Education: Risk Enhancing or Insurance Mechanism?

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(Very Rough Draft of Paper)

February 8, 2015

Abstract

This paper uses a structural life cycle model incorporating savings, labour supply, human capital accumulation, unemployment risk and wage risk to estimate the returns to higher education in the UK. Returns to education calculated from a single cross section using prime labour market ages (as is typical in the literature) are compared to those which employ a (i) life cycle perspective (ii) unemployment risk and (iii) wage risk. The use of rich cohort data on individuals born in a single week in 1958 and 1970 addresses the problem of endogenity by controlling for early ability measures. Finally, some counterfactual exercises are conducted analysing the impact of changing unemployment benefits to match the system in the US and of decreasing the variance of the permanent shocks for each education level on the returns to education.

1 Introduction

The returns to education is one of the most widely researched topics in economics. The common framework used is the Mincer (1974) earnings regression whereby log earnings are

*I would like to thank my supervisors, Sir Richard Blundell and Eric French, for great guidance and very helpful comments. I would also like to thank Barbare Flores, Paul Rodriguez and Alexandros Theloudis for many helpful discussions. Financial support from the Economic and Social Research Council is greatly appreciated. Any comments or questions should be addressed to judithmdelaney@gmail.com

regressed on years of schooling and a quadratic in experience. Criticism of this approach for failure to deal with the endogeneity of schooling led to a plethora of papers making use of instrumental variables in an effort to provide exogenous variation in schooling (see Card (1995) for a review). However the preoccupation with finding a credible instrument has abstracted from other equally important concerns with the Mincer approach. The model assumes non-linearity in returns to schooling, seperability between schooling and experience and abstracts from things like discounting, tuition and the tax and benefit system[1]. Moreover, it is clear that individuals are not interested in the earnings differences at a certain point in the life cycle but rather care about their lifetime earnings. The Mincer set up is only relevant if current earnings are a good proxy for life cycle earnings. However, Haider and Solon (2006) have shown that this is not the case and so if we look at returns to education at the beginning of the life cycle the returns will be downward biased while if we look at returns at the end of the life cycle the returns would be upward biased (Bhuller, Mogstad and Salvanes 2012). Thus it is important to look over the whole life cycle when evaluating the returns to education to avoid this kind of bias. The returns in the literature are typically estimated using prime labour market ages when earnings are at their highest point. Thus once we look over the whole life cycle and allow for things like discounting and tuition, returns may be substantially smaller.

But one of the most surprising features of the Mincer model is the omission of risk. Since almost all investment decisions involve some consideration of the amount of risk involved and the risk return trade off, it is surprising that such an important factor is almost omitted in the literature. Human capital like any other investment is subject to the perils of risk and so it is imperative to include this when analysing the return. An individual deciding whether to invest in education faces a huge amount of uncertainty

[1]Assumption of non linearity in returns is incorrect if years of schooling which result in a qualification provide higher retuns than other other years, the so called sheepskin effects (insert ref). Heckman, Lochner and Todd (2005) have shown that earnings growth rates are not parallel across schooling levels with the higher educated experiencing steeper profiles. Individuals are impatient and so the timing of income flows matters greatly so it is important to include discounting in the model. With progressive taxes the higher educated will take home a smaller fraction of their income. While generous welfare benefits, in addition to minimum wage laws will help to inflate the incomes of the lower educated.

concerning future labour market conditions, completion of the schooling level, length of life, future earnings and what fraction of time will be spent in employment. In this paper, I focus on the effect of unemployment risk and earnings risk. Given that there does not exist any market that insures against low returns to education this is a very important topic and may explain part of the reason why many students do not progress to further education despite the perceived benefits. If the probability of unemployment varies systematically with education, for example, if higher educated individuals face lower unemployment rates, this means that they will be in receipt of income for a larger fraction of their lives and thus we might expect standard rates of return estimates to be downward biased. On the other hand, if increased education comes at the cost of higher wage risk then individuals will place less value on higher education and the returns will be lower. There is no theoretical argument to show whether education increases or decreases risk and so it is mainly an empirical question. Higher education may lead to higher earnings on average but the distribution may be significantly skewed such that the majority of graduates will earn significantly less than mean earnings. Risk averse individuals care not just about the mean of the earnings distribution but also about the variance and may be willing to trade higher earnings for lower risk. Income levels among observationally similar people may differ due to luck, social connectedness, illness, promotions, ability, different training opportunities or motivation and therefore there is a wide range of potential earnings outcomes that may be realised. Thus, it is likely that individuals care not only about the mean of the earnings distribution but also the variance. [2] There are some reasons to think education might lead to lower rates of unemployment if those with more education have higher levels of human capital, are less likely to be fired due to higher training costs and have the option to downgrade occupation in times of recession. However, in order to rigorously examine whether this is indeed the case, it is necessary to have a life cycle model since the dynamic effects of unemployment may differ across education levels due to varying levels of human capital depreciation, costs of foregone work experience and the impact on future wages and employment prospects due to scarring and atropy. Additionally, the system of unemployment insurance that

