A comparison of A-level performance in economics and business studies: how much more difficult is economics?

Barry Reilly, Raymond Bachan

Publication date
01-03-2005

Citation for this work (American Psychological Association 7th edition)
Reilly, B., & Bachan, R. (2005). *A comparison of A-level performance in economics and business studies: how much more difficult is economics?* (Version 1). University of Sussex.
https://hdl.handle.net/10779/uos.23312075.v1

Published in
Education Economics

Link to external publisher version
https://doi.org/10.1080/0964529042000325225

A Comparison of A-level Performance in Economics and Business Studies: How Much More Difficult is Economics?

(Published in Education Economics, Vol. 13, No. 1, 2005)

Abstract

This paper uses ALIS data to compare academic performance in two subjects often viewed as relatively close substitutes for one another at A-level. The important role of GCSE achievement is confirmed for both subjects. There is evidence of strong gender effects and variation in outcomes across Examination Boards. A counterfactual exercise suggests that if the sample of Business Studies candidates had studied Economics nearly 40% of those who obtained a grade C or better in the former subject would not have done so in the latter. The opposite exercise suggests that 12% more Economics candidates would have achieved a grade C or better if they had taken Business Studies. In order to render a Business Studies A-level grade comparable to an Economics one in terms of relative difficulty, we estimate that a downward adjustment of 1.5 UCAS points should be applied to the former subject. This adjustment is lower than that suggested by correction factors based on conventional subject pair analysis for these two subjects.

Barry Reilly**
Department of Economics
University of Sussex
Falmer
Brighton
BN1 9SN
United Kingdom
e-mail:b.m.reilly@sussex.ac.uk

Ray Bachan
Brighton Business School
University of Brighton
Lewes Road
Brighton
BN2 4AT
United Kingdom
e-mail:rb2@brighton.ac.uk

January 2003

** Corresponding author.

JEL-Code: A2 C5 I2

Key words: Business Studies Economics Subject Difficulty Ordered Probit

(7,258 Words)

The authors would like to thank Carol Taylor Fitz-Gibbon and Paul Skinner of the CEM Centre, University of Durham for permission to use ALIS data in this study, and for providing comments on an earlier draft of this paper. The constructive and helpful comments of two anonymous referees are gratefully acknowledged. In addition, Samer Al-Samarrai, Mike Barrow, Tom Bourner, Peter Davis, Peter Kutnick, Mike Sumner and Alan Winters are also thanked for providing useful comments on earlier drafts. The authors are also grateful to Lynne Cahill for providing important technical assistance. In all cases, the usual disclaimer applies.

Introduction

There has been concern regarding falling enrolments on certain A-level courses in the UK through the late 1980s and the 1990s. The introduction of the National Curriculum in 1988 was expected to yield a reduction in student numbers on certain A-level courses. In particular, subjects not included in the GCSE core curriculum were anticipated to experience a decrease in popularity in the post-compulsory curriculum. There is evidence that this has indeed been the case for some subjects but inclusion in the core curriculum has not protected others (e.g., Physics, Mathematics and Chemistry) from declines in A-level enrolments over the same period (see Dearing (1996) and Fitz-Gibbon (1999)).

Over the last decade research into educational performance in the UK has placed an emphasis on student attainment and school performance. McPherson (1992), Goldstein, Rasbash, Yang, Woodhouse, Nuttall, and Thomas (1993), SCAA (1994), Sammons, Hillman, and Mortimore (1995), Fitz-Gibbon (1996,a and 1996,b), Gray, Goldstein, and Jesson (1996), Thomas and Mortimore (1996), Goldstein (1997), and Coe and Fitz-Gibbon (1998) provide examples of this particular interest. The research agenda in this area has been given impetus by the systematic publication from 1992 of school and college examination results in a series of 'league tables'. These now constitute an important part of the landscape of the educational system in England and Wales and cover both GCSE and GCE A-level subjects. The 'league tables' are intended to increase transparency and monitor the performance of educational institutions. The development of these tables and the extension of open subject enrolment provide educational institutions with obvious incentives to exclude weaker students from the more 'difficult' subjects and enrol them on less demanding courses in order to 'grade maximise'[1].

It is against this background that concern has been expressed about falling enrolment numbers in Economics at all levels of education in the UK. Ashworth and Evans (2000) report a 50% decline in numbers taking A-level Economics over the past fifteen years. Hurd, Coates, and Anderton (1997) note a corresponding increase in the popularity of Business Studies through the 1990s, suggesting perhaps that these two subjects provide close substitutes for one another[2]. Indeed, such substitution possibilities were cited by Heads of Economics Departments as part of

[1] Adnett, Bougheas and Davies (2002) examine in more detail the nature of the incentives created by the quasi-market reforms in education and analyse some of their implications.

the explanation for the reduced popularity of Economics degree programmes at university-level (see Machin and Oswald (2000)).

Figure A1 in the appendix provides some recent evidence on the national trends in enrolments for Business Studies and Economics at A-level. Student numbers in Economics fell by 48% over the eight-year period from 1992 to 1999, while Business Studies enrolments increased by nearly 80% over the same period. Though not reported in this figure, the Economics share of A-level candidates fell by half and that of Business Studies rose by nearly three-quarters over these years. By 1995 the number of students sitting examinations in Business Studies exceeded that for Economics. However, the aggregate number of candidates doing both subjects declined by about 5% over the period under consideration reflecting the strong growth of interest in other A-level subjects[3].

It might also be useful to review the trend in A-level performance in both subjects over a comparable period. Table A1 of the appendix reports the distribution of examination grades for both Economics and Business Studies candidates from 1992 to 1999 in England. Several features warrant comment. There appear to have been roughly twice the proportion of Economics candidates achieving a grade 'A' compared to Business Studies candidates. In addition, the proportion failing Economics (i.e., achieving either the 'N' or 'U' grade) has generally been above the failure rate associated with Business Studies. However, taken together both Economics and Business Studies have experienced a general decrease in their failure rates over the period covered. This may partly be explained by syllabus development (e.g., the introduction of modular courses), revisions to the subject content, modifications to the marking criteria, or a more efficient policy pursued by institutions in matching students to courses where their comparative advantage lies. Nevertheless, on average, Economics candidates achieve better grades than Business Studies candidates.

The fall in enrolments in A-level Economics impacts on the potential numbers interested in pursuing undergraduate degree programmes in Economics in the UK. Ashworth and Evans (2001) found that the early study of Economics influenced choice at both A-level and

---

[2] The substitution is also partly facilitated by the ease with which existing staff in most schools and colleges can move from Economics to Business Studies teaching.

[3] For instance, enrolments on Communications Studies courses have risen by nearly 90% over the corresponding period (see DfEE (various issues)).

university[4]. The decline in the number of Economics undergraduates is a matter of concern to university departments, and of some interest to the wider Economics profession within the UK.

A number of reasons are usually adduced for the declining trend in the A-level numbers studying Economics. These include the increased number of competitor subjects at A-level, the abstract and mathematical nature of the subject, student perception regarding its difficulty, anticipated examination performance, the core curriculum offered at GCSE (which excludes the study of Economics), the nature of A-level Economics syllabi, and the perception that a relatively severe grading policy is adopted by Economics examiners.

