger, effect for both sub-groups with the premium being *greater* for the non-manuals.

Clearly however occupational status, the choice of whether to be a manual or non-manual worker, is not exogenous: individuals choose what occupations to enter. It therefore makes sense to estimate the model for these groups as an endogenous regime-switching model. The problem is very similar to the familiar sample selection model associated with the work of Heckman and others, the key difference being that those who select out of one state, thereby select into another of interest. Lee(1978) present an estimator for such a model. The procedure is very similar to the Heckman two-step estimator. In the first step, one models using probit the decision to enter one state or the other (in his case a union job versus a non-union job). From the probit one derives a selection correction term that is entered into the wage equations and then these are estimated by OLS.

The underlying model is given by separate wage equations for manual and non-manual workers and a latent variable model predicting whether a worker become a Non-manual or a manual worker.:

$$\ln W_{NI} = \beta X_{Ni} + u_{Ni} \qquad (1)$$

$$\ln W_{MI} = \beta X_{Mi} + u_{Mi} \qquad (2)$$

$$I_i^* = \gamma Z + u_{*i} \qquad (3)$$

The dependent variable is the log hourly wage of the worker. The wage rate observed for workers depends on their status given by an indicator variable I_i. We observe W_{Ni} when I_i =1 and W_{Mi} when I_i =0 . Least squares estimation is biased since $E(u_{Ni} / I_i = 1) \neq 0$ and similarly for the manual workers. Estimating (3) by probit and then estimating the wage equations by OLS augmented by the controls for selection yields consistent estimates:

$$\ln W_{NI} = \beta X_{Ni} + \sigma_{1e} \cdot \left(- \frac{f(\Psi_i)}{F(\Psi_i)} \right) + \eta_{Ni} \qquad (4)$$

$$\ln W_{MI} = \beta X_{Mi} + \sigma_{2e} \cdot \left(\frac{f(\Psi_i)}{1 - F(\Psi_i)} \right) + \eta_{Mi} \qquad (5)$$

where $\Psi_i = \hat{\gamma} Z$. Lee uses as an approximation to the covariance matrix for each equation $(Q'Q)^{-1} Q'V^{-1} Q(Q'Q)^{-1}$ where Q is the matrix of independent variables, i.e. the

X's *and* the selection term and V is a diagonal matrix with estimates of the variance of the η's along the diagonal[19]. In fact he presents the t ratios based on the usual OLS based standard errors as they provide a good approximation, there being little heteroscedasticity in the residuals. In this paper the t ratios are those provided by applying the Heckman two-step selection estimator to each equation separately ('though obviously the first stage probit is common). Alternatively we calculated the Huber/White heteroscedastic-consistent robust standard errors. These two sets of estimates are extremely close.

In Lee's model individuals choose being in a union or non-union job on the basis of the expected wage gains. The probit is a reduced form since clearly the wage gain cannot be directly observed. However it is possible, having estimated the wage equations allowing for endogenous regime-switching, to re-estimate the probit with the imputed wage gap and recover the structural parameters. This last step is not pursued here since it is not of direct interest. The explanatory variables in the probit (the Z's) in the Lee model contain all the determinants of wages (the X's) and some additional identifying variables. A more recent application of endogenous regime switching to UK data is Blackaby, Murphy and Sloane (1992) also to a union/non-union model.

In column 3 of Table 3 the results of the probit predicting being in a non-manual job compared to a manual one are shown. The model is identified by including a number of family background variable that are likely to influence one's choice of career. As well as years of education we include a binary variable to indicate staying in school after the minimum school leaving age of 16, whether an individual is a first born, the number of siblings and the age at which the father left school. For the most part the coefficients make sense: more able and more educated workers being more likely to become non-manual workers. Given that handedness might have an effect on one's wages one might expect it to be a determinant of whether an individual becomes a non-manual or manual worker with left handers avoiding manual work. In fact the laterality variable is not significant in the probit. Of course this is perfectly consistent with our finding that left-handed manual workers do not appear to be at a disadvantage compared to their left-handed non-manual counterparts.

The estimated wage equations incorporating the selection terms are in columns 4 and 5. One striking result is that the return to education is no longer statistically significant. This reflects the fact that entry into manual or non-manual jobs depends heavily on education. However conditional on that, there are apparently no further financial gains from years of education.

---

[19] In the expression for the covariance matrix above Lee has V where we assume V-inverse is intended.