[2] If returns are normally distributed this is enough to summarise the entire distribution.

exists will also have a bearing on the outcome. Unemployment benefits represent a large chunk of their predisplacement income and this may be enough to negate the adverse affects of employment. Added to this, the existence of minimum wage laws provide a lower bound to the wage that one can receive and so this may decrease the risk adjusted returns. Any analysis of risk and insurance needs to include some measure of the tax and benefit system since generous benefits will tend to attenuate any adverse shocks. Blundell, Gruber and Mogstad (2012) using Norwegian data find that taxes and transfers play a substantial role in sheltering individuals from the adverse consequences of income shocks with particular benefit for the low educated.

The literature examining this topic is surprisingly quite scarce despite the fact that one of the earliest papers looking at the topic was back in 1972 when Weiss (1972) examined the risk in occupation and education using data on US scientists. He found the inclusion of risk has negligible effects on rates of returns. Olson, Shefrin and White (1979) estimate a model similar to Weiss but allow borrowing while in school with repayments being made in fixed instalments once schooling has been completed. They find that risk adjusted returns to college are small but positive. Nickell (1979), on the other hand, using UK data finds that after correcting for unemployment, the return to education using pre-tax weekly income rises by 0.6% but the inclusion of unemployment benefits and post-tax weekly income leads to the adjusted rate of return to rise by only 0.2 percentage points. Padula and Pistaferri (2005) using both US and Italian data find that returns to education are significantly higher when accounting for both wage and employment risk. However, they assume a world of complete markets and so do not allow for savings. As a result, the only form of insurance is got by choosing the education level with the most smooth earnings profile.

In this paper I estimate a structural life cycle model with savings, labour supply, ability, human capital accumulation and depreciation, unemployment risk and wage risk. In addition, similar to Keane and Wolpin (1997) who have a dynamic model of schooling, work, and occupational choice decisions, I explicitly model the education decision. The inclusion of savings is important as it provides a channel through which individuals can self insure; moreover, without savings the effect of labour supply on achieving

consumption smoothing would be greatly exaggerated. Labour supply is important for two reasons. Firstly, labour supply is the utilisation of human capital and so directly impacts the returns. Secondly, endogenous labour supply decisions result in earnings fluctuations so without modelling labour supply explicitly the measure of risk would be upward biased. This model is similar to Low, Meghir and Pistaferri (2010) who estimate a life cycle model with consumption, labour supply, job mobility, employment risk and wage risk. They are interested in the differential impacts of each risk measure on both overall welfare and output and the insurance value of prgrams such as Food Stamps and UI. The model also borrows from Blundell et al (2013) who examine the effects of in-work benefits on female labour supply and human capital accumulation, by allowing for education specific experience and depreciation effects to capture the dynamic effects of labour force participation and unemployment.

2 Model

Individuals complete HS/A-levels at age 18 then decide whether to enter the labour market or go to college in the next period – at age 19. The dDecision depends on expected benefits and costs including idiosyncratic tastes for education. College lasts for 3 years after which individuals enter the labour market. Each period an individual is subject to an unemployment shock if employed and a job offer arrival if unemployed. After observing these shocks he must decide whether it is optimal to work or not. Individuals retire at age 65 and face a mandatory spell of retirement of 10 years at the end of life where they consume their savings and receive state pension. The date of death is known with certainty and there is no bequest motive.