University admissions tutors and increasingly employers base their recruitment on A-level grades. They represent to some the ‘gold standard’ of the English education system. It is the case, however, that some A-levels are more demanding and challenging than others and a crude comparison of points may thus be misleading (see Dearing (1996)). The topic of comparative subject difficulty at A-level has been researched in the educational literature. Fitz-Gibbon and Vincent (1994) used a number of different methodologies including subject pair analysis and reference test (or ‘value-added’) procedures to inform this issue. The advantage of the subject pair approach, and variants of it, is that it yields a set of correction factors designed to render a particular A-level subject comparable in terms of difficulty with other subjects. Using A-level data from 1993, the authors concluded that grades in Economics should be increased by about one quarter of a letter grade and Business Studies reduced by one-half to make them comparable with grades on all other A-levels. This could be taken to imply that a Business Studies grade should be reduced by three-quarters of a letter grade to ensure it is compatible with an Economics grade.

The more recent analysis indicates a widening in the disparity in adjustment factors between Economics and Business Studies since 1993 (see Skinner (2001)). Over the period 1994 to 2000, Economics was classified as one of the ten most difficult A-levels out of a total of 35. The median rank of Economics over this seven-year period was 9th compared to the 27th ranking for Business Studies. The median correction factors were 0.67 for Economics and –0.78 for

[4] The recent work of Machin and Oswald (2000) highlighted the decline in the number of UK graduate economists applying for PhD programmes at British universities. The trends in A-level enrolments may have some indirect impact here.

Business Studies. This suggests that a Business Studies grade requires reduction by 1.45 of a letter grade to render it comparable in difficulty to an Economics grade.

The foregoing analysis leads to the inference that Economics is a more ‘difficult’ subject than Business Studies and perhaps more harshly graded. Ashworth and Evans (2000) confirm this particular finding using a dataset drawn from 1,000 A-level students. Their analysis suggests that students may be discouraged from the further study of Economics by the relative severity of marking/grading mid-way through their A-level courses. This is viewed as all the more surprising given that students taking an A-level in Economics are in the ‘average to better than average’ ability group (as measured by average GCSE scores).

The methodology used by Fitz-Gibbon and Vincent (1994) has not been free of criticism within the educational field. In particular, Goldstein and Cresswell (1996) attacked the methodologies on both conceptual and technical grounds but Fitz-Gibbon and Vincent (1997) provide a robust defence of their methods. The purpose of our paper is to offer some refinements to the methodologies that inform the issue of comparative subject difficulty. In so doing we address some of the criticisms ventilated in Goldstein and Creswell (1996)[5]. In contrast to previous studies in this area, we follow Fielding (1999) and use a limited dependent variable approach to model performance. We believe our approach provides sharper insights into the phenomenon of interest and offers a useful framework for educationalists and others to compare performance at A-level, thus enhancing judgements on relative subject difficulty.

The paper provides a comparative analysis of performance in a pair of subjects often regarded as providing close substitutes for one another. We are interested in examining possible explanations for the average differential in performance across the two subjects and inform our analysis by undertaking a number of counterfactual exercises. In particular, we explore what the A-level grade distribution for a sample of Business Studies candidates may have been if they had followed Economics and conversely what a sample of Economics candidates may have achieved if they had taken Business Studies. This then allows us to compute an average grade adjustment that standardises for difficulty across the comparator subjects.

[5] In contrast to subject pair analysis we control, within an econometric framework, for a range of characteristics that could potentially affect academic achievement.

The structure of this paper is now outlined. The next section describes the dataset used in our analysis, followed by a section containing a description of the econometric methodology employed. The penultimate section reports the empirical results and a final section provides a summary of our conclusions.

Data

The data used in this study are obtained from the A-Level Information System (ALIS) Project. ALIS is the original member of the family of value-added monitoring systems administered at the Curriculum, Evaluation and Management Centre (CEM Centre) at Durham University. ALIS provides performance indicators for post–16 students across all sectors of education, in both private and public schools and colleges, and includes analysis of A-level, AS-level and Advanced Vocational (AVCE) examinations. It makes reports available to institutions that participate in the project using responses obtained from questionnaires completed by students in the participating institutions.

In addition to providing information on performance, the data collected from the questionnaires contain other individual-level information. The information used in our study was collected from the ALIS+ Basic questionnaire. The specific data employed in this study are based on performance in the 1998 examinations by a sample of Economics and Business Studies candidates. The selected sample consists of students aged 16 to 19 years who completed two or more A-levels (excluding General Studies). Once allowance is made for missing values, 2,086 and 3,453 usable observations are available for Economics and Business Studies respectively. A small number of students (87) took both Economics and Business Studies. These are excluded from our primary analysis initially but are the focus of separate analysis below.

The variables used and their associated summary statistics are reported in table A2 of the appendix and are briefly discussed in the next section. The set of variables employed includes measures of prior attainment (average GCSE scores), gender, ethnicity, school-type, parental characteristics, Examination Board and other A-levels studied. The outcome of interest is the final A–level grade, which has a natural ordering. The appropriate econometric methodology for such an ordinal measure is discussed in the next section.

For reasons of confidentiality, the data are limited in a number of important respects. It is not possible to identify either schools/colleges by their names or postcodes, or students by their name or date of birth. It is therefore not possible to match certain factors (e.g., location, funding, staff/pupil ratios, numbers on roll, teacher or class characteristics and processes, and the number of teaching sets per college) to the individual level data used here. In addition, it did not prove possible to match prior attainment in either GCSE Economics or Business Studies (if taken) for the sample of students. Furthermore, we were also unable to differentiate between modular and linear courses from the available syllabus information.

Methodology

The statistical analysis of grade performance in educational research has largely used linear models with the dependent variable constructed on the basis of an arbitrary points scoring system. This approach has been the subject of some criticism in the educational field (see Fielding (1999)). If responses are coded 0 (for N/U) to 5 (for A) as in our case, the linear regression model implicitly treats the difference between any pair of integer values as the same (see Greene (2000)). An ordered probit model using an underlying latent dependent variable provides one approach that overcomes this limitation[6].

Let y_i denote an observable ordinal variable coded 0,1,2,3,4,5 on the basis of A-level performance, and y_i^* denote an unobservable variable that captures the performance level of the i^{th} individual. The performance level can be expressed as a function of a vector of explanatory variables (X_i) using the following linear relationship:

$$y_i^* = X_i'\beta + u_i \qquad \text{where } u_i \sim N(0, \sigma^2) \qquad [1]$$

It is assumed that y_i^* is related to the observable ordinal variable y_i as follows:

$$\begin{array}{lll}
y_i = 0 & \text{if} & -\infty < y_i^* < \theta_0 \\
y_i = 1 & \text{if} & \theta_0 \le y_i^* < \theta_1 \\
y_i = 2 & \text{if} & \theta_1 \le y_i^* < \theta_2 \\
y_i = 3 & \text{if} & \theta_2 \le y_i^* < \theta_3 \\
y_i = 4 & \text{if} & \theta_3 \le y_i^* < \theta_4 \\
y_i = 5 & \text{if} & \theta_4 \le y_i^* < +\infty
\end{array}$$

It is clear from the above that the first and the J^{th} intervals are open-ended so for j=0, $\Phi(\theta_{j-1}) = \Phi(-\infty) = 0$ and for j=5, $\Phi(\theta_j) = \Phi(+\infty) = 1$. If the X vector contains a constant term, then the remaining set of threshold parameters [θ_0, θ_1, θ_2, θ_3, θ_4] are not identified. The exclusion of a fixed threshold term facilitates an arbitrary location for the scale of y_i^*. The normalization adopted in this paper is $\theta_0 = 0$. Another identification restriction is also required. We can only identify the parameters of the ordered probit up to some factor of proportionality. As with the standard probit, we make the convenient normalization that $\sigma^2 = 1$. In general terms, we can write:

$$\text{Prob}[y_i = j] = \Phi(\theta_j - x_i'\beta) - \Phi(\theta_{j-1} - x_i'\beta) \qquad \text{for } j = 0,\ldots..J. \qquad [2]$$

Where Φ denotes the cumulative distribution function of the standard normal.