Turning to the laterality coefficient there are only small differences with the uncorrected estimates with the premium to left handed manual workers rising by about one percentage point. So any environmental hazards to the left-handers in the labour market are apparently dominated by the benefits, whatever they are. While we might expect the workplace to be more hazardous for the left handed manual worker this differential effect cannot be explained as a compensating differential since the *employer* would have plenty of cheaper, right handed workers to hire. It would appear 'though that *nature* compensates for any dis-amenity from sinistrality. Interestingly, from a biological point of view left-handers are equally "successful" in that their rate of reproduction is the same as right-handers and they show no sign of evolving away. The suggestions in the literature on the superior creative ability of left-handers help explain the results.

In Table 4 we provide estimates of wage equations for female workers. We do not pursue the endogenous regime-switching model since the sample is smaller and it seemed sensible to deal with the conventional participation decision. Whereas the estimates for males were for full time workers only, here we included part-time workers with an associated dummy variable. Columns 1 and 2 present earnings equations with and without laterality controls but with no correction for selection into employment. Unlike males, left handed females experience a *penalty* of about 7.5%. This result is robust to correcting for selection into employment (column 5). So what are left-handed women doing wrong? The tentative solution we suggest is based on the finding of Coren (1995) that only male left-handers display higher levels of creativity. This result does not yet enjoy the status of a stylised fact since more studies are needed and such results may be sensitive to the psychometric instrument used. The negative effect therefore needs to be explained by either environmental factors or other biological disadvantages. Clearly we are in the realm of speculation here in the absence of direct measures of these factors and in the complete absence of previous estimates of these effects. An alternative theory is that there is employer discrimination against left-handed females.

5 Conclusions

This paper started by considering how earnings equations have been augmented by a relatively small number of non-standard variables including psychological measures. It is not difficult to think of situations where earnings depend on more than years of education and experience or age. The potential role of cognitive ability is relatively easy to understand and given that IQ type measures are sometimes available they have shown some ability to predict earnings. The lack of measures of other abilities may have lead to their importance being over-estimated. Cognitive ability, like all abilities to some extent, is a feature of the brain and direct consideration of how brain function influence economic and social life seems a worthwhile research venture. The cost of acquiring the necessary data (i.e. of scanning the brains of large numbers of people and collecting labour market data on them) would be currently very high.

This paper looks one particular feature of the brain that has been widely studied and enjoys widespread cultural and scientific significance. Our evidence shows that by augmenting standard Mincer type models with indicators of handedness that there are significant effects with males benefiting from left-handedness and females being penalized. There is not yet enough good scientific evidence about the effects of laterality on individual's abilities and talents to give a simple interpretation of these results. It might be argued that the inclusion of laterality in an earnings equation is *ad hoc* since it lacks a strong theoretical foundation. If so, similar arguments apply to the inclusion of controls like employer size, school type, marital status or number of children, variables which are increasingly becoming common. Laterality by itself is a more profound phenomenon, being evident in every human (and many non-human) society and has existed for well over a million years.

Examining its relationship with economic success we find large effects that differ between the sexes. One explanation for the existence of such effects is the "environmental hazard theory". In this, left-handers are paid less as they struggle with a right-handed world. It would also predict the penalty is greater for manual than non-manual workers and that hence that left-handers would sort into non-manual jobs.

For males, all three predictions are rejected by the data. Left-handers are paid more, other things being equal. The premium is slightly greater for manual workers. There is no evidence of occupational sorting by laterality. This suggests that the complaints of (male) left-handers of their tribulations in life, if correct, appear to be compensated for generously and the folklore of talented left-handers may have some substance. Strangely, for females on the other hand, there is a significant penalty for being left-handed. There is no obvious economic or psychological explanation for this result.

Research on the brain and economic outcomes is in its infancy and has largely focused on a narrow set of behaviours that can be studied in an experimental setting such as strategic behaviour. However it seems highly likely that neuroscience will, in the future, provide more data to better understand labour market and other outcomes.

References

Arrow, K., S. Bowles and S.Durlauf (2000) *Meritocracy and Economic Inequality*, Princeton University Press, N.J.

Bakan, P., G., Dibb and P. Reed (1973). “Handedness and birth stress”, *Neuropsychologia*, 11, 363-366.

Benbow, C.P. (1986). “Physiological correlates of extreme intellectual precocity”, *Neuropsychologia*, 24(5), 719-25.