The agent wishes to maximise the present discounted value of lifetime utility subject to a budget constraint

$$\max_{c_t, P_t} E_t \sum_{t=0}^{T} \beta^t U(c_t, P_t)$$

where the utility function is non seperable in consumption and leisure.

$$U(c_t, P_t) = \frac{c_t^{(1-\gamma)}(\exp(\eta_i P_t))}{(1-\gamma)}$$

γ is the coefficient of risk aversion and η_i represents the disutility from working. P_t is an indicator variable denoting whether the individual is employed or not and allow η_i to differ by type.

Budget Constraint

$$a_{t+1} = (1+r)a_t + P_t(y_t) + (1-P_t)UI - c_t$$

$$a_{t+1} \geq B$$

UI represents unemployment benefits, y_t denotes after tax income, B is a borrowing constraint and P_t is an indicator variable denoting whether the individual is employed or not.

The earnings process is education specific and composed of a permanent and transitory component:

$$lny_{it} = \alpha_i + Ability_i + \mu ln(e_{it}+1) + u_{it} + v_{it}$$

$$e_{it} = e_{it-1} * (1-\delta) + P_{it}$$

$$v_{it} = \rho v_{it-1} + \zeta_{it}$$

δ is the human capital depreciation rate and μ is the return to experience.
$u_{it} \sim N(0, \sigma_{u_i^2})$ and $\zeta_{it} \sim N(0, \sigma_{\zeta_i^2})$ are independent and serially uncorrelated.

$\alpha_i \sim N(0, \sigma_\alpha^2)$ Thus allow for permanent unobserved heterogeneity in earnings and preferences such that $Cov(\alpha_i, \eta_i) \neq 0$

This earnings specification assumes that measurement error in earnings is negligible or subsumed by the transitory component. However, since I am only interested in comparing the returns at two different education levels, this should not be a problem if there is no systematic difference in measurement error across education levels. Bound and Kreuger (1994) find that measurement error is uncorrelated with education.

Let S denote the agent's information set which is composed of time, assets, experience, permanent wage shock, education, ability and type. $S = (t, a_t, exper_t, v_t, educ, type)$

The value functions conditional on employment status are as follows:

$$V_t^e(S) = U(c_{it}, P_{it} = 1) + \beta E(\pi) E_t V_{t+1}^u(S) + \beta(1 - E(\pi)) E_t max(V_{t+1}^e(S), V_{t+1}^u(S))$$

$$V_t^u(S) = U(c_{it}, P_{it} = 0) + \beta(1 - E(\omega)) E_t V_{t+1}^u(S) + \beta E(\omega) E_t max(V_{t+1}^e(S), V_{t+1}^u(S))$$

where π is the probability of job destruction and ω denotes the probability of a job offer.

Selection in to Education

Agents will select education depending on the initial joint distribution of assets and ability levels in addition to an unobserved preference parameter.

$$sch = \max(V_{hs}(S|age = 18, asset = a), V_{Coll}(S|age = 18, asset = a) + \theta_{Coll})$$

3 Data

I use the National Child Development Study (NCDS) and the British Cohort Study (BCS) to estimate the model. The NCDS and BCS each sampled approx 17,000 people living in the UK in a week in 1958 and 1970 respectively. These UK cohort studies contain rich data on family background, education, work experience, earnings and test scores. The information on test scores is obtained at early ages: 7 and 11 in NCDS and ages 5 and 10 in BCS. This is a great advantage of using these datasets since one of the main criticisms of papers estimating returns to education is the fact that education is endogenous as those with higher ability are more likely to receive higher education but it is likely that they would earn more anyhow regardless of whether or not they are educated. Most studies in the literature try to address this problem using an instrument (see Card 1995 for a review), but as Imbens and Angrist (1994) have shown, most of the time this will just lead to identification of a local average treatment effect, i.e., the treatment effect for those most sensitive to a change in the instrument. Other papers in the literature (Cameron and Heckman 1998, 2001, Cameron and Taber 2004) use the NLSY which contains measures of abilities but these are taken from ages 15 to 18 and so maybe confounded with education and likely will not pick up raw ability. Therefore using the cohort studies provides me with a unique advantage to plausibly address this question without worrying too much that the estimates are biased due to endogeneity. (But, of course, there may still exist endogeneity if, for example, those with more motivation or with higher tastes for work obtain more schooling but nevertheless it is reassuring to know that one of the main criticisms - that of selection on ability - has been adequately addressed). In addition, the use of the cohort studies allows me to answer several other questions: how have the returns to education changed over time? How have different types of risk and their effect on selection in to education changed over time? Has selection on ability changed over time? Have returns to ability changed over time?