The general expression for the log-likelihood function of this particular model is then given by:

$$L = \sum_{j=0}^{J} \sum_{y_i = j} \log_e[\Phi(\theta_j - x_i'\beta) - \Phi(\theta_{j-1} - x_i'\beta)] \qquad [3]$$

Conventional algorithms can be employed to provide maximum likelihood estimates for the β parameter vector and the remaining four threshold parameters [θ_1,θ_2,θ_3,θ_4]. The log-likelihood function in this case is known to be globally concave (see Pratt (1981))[7].

The pseudo-residuals from the ordered probit models are used to inform on the adequacy of the estimated models. Machin and Stewart (1990) provide the computational details for the pseudo-residuals and the relevant efficient score tests for the ordered probit model[8]. The score (or Lagrange Multiplier) tests focus on five key properties of the econometric specification. These

---

[6] One potential econometric problem with the modelling approach adopted is that no attempt is made to correct for selectivity bias. Since the magnitude of selection bias effects cannot be known *a priori*, some caution needs to be exercised in the interpretation of our results.

[7] All the estimation reported in this paper was undertaken using the LIMDEP 7.0 and the STATA 6.0 software packages.

[8] The testing principle used is based on the outer-product gradient (OPG) form of the efficient score (or Lagrange Multiplier) tests (see Chesher and Irish (1987)). Orme (1990) has questioned the use of OPG-based tests in the context of a simple binary probit and demonstrated their poor finite sample properties in this setting. Orme (1990) demonstrated that the null hypothesis was rejected more often than suggested by the nominal size of the test. The sample sizes used in our application are relatively large. In addition, the implication of the Orme (1990) findings, if they extend to the ordered probit model, is that we are actually setting our estimated models a more stringent set of tests to pass.

are (i) threshold homogeneity, (ii) omitted variables[9], (iii) Pseudo-functional form[10], (iv) homoscedasticity, and (v) normality.

The variance-covariance matrix of the ordered probit model is corrected for heteroscedasticity of an unknown form using a 'sandwich' estimator (see Huber (1967)). In addition, since the data allow us to identify whether candidates studied at the same institution or not, we use this information to cluster the candidates by educational institution. Ignoring the clustered nature of the data in this case may lead to an under-statement of the estimated standard errors, since there may be a greater degree of homogeneity in performance within rather than across institutions. The variance-covariance matrices are thus subject to a further adjustment to account for this particular feature of the data. This adjustment relaxes the assumption of observation independence within educational institutions but retains the assumption of independence across institutions[11].

The primary theme of this paper is a comparison of performance between Economics and Business Studies candidates. In order to undertake such a comparison, simulation exercises predicting the grade distribution of Business Studies candidates based on the estimated coefficients from the Economics equation are implemented. A converse approach is also implemented. These simulations also enable us to assign the overall average differential in performance by grade category between Economics and Business Studies candidates into explained and unexplained parts. The relevant decomposition may be undertaken using the estimated coefficients from either the Economics or from the Business Studies equation. If we use the estimated coefficients from the Economics equation, the decomposition is expressed as:

$$\Delta_j = [\,\overline{P_j^E} - [\,\overline{\Phi(\theta_j^E - X^B\beta^E)} - \overline{\Phi(\theta_{j-1}^E - X^B\beta^E)}\,]\,] + \qquad [4]$$

[9] The omitted variables' tests will focus on the role of gender interactions given the potential influence that gender differentials in the effects of characteristics may exert on academic performance.

[10] The pseudo-functional form tests are based on the RESET testing principle conventionally applied in the linear regression model (see Ramsey (1969)). The test uses the predicted ordered probit standardised index raised to the second, third and fourth powers as auxiliary measures to capture model mis-specification. Ramsey (1969) demonstrated the optimality of this polynomial order. Peters (2000) provides some empirical evidence on the power of this type of test for a number of different limited dependent variable models.

[11] This correction to the variance-covariance matrix is comparable to adjustments undertaken by educational researchers in multi-level analysis. In our application the data could be interpreted as comprising just two levels (i.e., the candidates and their institutions). There is insufficient information in the data to take the clustering any further (e.g., by teacher, tutor or class). Goldstein (1987) provides further details on multi-level analysis for the interested reader.

$$[[\overline{\Phi(\theta_j^E - X^B\beta^E)} - \overline{\Phi(\theta_{j\text{-}1}^E - X^B\beta^E)}] - \overline{P_j^B}\,] \qquad (j = 0,1,2,3,4,5)$$

where Δ_j is the average differential in proportions between the two subjects for the j^{th} grade category, θ^k and β^k are the ordered probit maximum likelihood coefficients where the k superscripts E and B denote Economics and Business Studies respectively, the bar denotes average values, $\overline{P_j^E}$ and $\overline{P_j^B}$ are the sample proportions in the j^{th} grade for the Economics and Business Studies samples respectively, and X^k denotes a vector of explanatory variables for the k^{th} category of individual. The first bracketed component on the right-hand side of expression [4] represents the portion of the average j^{th} grade differential between Economics and Business Studies explained by differentials in characteristics. This is sometimes referred to as the endowment effect. The second bracketed term represents the unexplained component and this is sometimes referred to as the treatment effect. The explained component could be viewed as representing that part of the total differential in achievement that is justified by differences in the level of characteristics or endowments between the two groups of candidates. The unexplained or treatment effect represents that part of the total differential that is attributable to a different treatment of the two groups of candidates given an identical set of characteristics.

It is important to note that we could also use the estimated coefficients for the Business Studies performance equation and the decomposition could then be re-expressed as:

$$\Delta_j = [[\overline{\Phi(\theta_j^B - X^E\beta^B)} - \overline{\Phi(\theta_{j-1}^B - X^E\beta^B)}] - \overline{P_j^B}\,] \quad + \qquad [5]$$

$$[\overline{P_j^E} - [\overline{\Phi(\theta_j^B - X^E\beta^B)} - \overline{\Phi(\theta_{j-1}^B - X^E\beta^B)}]] \qquad (j = 0,1,2,3,4,5)$$

The first term on the right-hand side of expression [5] represents the explained portion and the second term represents the unexplained portion. The procedure is known as the ‘index number’ approach. The two variants are unlikely to yield similar estimates for the explained and unexplained parts given the ‘index number’ problem. It is known that the estimated effects can be sensitive to the choice of coefficient vector used in the computation of these two components[12].

[12] The methodology used here is an extension to the ordered probit of the Oaxaca (1973) decomposition for a linear regression model, which has had some popularity in empirical labour economics.

Empirical Results

It might be instructive to examine initially some of the key characteristics of the two samples used in our analysis. Table A2 of the appendix reports summary statistics for a selection of the variables used. The sample of Economics candidates appear better qualified than their Business Studies counterparts using average GCSE performance measures. The average differential in GCSE scores is statistically significant and suggests an average advantage for the Economics sample that is close to one-half of one point. Indeed, on the assumption of a normal distribution of Economics GCSE scores, the average Business Studies candidate is computed to be located around the 31st percentile of the Economics distribution. A significantly higher proportion of Economics candidates achieved A/A* grades in Mathematics GCSE relative to Business Studies with smaller proportions obtaining a grade C (or less). A higher proportion of Economics candidates are in private schools as compared to Business Studies and are relatively less well represented in Sixth Form and FE colleges. The EDEXCEL syllabus is the dominant one for the Economics sample while about three-quarters of Business Studies candidates follow an AEB syllabus.