Bisazza, A; C. Cantalupo, M. Capocchiano and G. Vallortigara (2000). “Population lateralisation and social behaviour: A study with 16 species of fish”, *Laterality*, 5(3), 269-284.

Blanchflower D. & J. Sargent, J. (1998). “Adolescent obesity and socio-economic status seven years later: do fat children earn less as adults?” unpublished, Dartmouth College.

Bourassa, D.C., I. C. McManus, & M. P. Bryden, (1996), “Handedness and Eye-dominance: a meta-analysis of their Relationship”, *Laterality*, 1, 5-34.

Bowles, S; H. Gintis and M. Osborne (2001). “The determinants of earnings: a behavioural approach”, *Journal of Economic Literature*, 39(4), 1137-1176.

Buchele, R. (1983). "Economic achievement and the power of positive thinking", *Journal of Human Resources*, 18, 441-449.

Bryden, M.P; E.A. Roy, I.C. McManus and M.B. Bulman-Fleming (1997). “On the Genetics and measurement of human handedness”, *Laterality* , 2, 3-4, 317-336.

Carneiro, P. and J. Heckman (2004). “Human Capital Policy” in *Inequality in America: What Role for Human Capital Policies.* Edited by J. Heckman and A. Krueger, MIT Press: Cambridge, Ma.

Coren, S. (1993). *The left-hander syndrome, the causes and consequences of left-handedness.* New York: Vintage.

Coren, S. (1995). “Differences in divergent thinking as a function of handedness and sex”. *American Journal of Psychology*, 108(3), 311-25.

Coren, S. (1996) “Handedness as a predictor of increased risk of knee, elbow or shoulder injury, fractures and broken bones”, *Laterality*, 1(2), 139-152.

Coren, S. and F.H. Previc (1989). “Left-handedness and accident-related injury risk”, *American Journal of Public Health*, 79(8), 1040-1041.

Coren, S. and C. Porac (1977). “Fifty centuries of right-handedness: The historical record” *Science*, 198, 631-632.

Dearden, L. (1999). “The effects of families and ability on men’s education and earnings in Britain” *Labour Economics*, 6, 551-567.

Douglas, J.W.B. (1964). *The home and the school.* London: MacGibbon Kee.

Edwards, B.(1989). *Drawing on the right side of the brain*. New York: Tarcher/Putnam.

Elias, L.J. and M. P. Bryden (1998). “Footedness is a better predictor of language lateralization than handedness”, *Laterality*, 3(1), 41-51.

Fischer C.S., M. Hout, M. Sánchez Jankowski, S.R. Lucas, A. Swidler & K. Voss (1996) *Inequality by design : cracking the Bell Curve myth*, Princeton University Press, Princeton , N.J.

Gardner, H. (1983). *Frames of Mind*. New York: Basic Books.

Gatz, M. and P.R. Good (1978). “An Analysis of the Effects of the Forced-Choice Format of Rotter's Internal-External Scale” *Journal of Clinical Psychology* 34, 381-85.

Glimcher P.W. (2002) “Decisions, Decisions, Decisions: Choosing a Biological Science of Choice”, *Neuron*, 36(2), 323 -332

Goleman, D. (1995). *Emotional Intelligence: Why it can matter more than IQ*. New York: Bantam.

Griliches, Z. (1977). “Estimating the return to schooling: Some econometric problems” *Econometrica*, 45(1), 1-22.

Hamermesh, D. and J.E. Biddle (1994). “Beauty and the labor market”, *American Economic Review*, 84, 5, 1174-94.

Hardyck C., L.F. Petrinovich, and R.D. Goldman (1976) “Left-handedness and cognitive deficit”, *Cortex*, 12, 266-279

Herrnstein, R. and C. Murray (1994). *The Bell Curve*. New York: Free Press.

Hungerford, T. and G . Solon (1997) “Sheepskin effects in the return to education”, *Review of Economics and Statistics*, 69, 175-177

Kline, P. (1998). *The new psychometrics : science, psychology and measurement.* London: Routledge.

Krueger, A.B. and M. Lindahl (2001). “Education for growth: why and for whom?” *Journal of Economic Literature*, 39, 1101-1136.

Lee, L. (1978). “Unionism and wage rates: a simultaneous equations model with qualitative and limited dependent variables”, *International Economic Review*, 19, 2, 415-433.