One caveat to using the cohort studies is that information is only collected at several points in the life cycle: NCDS at ages 0, 7, 11, 16, 23, 33, 42, 50, (55) and BCS at ages 0, 5, 10, 16, 26, 30, 34, 38, (42). [3] Therefore it is necessary to impute earnings for the years

[3] At the moment there is work to use the individual's social security number to infer earnings for the

when the indiviudal is not surveyed. The BHPS and the GHS are two other UK datasets containing similar variables as the cohort studies and overlapping with the cohorts life cycle allowing me to do just this. For imputing earnings for the NCDS cohort I use the first 18 waves of the BHPS covering the period 1991-2008. I use variables such as region, mother's highest education level, father's highest education level, education, and sex to predict the earnings. The GHS is a cross sectional survey and can be used to impute earnings before 1991. The variables I use to do this include region, father's social class, education, and sex.

4 Return Measures

The rate of return (CE) is got by finding the percentage increase in consumption a high school graduate would need in each period in order to have the same expected life-time utility as a college graduate:

$$EU_{COL} = \frac{E_0 \sum_t \beta^{t-1}((1+CE)C_{HS}exp(\eta P_{HS}))^{1-\gamma}}{1-\gamma}$$

$$CE = \Big(\frac{EU_{COL}}{EU_{HS}}\Big)^{\frac{1}{1-\gamma}} - 1$$

I also look at the monetary return (M) so as to compare with other studies.

$$PDY_s = \sum_{t=0} \frac{Y_t}{(1+r)^t}$$

$$M = \frac{PDY_{COL} - PDY_{HS}}{PDY_{HS}}$$

5 Results

ESTIMATION IN PROGRESS...

years unobserved. Once the data become available I will use it to estimate the model.

5.1 Parameter Estimates

There paramers I will estimate are (by education):

- Return to experience
- Return to Ability
- Depreciation rate
- Parameters determining probability of job destruction and job offer arrival
- Variance of the permanent shocks
- Mean and variance of taste shifter for college
- Disutility of work parameter

I will use the **method of simulated moments** with the following moments:

- Average employment rate by education
- Average, variance and percentiles of wage distribution by education
- Transition rates between employment and unemployment by education
- The distribution of education attainment
- Regress the squared residual of the wage equation on a constant and a function of experience and ability
- Moments conditional on ability

Thus, I show results in the next section obtained from calibrating the model. This is mainly for illustrative purposes to highlight how the returns are sensitive to the inclusion of risk as well as the importance of looking over the whole life cycle.

5.2 Returns from Calibration

Estimates

Table 1: Returns to University vs A-levels (Males in UK)

	CRRA = 1.65
NCDS	
Age 42	0.1934
Life Cycle Model	
Monetary Measure	
No Risk	0.063
Unemployment Risk	0.097
Wage Risk	0.075
Both	0.082

In this section I show the returns to education using the typical approach in the literature whereby earnings at prime ages are regressed on a categorised education variable with the coefficient on the education variable taken as the return to college. The returns got from looking at the coefficient on the college dummy variable controlling for ability measures is 19.34 %. However, once we look over the whole life cycle we see that the returns are indeed a lot smaller. Finally, unemployment risk leads to higher returns while earnings risk decreases returns somewhat. Including both types of risk leads returns to fall somewhere in between the two types of risk.

6 Conclusion

It is important that future studies investigating the returns to education account for risk and take a life cycle perspective. Given that there is no insurance market which insures against low returns to college makes this extremely policy relevant. Government could try to alleviate this risk by implementing various measures such as fixed wage contracts, having unemployment benefits be dependent on predisplacement income. In addition, they could make college more attractive by lowering the minimum wage or decreasing

benefits to provide an incentive to go to college. From a macro perspective this is also important as increased risk may result in increased saving and so policies that reduce risk may result in increased spending and stimulate the economy. Finally, risk in college may be a main reason for the low degree of intergenerational mobility found in the UK; even though the returns to college are high, the risk may be large enough to prevent families from investing in education and this cycle may be perpetuated until factors are taken to decrease the risk to a sufficient level.