The gender balance for Business Studies is relatively even. The Economics sample has a slight male dominance. The proportion of female candidates studying Economics in this sample appears on the high side compared to national estimates. For instance, according to the DfEE, 36% of candidates taking A-level Economics in 1998 were female with a comparable estimate of 46% for Business Studies (see DfEE (various issues)). The ethnic mix of those studying A-level Economics is more varied than for the sample of Business Studies candidates. It is worth noting that a higher proportion of Economics candidates appear to complement their study of Economics with a Mathematics and/or a Physics at A-level. In terms of A-level performance itself, the aggregate proportion of Business Studies candidates in the B/C categories is about eight points higher compared to Economics candidates. Almost twice the proportion of Economics candidates secure an A grade in comparison to their Business Studies counterparts but a higher proportion also fail. These sample averages are broadly in line with the national figures reported in table A1 of the appendix.

Table 1 contains ordered probit maximum likelihood estimates for both the Economics and Business Studies equations. The standard errors are corrected for heteroscedasticity and for clustering by educational institution, but the adjustment is not found to make a material difference to any inferences. We do not report estimates for all variables included in our specifications. In particular, those relating to parental background and educational levels are excluded to conserve space[13]. In the first instance, it might be useful to focus on the diagnostic tests for both models and we examine initially the Economics specification. The null hypothesis of normality in the distribution of the pseudo-residuals is not rejected and, as already noted, appropriate corrections to the variance-covariance matrix have been implemented to deal with heteroscedasticity. The omitted variables' tests indicate that the estimated model is adequately specified in terms of the modest set of gender interactions included. The overall z-score for homogeneity in the threshold effects is less than the relevant critical value but there is some evidence of threshold variation in regard to the GCSE background variables. The most serious problem encountered, however, relates to the significant RESET value. This may be attributable to the exclusion of relevant variables or the use of an inappropriate functional form[14].

The Business Studies specification fares less well in terms of both the goodness of fit measures and the score tests. Although the normality assumption is satisfied, it lies close to the boundary of rejection. The omitted variables' tests again indicate no role for additional gender interactions. The assumption of homoscedasticity in the residual variance is again rejected and the RESET value, as in the Economics case, indicates some form of model mis-specification. The constancy of the threshold parameters across variables is also decisively rejected with the dominant source of the overall rejection residing in the set of Examination Board variables.

The result in regard to the threshold coefficients has important implications for the specification of the Business Studies model. However, it has broader policy implications in that it suggests that the thresholds delineating the grade boundaries are not constant across the different Examination Boards. This might imply that the thresholds are not consistent with a given standard and that standards might be subject to some degree of variation across different Boards. Given the diagnostic values reported, the problem appears considerably more acute in Business Studies than in Economics. Overall, it could be argued, that the Economics specification is

[13] On the basis of Likelihood Ratio Tests the joint effects of fourteen controls for parental labour force status when the student is sixteen are statistically insignificant in both Economics and Business Studies models. The chi-squared values are 6.3 and 14.1 respectively with a critical value of 23.7. The joint effects of four parental educational level variables are statistically significant in the Economics model but not the Business Studies model. The chi-squared values are 11.1 and 4.5 respectively with a critical value of 9.5.

[14] However, the significant RESET value may be attributable to the neglect of selection effects discussed earlier.

slightly superior to the Business Studies one in terms of the diagnostics and goodness-of-fit measures.

Attention now turns to the interpretation of the estimated coefficients. The estimates provide the effect of an explanatory variable on the standardised ordered probit index and are thus measured in terms of standard deviations. The estimated coefficients can also be translated into probability effects using appropriate formulae (see Greene (2000, pp.876-877)) and this conversion is adopted in certain circumstances to underpin interpretation. The complete set of marginal effects is not included to conserve space.

The effects of the GCSE background variables are discussed in conjunction with the Business Studies estimates later and so our initial focus on the Economics equation will concern itself with the estimated effects for the other characteristics of interest. There are two interaction terms allowing for variation in gender effects across institution type (i.e., Grant Maintained and FE College) and one A-level subject (i.e., Arts subject). The estimated gender effect suggests that, on average and *ceteris paribus*, being male increases the standardised index by a quarter of a standard deviation relative to the female base. In probability terms, the point estimate implies that male Economics candidates are five-percentage points more likely to obtain an A grade. Conversely, males are less likely to fail by just over two percentage points. In addition, females in Grant Maintained institutions, on average and *ceteris paribus*, do less well than their male counterparts in these institutions but male students taking an Arts-based A-level subject perform less well than females taking comparable subjects. The finding that female candidates do less well than male candidates is in contrast to the work of Ashworth and Evans (1999), which suggested no evidence of a lower female achievement in A-level Economics.

It is sometimes argued that an institution's choice of Examination Boards influences student achievement through the syllabi on offer, modes of assessment and the marking schemes adopted. Hurd, Coates and Anderton (1997) report that in Economics there has been a major shift in the distribution of candidates by Examination Boards over the last decade. Tymms and Fitz-Gibbon (1991) identified outcome differentials for Economics candidates in regard to some Examination Boards in 1989 but subsequent work undertaken by Tymms and Vincent (1995) for 1993 detected no such variation. Our empirical analysis suggests that 1998 candidates following an EDEXCEL syllabus, on average and *ceteris paribus*, achieved a higher grade than all others with an effect on the standardised index, relative to the AEB base, of just over one-fifth of a standard deviation. This implies that an average Economics candidate following this syllabus, and holding constant all other control variables, was nearly five percentage points more likely to secure an A-grade and two percentage points less likely to fail relative to candidates in the AEB reference category. It is worth noting that about 47% of candidates in the Economics sample followed the EDEXCEL syllabus.

We now turn to the maximum likelihood estimates for the Business Studies equation. The estimated gender effect is not directly interpretable in this equation given the use of gender interactions with a number of variables but most importantly with the continuous average GCSE score. We can obtain the approximate effect of being male on Business Studies performance using the GCSE average score (from table A2) as $1.492 - 0.237\times5.666 = 0.149$. This effect, expressed in standard deviations, is smaller in magnitude compared to Economics but again suggests that being male raises the probability of securing an A grade in Business Studies by just over one percentage point[15].

It is well established in the educational literature that GCSE scores provide an extremely good predictor of A-level performance (see Fitz-Gibbon and Vincent (1994)). One would anticipate, therefore, relatively strong effects from such variables in the type of performance equations estimated. The estimated effects of the GCSE scores are indeed relatively large and exceed one standard deviation in both cases[16]. There is a statistically significant gender differential in the effect of GCSE scores on A-level performance for Business Studies candidates. In particular, a unit increase in the overall GCSE score raises, on average and *ceteris paribus*, the female A–level performance by 1.12 standard deviations but only raises male performance by $1.12 - 0.24 = 0.88$ of a standard deviation[17].

---

[15] The estimated standard error for the point estimate of the gender effect in the Business Studies equation is 0.048 thus rendering the effect well determined with an asymptotic t-ratio of 3.1. However, on the basis of a simple t-test, there is no statistical difference in gender effects across the two subjects. The absolute asymptotic t-test computed for this hypothesis is 1.3.

[16] A unit increase in the average GCSE score represents a considerable academic achievement. If the average student takes eight GCSEs, a unit increase in the average score from say five to six could represent a movement from Cs to Bs in all eight GCSE subjects. Thus, if we wanted to roughly obtain the effect of a one letter grade increase in just one of the eight GCSE subjects, we would need to divide the estimated ordered probit coefficient by eight.