Maguire, E.A. , D.G. Gadian, I.S. Johnsrude, C.D. Good, R.S.J. Frackowiak, C.D. Frith & J. Ashburner (2000) “Navigation-related structural change in the hippocampi of taxi drivers”, *Proceedings of the National Academy of Sciences,* 97 (8) (April), 4398–4403

McManus, C. (2002). *Right hand, left hand: the origins of asymmetry in brains, bodies, atoms and cultures.* London: Weidenfeld & Nicholson.

McManus, I.C. and C.G.N. Mascie-Taylor (1983). “Biosocial correlates of cognitive abilities”, *Journal of Biosocial Science*, 15, 289-306.

Montague, P.R. & G.S. Berns (2002) “Neural economics and the biological substrates of valuation”. *Neuron* 36 (2), 265-284

Murphy P.; P. Sloane & D. Blackaby (1992). “The effects of trade unions on the distribution of earnings: A sample selectivity approach”, *Oxford Bulletin of Economics and Statistics*, 54(4) 517-542.

Newland, G.A. (1981). “Differences between left- and right-handers on a measure of creativity”, *Perceptual and Motor Skills*, 53, 787-792.

Pekkarinen, A.; S. Salminen and M.R. Järvelin (2003) “Hand preference and risk of injury among the Northern Finland birth cohort at the age of 30”, *Laterality*, 8, 4, 339–346.

Pringle, M.L., Kellmer; N.R. Butler and R. Davie (1966). *11,000 seven year olds: the first report of the National Child Development study (1958 cohort).* London: Longmans.

Ray, J. (1984). “Some pitfalls in measuring perceived locus of control as an economic variable: A comment on Buchele”, *The Journal of Human Resources*, 19 (4), 580-581.

Rotter, J. B. (1966). "Generalized expectancies for internal versus external control of reinforcement." *Psychological Monographs,* 80:609.

Southgate, V. (1962). *Southgate group reading tests: manual of instructions.* London: University of London Press.

Turner, C.F, and D.C. Martínez (1977). "Socioeconomic achievement and the Machiavellian personality", *Sociometry*, *40*, 4, 325-336.

Witelson, S.F. (1985). "Brain connection: The corpus callosum is larger in left-handers", *Science*, 229:665

Table 1a: Descriptive statistics: Men

	All NCDS:	% non-missing values:	Sample Used:
Age left education:	17.03	0.78	17.08
	(1.86)		(1.93)
Experience in years:	16.57	0.40	16.14
	(1.56)		(1.50)
Standardized math test- age 7:	0.02	1.00	0.34
	(1.02)		(0.79)
Standardized verbal test- age 11:	-0.07	1.00	0.41
	(0.99)		(0.73)
Standardized nonverbal test- age 11:	-0.02	1.00	0.51
	(1.00)		(0.67)
Log hourly wages 1991:	1.95	0.35	1.94
	(0.29)		(0.31)
Log hourly wages 1991– non-manual:	2.06	0.18	2.04
	(0.28)		(0.29)
Log hourly wages 1991– manual:	1.82	0.16	1.80
	(0.26)		(0.29)
Father's school leaving age:	15.06	0.63	14.96
	(2.011)		(1.87)
Number of siblings:	2.45	0.66	2.15
	(1.83)		(1.64)
Laterality age 7:		0.81	
Right:	0.80		0.90
Left:	0.12		0.10
Mixed:	0.08		
Married:	0.63	0.63	0.68
Trade union:	0.33	0.65	0.48
Has children:	0.37	1.00	0.67
Type of school:		0.62	
Selective:	0.62		0.65
Maintained:	0.34		0.34
Independent:	0.04		0.01
Employer size:		0.62	
1-10 co-workers:	0.28		0.10
11-25 co-workers:	0.11		0.13
26-99 co-workers:	0.20		0.27
100-499 co-workers:	0.22		0.28
500+ co-workers:	0.19		0.23
Eldest child in own family:	0.24	1.00	0.41
Father's social class 1974:		0.61	
Professionals:	0.05		0.05
Managerial & technical:	0.19		0.19
Skilled – non-manual:	0.10		0.12
Skilled – manual:	0.45		0.50
Partly skilled – non-manual:	0.02		0.00
Partly skilled – manual:	0.13		0.12
Unskilled:	0.06		0.02
Stayed in post-16 education:	0.58	1.00	0.36
Non-manual:	0.50	0.63	0.54
N:	8960		1259

Notes: Standard deviation in parentheses.