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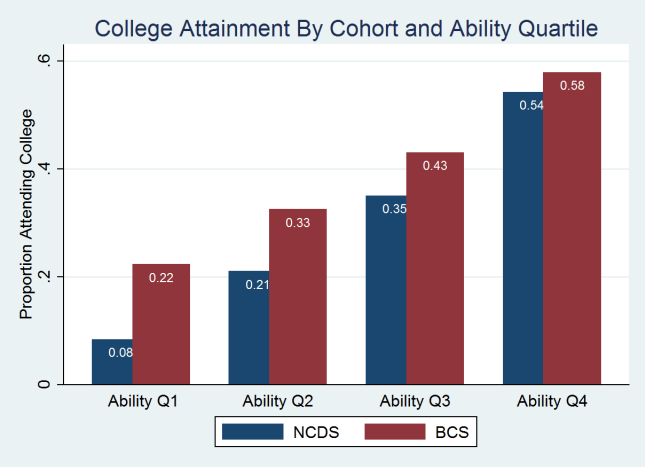


College attainment increased from **27%** for **NCDS** to **37%** for **BCS** but most of the increase has come from the **lower end of ability distribution**

8 How important is it to control for ability?

Table 2: Males: OLS Regression of Log Weekly Pay at Age 33/34 with controls for Ability

	NCDS	NCDS	BCS	BCS
college	0.2645***	0.1620***	0.2536***	0.1957***
	(0.0215)	(0.0235)	(0.0279)	(0.0291)
white	0.0100	-0.0019	-0.0474	-0.1078
	(0.1472)	(0.1332)	(0.0871)	(0.0843)
birth order	-0.0153*	-0.0041	-0.0242**	-0.0175
	(0.0078)	(0.0076)	(0.0118)	(0.0117)
dad_agelfs	0.0391***	0.0279***	0.0371***	0.0286**
	(0.0076)	(0.0075)	(0.0125)	(0.0124)
mam_agelfs	0.0162	0.0056	0.0143	0.0070
	(0.0099)	(0.0097)	(0.0105)	(0.0104)
math		0.0846***		0.0283
		(0.0180)		(0.0178)
read		0.0346**		0.0327*
		(0.0148)		(0.0180)
ability		0.0120		0.0356**
		(0.0173)		(0.0150)
Observations	2298	2298	1863	1863

SEs in parentheses.

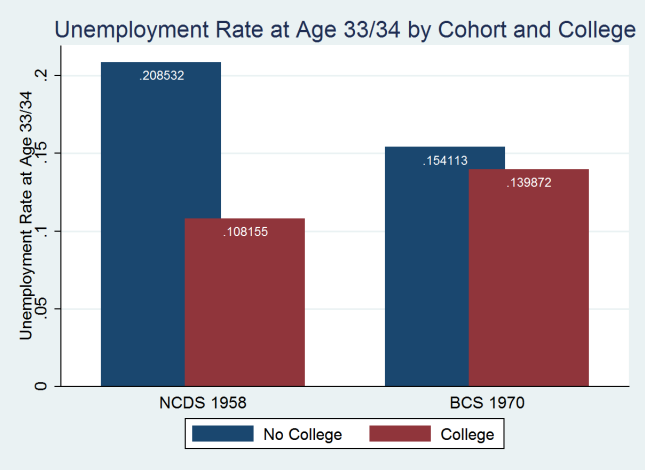
Significance levels: * 10%, ** 5%, *** 1%.

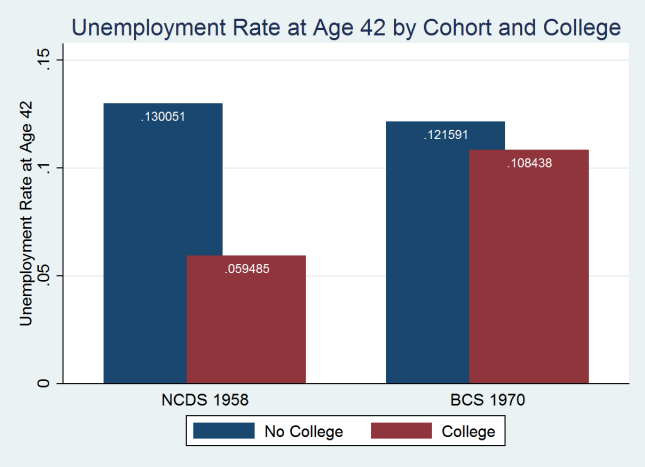
Table 3: Males: OLS Regression of Log Weekly Pay at Age 42 with Controls for Ability