[17] Thus, although being male raises performance in Business Studies, *ceteris paribus*, there is an interesting counter-effect present in that given the GCSE achievement level, the value-added effect for females doing Business Studies is higher than for males, *ceteris paribus*.

There is a wider variation in performance by Examination Board in Business Studies than in Economics. The range is just over 0.8 of a standard deviation. For instance, candidates following an EDEXCEL syllabus are, on average and *ceteris paribus*, five percentage points less likely to secure an A grade relative to the AEB base with candidates following NEAB five percentage points more likely to secure an A grade relative to candidates following the base syllabus. However, the wide range is confined to Boards that account for only 12% of Business Studies candidates.

TABLE 1 ABOUT HERE

The effects of GCSE background on performance in both Economics and Business Studies are now examined in more detail. Tables 2 and 3 report the effects of GCSE Mathematics attainment level and average GCSE scores on A-level outcomes respectively. The estimated effects are computed using stylised individuals whose characteristics are explained in the notes to both these tables.

It is almost taken as axiomatic that competence in basic mathematics enhances the study of Economics. Table 2 provides some insight on this issue and largely confirms the axiom. The effect of an improved performance in GCSE Mathematics has differential effects at the top end of the grading distribution for both subjects. For instance, the effect of moving from a grade C to a grade B in GCSE Mathematics raises the probability of securing an A grade in Business Studies by about six percentage points – well over twice the impact a comparable change has on Economics performance. However, the effect of moving from a grade B to a grade A/A* raises the probability of securing the same grade in Business Studies by four percentage points – slightly over half the impact a comparable change has on Economics performance. At the bottom end of the grading distribution, improvements in GCSE mathematical attainment near the top end of achievement reduce the failure rate by considerably higher magnitudes for Economics compared to Business Studies candidates.

Table 3 examines the effect of overall GCSE scores on A-level performance. The table confirms the important role that these average scores exert in determining the A-level outcomes of candidates in both subjects. However, there are some important differences between the two subjects. For instance, if the average GCSE score obtained by candidates taking these two A-level subjects was six (i.e., the equivalent of all Bs at GCSE level), the proportion of Business Studies students achieving a grade C or better would be 88% as compared to 66% for

Economics students. The average GCSE score of 5 reported in table 3 is low relative to the average entry requirement for most A-level programmes. In spite of this, in excess of 60% of Business Studies candidates with this level of achievement and the characteristics noted would achieve a C grade or better in this subject – nearly three times the rate for the sample of comparably qualified Economics candidates.

TABLES 2 AND 3 ABOUT HERE

The latter results emphasize not only the importance of average GCSE scores for A-level attainment. However, it could also be taken to reflect either the more demanding nature of the Economics syllabus relative to Business Studies, a more harsh marking policy on the part of Economics relative to Business Studies examiners, or a combination of both. A counterfactual exercise may provide a sharper insight into this particular matter. Our approach simulates how, on average, the sample of Business Studies candidates would have fared if they had followed Economics rather than Business Studies as an A–level course. The converse counterfactual is also implemented for Economics candidates. The first two columns of table 4 report the actual distribution of candidates across the six grade categories for Economics and Business Studies respectively. Nearly 57% of all Business Studies candidates secured an A–level grade C or better. If this sample of candidates had followed Economics instead, only 35.4% would have achieved grade C or better. Specifically, only 7.7% would have obtained a grade A in Economics as compared to the 12.2% that actually secured this grade in Business Studies. More significantly, 28.3% of these candidates would have failed Economics – almost three times the proportion that actually failed Business Studies[18].

We now undertake the opposite simulation exercise using the Business Studies coefficients in conjunction with the sample of Economics candidates. We recognise that the estimated Business Studies specification performed less well than the Economics one and so some caution is required in regard to this particular exercise. If the Economics sample of candidates had taken Business Studies over 70% would have obtained a grade C or better as compared to the 59.4% that actually did so in Economics. Nearly a quarter would secure a grade A. This represents

[18] One potential weakness of the counterfactual exercise is that the predicted performance for the sample of Business Studies (Economics) candidates in Economics (Business Studies) is based on the assumption that they are constrained to follow the same Examination Board as in their chosen subject. It is not implausible that educational institutions use a different board depending on the subject. Unfortunately, our analysis cannot deal with this particular problem.

almost a doubling of the actual proportion of Business Studies candidates who achieved this grade. The proportion failing would be just 6% – half the rate that actually failed in Economics.

It might be useful to re-interpret the above results in terms of a conventional UCAS A-level point score for the average student[19]. This information is provided in the bottom two rows of table 4. The average Economics candidate obtained a point score of 5.7 while the average Business Studies candidate secured a score of 5.3. If the average Business Studies candidate had sat for Economics, the average predicted point score would have been 3.8. In an 'index number' sense, this represents the average reward for a 'basket' of average Business Studies characteristics using Economics 'prices'. The average Business Studies candidate would have been worse-off by three-quarters of a letter grade if Economics had been chosen in preference to Business Studies. This could also be interpreted as the adjustment required to a Business Studies grade to render it comparable in difficulty to Economics. In contrast, the average Economics student would have been better-off by nearly one-half of a letter grade if Business Studies rather than Economics had been chosen. The difference in outcome between the two procedures is attributable to the 'index number' problem.

Table 5 re-expresses this information to provide a decomposition of the total raw differentials into explained and unexplained parts using expressions [4] and [5]. The point estimates are sensitive to the coefficients used given the 'index number' problem but the pattern is broadly similar across the two decompositions. Given the greater degree of econometric confidence in the Economics specification, attention is concentrated on the components computed using the estimated coefficients from the Economics model. The largest average performance differential between Economics and Business Studies is in terms of the A grade category and, on the basis of the Economics coefficients, most of this is assigned to differences in characteristics (i.e., the endowment effect). We calculate that about a quarter of the total differential is accounted for by differentials in the GCSE background variables – by far the single most important contributory factor. At the bottom end of the grading distribution the treatment effect acts to widen the differential in failure rates between the two subjects, while the endowment effect exerts an opposite influence. This could perhaps be interpreted as indicative of a harsher grading policy by Economics examiners at the bottom end of the marking scale. The final row of table 5 expresses the differential in terms of an average UCAS point score. The exercise again

[19] We use the UCAS points score here to facilitate the computation of a correction factor and to allow a numerical interpretation of the decomposition analysis.

illustrates the sensitivity of the 'index number' approach to the coefficients used. The endowment differences act to widen the average differential in UCAS points between the two subjects with differentials in treatment exerting the opposite effect.

TABLES 4 AND 5 ABOUT HERE

Finally, we examine the small sample of 87 candidates that followed A-levels in both subjects. These individuals were excluded from the econometric analysis. In terms of their GCSE background characteristics, the sample is more likely to be drawn from the Business Studies population than the Economics population. The average candidate in this sub-sample is located at the 34th percentile of the GCSE distribution for Economics candidates and at the 52nd percentile of the GCSE distribution for Business Studies candidates assuming normal distributions for both scores. The average GCSE score (5.7) of this small sample is statistically lower than the Economics sample average (t-test=5.31) but not significantly different from the Business Studies sample average (t-test=1.02). In addition, the proportion of the sample obtaining grade A/A* in Mathematics GCSE (0.17) is also statistically lower that the Economics sample average (z-score = 4.3) but not different from the Business Studies sample average (z-score=0.2). The sample could broadly be defined as one drawn from a Business Studies rather than an Economics population. The following table reports the A-level grade distribution of the sub-sample for the two subjects and an average UCAS points score.