Table 1b: Descriptive statistics: women

	All NCDS:	% non-missing:	Sample Used:
Age left education:	17.13	0.81	17.08
	(1.81)		(1.76)
Experience in years:	15.13	0.82	14.98
	(2.87)		(2.79)
Standardized math test- age 7:	-0.02	1.00	0.26
	(0.98)		(0.79)
Standardized verbal test- age 11:	0.08	1.00	0.33
	(1.01)		(0.89)
Standardized nonverbal test- age 11:	0.02	1.00	0.27
	(0.99)		(0.87)
Log hourly wages 1991:	1.61	0.31	1.63
	(0.37)		(0.37)
Number of children under 3 yrs:	0.24	1.00	0.35
	(0.5)		(0.59)
Number of children under 7 yrs:	0.37	1.00	0.51
	(0.62)		(0.67)
Number of children:	1.17	1.00	1.59
	(1.28)		(1.22)
Partner's weekly wages if has working partner:	260.15	0.83	257.92
	(96.47)		(92.08)
Laterality age 7:		0.80	
Right:	0.86		0.91
Left:	0.09		0.09
Mixed:	0.06		
Married:	0.64	0.68	0.62
Trade union:	0.23	0.69	0.24
Has children:	0.54	0.97	0.75
Type of school:		0.61	
Selective:	0.63		0.64
Maintained:	0.34		0.34
Independent:	0.03		0.02
Employer size:		0.62	
1-10 co-workers:	0.29		0.27
11-25 co-workers:	0.16		0.16
26-99 co-workers:	0.20		0.21
100-499 co-workers:	0.18		0.17
500+ co-workers:	0.16		0.18
Labour force participant:	0.49	0.97	0.68
Part-time worker:	0.26	0.97	0.37
Long-term disability:	0.10	0.97	0.13
Bad health:	0.07	0.97	0.11
Own mother worked in 1965:	0.44	0.97	0.50
Has partner:	0.58	0.97	0.77
Has working partner:	0.54	0.97	0.68
N	9593		2506

Table 2: Estimation Results: Men

	(1) Log Hourly Wages	(2) Log Hourly Wages	(3) Log Hourly Wages	(4) Log Hourly Wages
Age left education:	0.034	0.024	0.036	0.037
	(4.91)	(3.54)	(8.81)	(8.85)
School type – maintained:			0.021	0.021
			(1.32)	(1.29)
School type – independent:			0.025	0.032
			(0.3)	(0.39)
Standardized math test- age 7:		0.055	0.054	0.054
		(5.04)	(4.86)	(4.83)
Standardized verbal test- age 11:		0.044	0.052	0.054
		(2.58)	(2.97)	(3.06)
Standardized nonverbal test- age 11:		0.023	0.024	0.022
		(1.24)	(1.29)	(1.17)
Married:	0.053	0.053	0.05	0.049
	(2.94)	(3.1)	(2.92)	(2.88)
Has children:	0.041	0.035	0.031	0.035
	(2.28)	(2.02)	(1.8)	(2.05)
Trade Union member:	0.009	0.009	0.012	0.014
	(0.56)	(0.54)	(0.72)	(0.83)
Laterality age 7 – left:				0.066
				(2.88)
Experience in years:	0.308	0.256		
	(4.91)	(4.05)		
Experience in years squared:	-0.011	-0.009		
	(4.85)	(3.99)		
N	1259	1259	1259	1259

Notes:
Regional dummies & employer size effects omitted.
t-statistics in parenthesis.