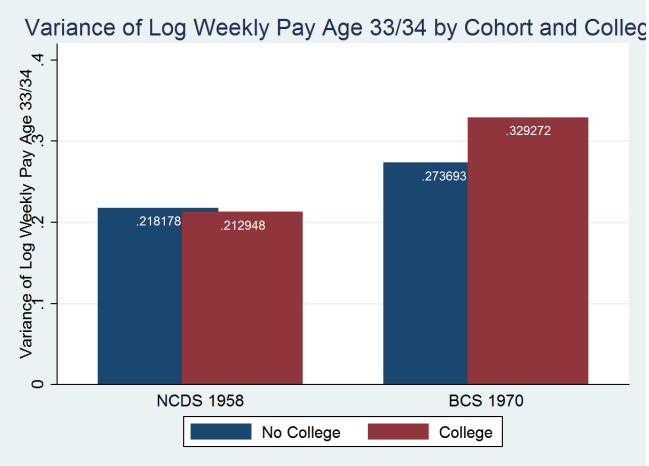
	NCDS	NCDS	BCS	BCS
college	0.2895***	0.1934***	0.3925***	0.3149***
	(0.0315)	(0.0330)	(0.0295)	(0.0315)
white	0.0949	0.0996	-0.0666	-0.1292
	(0.0887)	(0.0792)	(0.1261)	(0.1183)
birth order	-0.0249**	-0.0138	-0.0328**	-0.0254*
	(0.0108)	(0.0106)	(0.0138)	(0.0138)
dad_agelfs	0.0444***	0.0317***	0.0245*	0.0131
	(0.0118)	(0.0118)	(0.0133)	(0.0130)
mam_agelfs	0.0121	0.0029	0.0077	-0.0013
	(0.0150)	(0.0149)	(0.0110)	(0.0108)
math		0.0803***		0.0509**
		(0.0246)		(0.0213)
read		0.0295		0.0419**
		(0.0196)		(0.0194)
ability		0.0236		0.0424***
		(0.0243)		(0.0155)
Observations	1854	1854	1493	1493

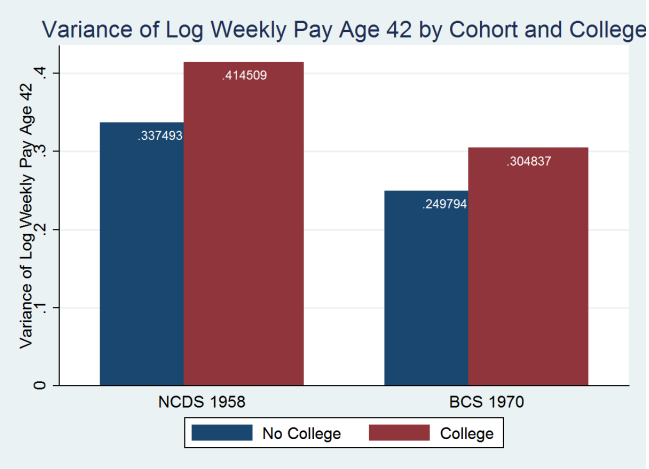
SEs in parentheses.

Significance levels: * 10%, ** 5%, *** 1%.


Unemployment Rate at Age 33/34 by Cohort and College
Unemployment Rate at Age 33/34
0
.05
.1
.15
.2
.208532
.108155
.154113
.139872
NCDS 1958
BCS 1970
No College
College


Unemployment Rate at Age 42 by Cohort and College
Unemployment Rate at Age 42
0
.05
.1
.15
.130051
.059485
.121591
.108438
NCDS 1958
BCS 1970
No College
College


Variance of Log Weekly Pay Age 33/34 by Cohort and Colleg
Variance of Log Weekly Pay Age 33/34
0
.1
.2
.3
.4
.218178
.212948
.273693
.329272
NCDS 1958
BCS 1970
No College
College


Variance of Log Weekly Pay Age 42 by Cohort and College
Variance of Log Weekly Pay Age 42
0
.1
.2
.3
.4
.337493
.414509
.249794
.304837
NCDS 1958
BCS 1970
No College
College