The comparison in the table is similar in nature to the counterfactual econometric exercise undertaken in table 4 where we computed what a sample of Business Studies candidates would achieve if they studied Economics. Over two-thirds of the sample obtained a grade C or better in Business Studies with only one-half performing as well in Economics. In addition, the failure rate is twice as high in Economics as in Business Studies. The average grade achieved in Business Studies is 1.3 UCAS points higher than that achieved in Economics. The sample size is acknowledged as small but the outcome is consonant with the econometric-based work reported in table 4.

Table 6: A-Level Grades for Matched Pairs

Subject	N/U	E	D	C	B	A	Average Score	Total
Economics	6	13	20	19	15	14	5.5	87
Business Studies	3	1	20	21	20	22	6.8	87

Notes to table 6:

(a) The points scores are weighted averages computed using the old UCAS points tariff: A=10, B=8, C=6, D=4, E=2, N/U=0.

Conclusions

The primary purpose of this paper was to undertake a comparative analysis of A-level examination performance for Economics and Business Studies candidates. The analysis also helped to inform some more established issues on A-level performance relating to gender and Examination Board variability[20]. We find in regard to both subjects that female candidates perform less well, *ceteris paribus*, than their male counterparts. The result for Economics is not entirely consistent with the findings of Ashworth and Evans (1999) but is in agreement with Hirschfeld, Moore, and Brown (1995), who detected a gender gap in performance using data drawn from the more advanced US Graduate Record Examinations in Economics[21]. The estimated gender effect for Economics in our study is largely mediated through an intercept shift. The reasons for the apparent male advantage in the study of Economics are likely to be varied and complex, ranging from greater male skills in spatial relationships (see Williams, Waldauer and Duggal (1992)) to the absence of role models or mentors for female students (Ashworth and Evans (1999)). We are not in a position to offer any useful insights that may account for the gender gap itself. However, it may provide one explanation for a lack of female interest in the subject at A-level. This depressing finding inspires little confidence that the male domination of the Economics profession in the UK, most recently documented in Booth, Burton and Mumford (2000), is under threat of erosion.

Tymms and Fitz-Gibbon (1991) and Tymms and Vincent (1995) explored Examination Board variability for earlier cohorts of examination candidates in Economics with the more recent study suggesting no variation across Examination Boards. Our results are mildly in conflict with that finding, and we detect a wide variation (almost by a factor of four) in *ceteris paribus* performance across Boards for Business Studies. This finding was complemented by evidence from score tests suggesting that the threshold coefficients of the ordered probit model varied across the set of Business Studies Examination Boards. This could be interpreted as confirmation that grading standards are subject to some degree of variation across different Boards. The evidence of threshold heterogeneity is considerably weaker for Economics, though it is conceded that the test result is close to the margin of significance at a conventional level.

[20] It should be stressed that our findings and conclusions relate to just one cohort drawn from 1998. It is conceded that a different picture in regard to say subject difficulty, Exam Board variability or gender might emerge in later years.

[21] Ashworth and Evans (2001) note that the absence of a critical mass of female students studying Economics at secondary school level also acts as a deterrent for females in choosing this subject.

Thus, despite the efforts of Boards to ensure comparability, variation remains for both subjects. The larger variation in Business Studies relative to Economics may be viewed as unsurprising given the more settled subject matter of Economics relative to the broader, more heterogeneous, and evolving Business Studies field. It is conceded that recent amalgamations of Examination Boards are likely to reduce such variability in the foreseeable future.

It is evident that there is a relatively large quality differential between the two samples in terms of their GCSE background levels. Our econometric analysis confirms the important role of GCSE attainment in A–level achievement for both subjects. However, there is evidence of some important differences. An increase in the GCSE Mathematics grade from a B to an A/A*, for instance, increases the share of A-level Economics candidates in the top two A–level categories by approximately nine percentage points – nearly three times the effect for Business Studies candidates – confirming a greater complementarity between these two disciplines than between Mathematics and Business Studies. In contrast, the study of A-level Mathematics enhances performance in Business Studies but not in Economics[22]. The average GCSE score exerts a differential impact on male performance in the two subjects. A given GCSE score has a stronger effect on performance for male Economics candidates than for male Business Studies candidates. A similar finding was not detected for female candidates. One interesting finding, however, is that candidates with GCSE grades close to the average minimum requirement for the study of A–levels perform considerably better on Business Studies than on Economics.

The core theme of this paper has been the implementation of a counterfactual analysis using non-overlapping samples of Business Studies and Economics candidates. Our general finding is that in regard to Business Studies, institutions and students are broadly making the correct decisions if the choice being exercised is exclusively between these two subjects. On the basis of our analysis, almost 40% of candidates who achieved a grade C or better in Business Studies would not have done so had they studied Economics. This was found to be largely attributable to the average GCSE quality differential between the two samples. In terms of the converse exercise, an additional 12% of Economics candidates would have secured a grade C or better if they had followed a Business Studies course. The simulation exercises tend to support the notion that the educational institutions are acting in a relatively efficient manner in matching

[22] The weaker effect for Economics may be attributable to a stronger correlation between achievement in A-level Mathematics and GCSE Mathematics for the Economics candidates. This might act to attenuate the estimated effect for the Mathematics A-level subject in the Economics specification.

students to courses. However, if grade-maximization is one of the guiding factors underlying the behaviour of educational institutions, there remains scope for improvement. In particular, a significant portion of the poorer qualified Economics candidates would be better-off doing Business Studies.

Our empirical results are consistent with the notion that Economics is a more ‘difficult’ subject than Business Studies. Our econometric estimates, using the preferred Economics specification, suggest that the correction factor between the two subjects is, on average, about three-quarters of a letter grade. In other words, average Business Studies grades should be reduced by three quarters of a letter grade (1.5 old UCAS points) to render them comparable to Economics grades. Our adjustment factor is about half the magnitude suggested by the subject pair analysis reported in Skinner (2001) for 1998 and may indicate that for these two subjects, at least, conventional pair analysis over-states the degree of relative subject difficulty. If we use the Business Studies specification, the adjustment, however, is just under one-half of a letter grade. The difference in estimated adjustment factors is anticipated given the conventional ‘index number’ problem but could also be attributable to Business Studies examiners marking within a narrower range than their Economics counterparts. From the perspective of the Economics profession, conversion to an Economics standard appears most appropriate. We thus favour the adjustment factor based on the Economics coefficients.

Ashworth and Evans (2000) perhaps rightly conclude that ‘economists are grading students away from the subject’. Given that the newly introduced AS–level offers greater opportunity for movement after the first year of study, Economics may be more vulnerable to attrition than other subjects. None of this would appear to augur well for enrolment numbers on either A-level or undergraduate degree programmes in Economics in the UK. However, it is too early to conclude whether this type of development at A-level, and subsequently at degree level, is likely to impinge on the labour market creating skill shortages with potential for social loss. There is no detailed empirical evidence yet available on the broader labour market implications of the substitution from Economics to Business Studies degree programmes in terms of either graduate employment effects or the private rates of return. Blundell, Dearden, Goodman and Reed (1997) noted robust degree effects on earnings, but no independent effects were detected for men possessing an Economics, Accountancy or Law degree[23]. In addition, Harkness and Machin

[23] It is worth noting that independent earnings effects were detected for women for these particular degree subjects.

(1999) report an upward trend in the earnings premia for science, social science and business graduates through the 1980s and 1990s. Thus, it might be the case that the enrolment trends noted here represent a problem for the Economics profession and its labour market, but not necessarily for the broader labour market.