Table 3:
Estimation Results for Men: by manual / non-manual

	(1) Log Wages Non-manual:	(2) Log Wages Manual:	(3) Non-manual Job: (probit)	(4) Log Wages Non-manual (endogenous regimes)	(5) Log Wages Manual (endogenous regimes)
Age left education:	0.02	0.052	-0.317	0.002	0.025
	(4.08)	(4.27)	(-5.19)	(0.3)	(0.96)
School type – maintained:	0.034	0.015	0.067	0.035	0.019
	(1.55)	(0.61)	(0.72)	(1.48)	(0.79)
School type – independent:	0.096		0.655	0.097	-0.328
	(1.3)		(1.41)	(1.19)	(-1.66)
Standardized math test- age 7:	0.072	0.049	-0.007	0.071	0.049
	(5.23)	(2.8)	(-0.1)	(4.65)	(3)
Standardized verbal test- age 11:	0.031	0.04	-0.448	-0.005	0.012
	(1.2)	(1.76)	(-4.47)	(-0.15)	(0.38)
Standardized nonverbal test- age 11:	0.018	-0.007	-0.030	0.010	-0.009
	(0.72)	(0.28)	(-0.29)	(0.38)	(-0.33)
Married:	0.051	0.054	0.072	0.052	0.056
	(2.25)	(2.14)	(0.7)	(2.14)	(1.98)
Has children:	0.078	-0.001	0.178	0.101	0.012
	(3.49)	(0.03)	(1.69)	(3.97)	(0.38)
Trade Union member:	-0.023	0.074	0.452	0.011	0.101
	(1.05)	(2.85)	(4.89)	(0.43)	(3)
Laterality age 7 (left):	0.071	0.085	0.074	0.075	0.094
	(2.5)	(2.23)	(0.51)	(2.1)	(2.47)
Eldest child in family:			0.177		
			(1.8)		
Number of siblings:			0.071		
			(2.48)		
Father's school leaving age:			-0.029		
			(-0.93)		
Stayed in education post-16:			-0.219		
			(-1.37)		
Regime selection correction				-0.158	0.101
				(2.87)	(1.29)
n	645	546	1259	645	546

Notes:
Region dummies, employer size effects and father's social group not displayed.
Specifications 4 & 5 incorporate regime switching model using the probit in column 3.
t-statistics in parenthesis.

Table 4: Estimation Results for Women:

	(1) Log Wages:	(2) Log Wages:	(3) Labour force participation: (probit)	(4) Log Wages:	(5) Log Wages:
Age left education:	0.051	0.051	0.025	0.052	0.049
	(8.81)	(8.8)	(1.15)	(9.43)	(9.03)
School type – maintained:	0.022	0.019	0.164	0.030	0.028
	(1.31)	(1.14)	(2.48)	(1.68)	(1.61)
School type – independent:	-0.033	-0.04	0.234	0.002	-0.019
	(0.53)	(0.63)	(0.99)	(0.04)	(0.34)
Standardized math test, age 7	0.027	0.026	-0.014	0.019	0.027
	(2.48)	(2.38)	(-0.31)	(1.71)	(2.44)
Standardized verbal test, age 11	0.105	0.106	0.180	0.120	0.117
	(5.09)	(5.16)	(2.35)	(6.01)	(6.02)
Standardized nonverbal test, age 11	-0.017	-0.018	0.079	-0.014	-0.018
	(0.81)	(0.87)	(0.99)	(-0.7)	(-0.91)
Married:	0.094	0.095		0.088	0.100
	(5.44)	(5.56)		(5.03)	(5.79)
Has children:	-0.11	-0.109		-0.185	-0.167
	(5.5)	(5.49)		(-7.88)	(-7.05)
Trade Union member:	0.167	0.164		0.159	0.165
	(9.69)	(9.51)		(9.49)	(9.93)
Laterality, age 7 (left):		-0.074			-0.073
		(2.77)			(-2.82)
Experience:	0.029	0.028		0.047	0.037
	(1.92)	(1.8)		(2.7)	(2.12)
Experience squared:	-0.001	-0.001		-0.002	-0.001
	(1.38)	(1.26)		(-2.25)	(-1.66)
Part time worker:	-0.163	-0.162		-0.176	-0.177
	(8.37)	(8.35)		(-9.29)	(-9.45)
Long term disability:			-0.154		
			(-1.74)		
Bad health:			-0.316		
			(-3.44)		
Number of kids under 3yrs:			-0.695		
			(-12.2)		
Number of kids under 7yrs:			-0.349		
			(-6.32)		
Number of kids:			-0.261		
			(-7.36)		
Own mother worked in 1965:			0.087		
			(1.41)		
Partners weekly earnings /10:			-1.638		
			(-4.12)		
Has partner:			-0.158		
			(-1.37)		
Has working partner:			0.886		
			(6.52)		

Sample selection correction				0.179 (6.03)	0.150 (4.87)
n:	1484	1484	2506	1484	1484

Notes:
t-statistics in parenthesis
Specifications 4 & 5 incorporate Heckman selection model based on probit in column 3.
Region dummies & employer size terms not displayed.