It might be useful to conclude on a slightly more positive note. We believe the methodology adopted here might have broader applications for educationalists engaged in research on comparative subject difficulty. Determining an adequate specification for the attainment models is indeed a difficult task, but the approach outlined addresses some of the criticisms levelled at the existing methods adopted by researchers in the education field, and might also provide sharper insights into other academic attainment issues of interest. Our model evaluation indicated, however, that a further refinement to the econometric methodology is required. The issue of sample selection clearly needs to be explicitly addressed with the performance outcome modelled in conjunction with subject selection. This represents one possible path for future research.

Table 1: Maximum Likelihood Ordered Probit Estimates for Performance in Economics and Business Studies

Variable	Economics		Business Studies	
Constant	–6.105***	(0.305)	–5.073***	(0.321)
Male	0.252***	(0.063)	1.492***	(0.324)
<u>Ethnic Background:</u>				
White	*f*		*f*	
Black	–0.022	(0.148)	0.035	(0.153)
Asian	–0.052	(0.104)	–0.112	(0.109)
Chinese	–0.492 ***	(0.183)	–0.315	(0.222)
Other	0.102	(0.148)	–0.150	(0.175)
Mother Tongue – English	–0.086	(0.120)	–0.083	(0.114)
<u>GCSE Background:</u>				
GCSE Score	1.206***	(0.051)	1.119***	(0.055)
GCSE Score×Male	†		–0.237***	(0.059)
GCSE Maths – A/A*	0.361***	(0.098)	0.308***	(0.103)
GCSE Maths – B	0.121	(0.072)	0.201***	(0.048)
GCSE Maths – C	*f*		*f*	
GCSE Maths – D	–0.195	(0.276)	–0.043	(0.079)
<u>School Type:</u>				
LEA	*f*		*f*	
Grant Maintained	–0.293*	(0.161)	0.113	(0.147)
Private	–0.066	(0.104)	–0.028	(0.120)
Sixth Form	–0.039	(0.125)	0.111	(0.119)
FE College	–0.044	(0.118)	–0.216***	(0.108)
Grant Maintained×Male	0.443**	(0.183)	†	
FE College×Male	†		0.173***	(0.083)
<u>Examination Board:</u>				
EDEXCEL	0.232**	(0.092)	–0.415***	(0.109)
NEAB	–0.076	(0.123)	0.405***	(0.129)
OCR	0.171	(0.122)	–0.105	(0.097)
Other	0.139	(0.115)	†	
AEB	*f*		*f*	
<u>Other A-Levels Taken:</u>				
Mathematics	–0.021	(0.078)	0.148**	(0.073)
Physics	0.025	(0.104)	0.014	(0.123)
English	–0.093	(0.068)	0.145***	(0.050)
Statistics & Accounting	–0.196	(0.258)	0.265	(0.168)
Science Subject	–0.075	(0.076)	0.073	(0.052)
Social Sciences Subject	0.150***	(0.069)	0.250***	(0.044)
Humanities Subject	0.265***	(0.074)	0.268***	(0.059)
Modern Languages	–0.137*	(0.078)	0.022	(0.075)
Arts Subject	–0.263*	(0.141)	0.026	(0.072)
Arts Subject×Male	–0.388**	(0.181)	–0.270***	(0.090)

Estimated Threshold Parameters:				
θ_1	0.621***	(0.028)	0.664***	(0.038)
θ_2	1.327***	(0.056)	1.347***	(0.070)
θ_3	2.063***	(0.082)	2.124***	(0.100)
θ_4	2.825***	(0.105)	3.131***	(0.134)
Efficient Score Tests:				
(i) Threshold Heterogeneity Tests:				
Ethnic Background – χ^2_{20}	22.31	(0.324)	28.83*	(0.091)
GCSE Background – χ^2_{16}	31.73**	(0.011)	25.98	(0.166)[£]
School Type – χ^2_{20}	18.75	(0.538)	45.70***	(0.000)
Examination Board – χ^2_{16}	26.09*	(0.053)	44.10***	(0.000)[§]
Other A-levels Taken – χ^2_{40}	53.25*	(0.078)	30.33	(0.866)
Mother's Status – χ^2_{28}	20.27	(0.854)	25.12	(0.621)
Father's Status – χ^2_{28}	22.15	(0.774)	29.51	(0.288)[$]
Parental Education – χ^2_{16}	18.93	(0.272)	30.60**	(0.015)
Overall Z-score for Threshold Effects	1.50	(0.136)	3.76***	(0.000)
(ii) Omitted Variables Tests:				
Gender and Ethnic Background – χ^2_5	2.50	(0.776)	0.99	(0.963)
Gender and GCSE Background – χ^2_4	5.56	(0.234)	1.79	(0.617)[$$]
Gender and School Type – χ^2_3	5.04	(0.169)	2.04	(0.565)
Gender and Examination Board – χ^2_4	6.08	(0.193)	2.63	(0.453)[$$]
Gender and Other A-Levels Taken – χ^2_8	11.83	(0.159)	11.01	(0.201)
Gender and Parental Status – χ^2_{14}	9.49	(0.799)	12.55	(0.562)
Gender and Parental Education – χ^2_4	1.39	(0.846)	6.51	(0.164)
Overall Z-score for Omitted Variables	0.04	(0.968)	–0.34	(0.734)
(iii) RESET Mis-specification Test – χ^2_3	11.93***	(0.007)	10.85**	(0.013)
(iv) Homoscedasticity Test – χ^2_{47}	79.34***	(0.000)	86.20***	(0.000)
(v) Normality Test – χ^2_2	0.57	(0.751)	5.29*	(0.071)
Log-Likelihood Value	–2942.99		–5194.71	
Pseudo-R^2	0.200		0.141	
Observations	2086		3453	

Notes to table 1:

(a) Both specifications also include seven controls for father's employment background, seven controls for mother's employment background, two controls for father's educational level and two controls for mother's educational level.

(b) The numbers in parentheses for the ordered probit coefficients are the asymptotic standard errors.

(c) ***, **, * denotes statistical significance at the 0.01, 0.05 and 0.1 level respectively using two-tailed tests.

(d) f denotes category omitted in estimation and † denotes not applicable in estimation.

(e) Robust standard errors correcting for heteroscedasticity and adjusted for clustering by educational institution are reported in parentheses.

(f) The efficient score tests and are of the form $i'R(R'R)^{-1}R'i$ where i is an n-element vector of ones and R is a matrix with row order n containing the score contributions (see text and Machin and Stewart (1990)). The significance levels for these tests are reported in parentheses.

(g) The RESET test uses as auxiliary variables the ordered probit standardised index raised to polynomials of the fourth order.

(h) The homoscedasticity test uses all the original regressors as auxiliary variables.

(i) The omitted variables tests use the male variable interacted with the stated set of variables as auxiliary regressors.

(j) Since chi-squared values are additive, the overall z-scores are based on the fact that $\sqrt{2 \times \chi^2_k} \sim N(\sqrt{2k-1}, 1)$ for large k.

(k) § This is a chi-squared statistic with 12 degrees of freedom in the case of the Business Studies specification.

(l) $ This is a chi-squared statistic with 26 degrees of freedom in the case of the Business Studies specification.

(m) £ This is a chi-squared statistic with 20 degrees of freedom in the case of the Business Studies specification.

(n) $$ This is a chi-squared statistic with 3 degrees of freedom in the case of the Business Studies specification.

(o) The Pseudo-R^2 is based on the McFadden measure.

(p) The numbers in parentheses for the efficient score tests are the significance levels of the individual tests.

Table 2: The Effects of GCSE Mathematics Attainment on A-level Performance

A-Level Subject	Predicted A-Level Grade	GCSE Maths Grade C	GCSE Maths Grade B	GCSE Maths Grade A/A*
Business Studies Economics	A	0.209 0.115	0.271 0.140	0.308 0.201
Business Studies Economics	B	0.369 0.216	0.383 0.235	0.385 0.269
Business Studies Economics	C	0.257 0.286	0.225 0.287	0.207 0.275
Business Studies Economics	D	0.116 0.225	0.089 0.207	0.075 0.169
Business Studies Economics	E	0.039 0.106	0.026 0.090	0.021 0.063
Business Studies Economics	N/U	0.010 0.052	0.006 0.041	0.004 0.023

Notes to table 2:
The predicted probabilities are computed based on the ordered probit coefficient estimates reported in table 1. The stylised individual is a white male, whose mother tongue is English, with a GCSE score of six studying at a sixth-form college using the AEB syllabus and taking two other A-levels (one in the social sciences and the other in humanities). Both parents are assumed to have completed secondary schooling with the mother working part-time and the father full-time.

Table 3: The Effects of Average GCSE Attainment on A-level Performance

A-Level Subject	Predicted A-Level Grade	Average GCSE Score =5	Average GCSE Score =6	Average GCSE Score = 7
Business Studies Economics	A	0.068 0.011	0.271 0.140	0.608 0.551
Business Studies Economics	B	0.246 0.053	0.383 0.235	0.292 0.262
Business Studies Economics	C	0.301 0.152	0.225 0.287	0.080 0.135
Business Studies Economics	D	0.220 0.252	0.089 0.207	0.017 0.042
Business Studies Economics	E	0.114 0.238	0.026 0.090	0.003 0.008
Business Studies Economics	N/U	0.051 0.294	0.006 0.041	0.000 0.002

Notes to table 3:
The predicted probabilities are computed based on the ordered probit coefficient estimates reported in table 1. The stylised individual is a white male, whose mother tongue is English, with a grade B in Maths GCSE, studies at a sixth-form college using the AEB syllabus and whose two other A-levels are in the social sciences and humanities respectively. Both parents are assumed to have completed secondary schooling with the mother working part-time and the father full-time.

Table 4: Predicted Outcomes for Business Studies and Economics Samples

A-Level Grade	Actual Economics	Actual Business Studies	Predicted Economics Outcome for Business Studies Students	Predicted Business Studies Outcome for Economics Students
A	0.226	0.122	0.077	0.233
B	0.175	0.218	0.109	0.270
C	0.191	0.229	0.168	0.213
D	0.165	0.187	0.197	0.141
E	0.110	0.130	0.166	0.083
N/U	0.129	0.110	0.283	0.060
Average Points	5.7	5.3	3.8	6.5

Notes to table 4:

(a) Predicted Economics outcomes for Business Studies students based on using estimated coefficients from the ordered probit model for Economics performance from table 1.

(b) Predicted Business Studies outcomes for Economics students based on using estimated coefficients from the ordered probit model for Business Studies performance from table 1.

(c) The points scores are based on weighted averages computed using the UCAS points tariff: A=10, B=8, C=6, D=4, E=2, N/U=0.

Table 5: Explained and Unexplained Differentials in Grade Performance between Economics and Business Studies

		Based on Business Studies Coefficients[f]		Based on Economics Coefficients[§]	
A-Level Grade	Total Raw Differential	Explained	Unexplained	Explained	Unexplained
A	0.104	0.111	–0.007	0.149	–0.045
B	–0.043	0.052	–0.095	0.066	–0.109
C	–0.038	–0.016	–0.022	0.023	–0.061
D	–0.022	–0.046	0.024	–0.031	0.009
E	–0.020	–0.047	0.027	–0.056	0.036
N/U	0.019	–0.050	0.069	–0.154	0.173
Average Points	0.4	1.2	–0.8	1.9	–1.5

Notes to table 5:

(a) § Decompositions using coefficients from Economics performance equation in table 1 (see expression [4] in the text).

(b) *f* Decompositions using coefficients from Business Studies performance equation in table 1 (see expression [5] in the text).

(c) The points scores are based on weighted averages computed using the UCAS points tariff: A=10, B=8, C=6, D=4, E=2, N/U=0.

References

Adnett, N., S. Bougheas and P.Davis (2002), Market-based reforms of public schooling: some unpleasant dynamics, *Economics of Education Review*, **21**, 323 – 330.

Ashworth, J., and Evans, L. (2001) Modelling Student Choice at Secondary and Tertiary Level: A Cross-section Study, *Journal of Economic Education,* **32**, 311 – 320.

Ashworth, J. and Evans L. (2000) Economists are grading students away from the subject, *Educational Studies*, **26**, 475–487.

Ashworth, J. and Evans L. (1999) Lack of knowledge deters women from studying economics, *Educational Research,* **41**, 209–227.

Booth, A., Burton, J. and Mumford, K. (2000) The position of women in UK academic economics, *Economic Journal*, **110**, F312 – F333.

Blundell, R. Dearden, L., Goodman, A, H. Reed (1997), *Higher Education, Employment and Earnings in Britain*, The Institute for Fiscal Studies: London.

Chesher, A. and M. Irish (1987) Residual analysis in the grouped and censored normal regression model, *Journal of Econometrics*, **34**, 33–61.

Coe, R., and C.T. Fitz-Gibbon (1998) School effectiveness research: criticism and recommendations, *Oxford Review of Education*, **24**, 421–438.

Dearing, R. (1993) *The National Curriculum and its Assessment: Final Report*, London: National Curriculum Council and School Assessment Council.

Dearing, R. (1996), *Review of Qualifications for 16-19 Year Olds*, London: National Curriculum Council and School Assessment Council.

DfEE (Various Issues), *Statistics of Education: Public Examinations GCE and GCSE*, London (HMSO).

Fielding A. (1999) Why use arbitrary points scores? Ordered categories in models of educational progress, *Journal of the Royal Statistical Society, A*, **162**, 303–328.

Fitz-Gibbon, C.T. (1996,a) *Monitoring Education: Indicators, Quality and Effectiveness,* London, New York: Cassell.

Fitz-Gibbon, C.T. (1996,b) Why value-added is here to stay, *Managing Schools Today, September.*

Fitz-Gibbon, C.T. (1999) Long term consequences of curriculum choices with particular reference to mathematics and science, *School Effectiveness and School Improvement*, **10**, 217–232.

Fitz-Gibbon, C.T. and L. Vincent (1994) *Candidates' Performance in Public Examination in Mathematics and Science,* London, School Curriculum and Assessment Authority.

Fitz-Gibbon, C.T. and L. Vincent (1997) Difficulties regarding subject difficulties: developing reasonable explanations for observable data, *Oxford Review of Education*, **23**, 291–298.

Goldstein H. (1987) *Multi-level Models in Educational and Social Research*, Oxford University Press: New York.

Goldstein H. (1997) Value-added tables: less than the holy-grail, *Managing Schools Today,* **6**, 18–19.

Goldstein H. and M. Creswell (1996) The comparability of diffeent subjects in public examinations: a theoretical and practical critique, *Oxford Review of Education*, **22**, 435–442.

Goldstein H., Rasbash, J., Yang, M., Woodhouse, G., Pan, H., Nuttall, D. and S. Thomas (1993), A multilevel analysis of school examination results, *Oxford Review of Education*, **19**, 425–433.

Gray, J., Goldstein, H. and D. Jesson (1996) Changes and improvements in schools' effectiveness: trends over five years, *Research Papers in Education*, **11**, 35–51.

Greene, W. (2000) *Econometric Analysis (4th edition)* New York, Macmillan.

Harkness, S., and S. Machin (1999). *Graduate Earnings in Britain, 1974-1995*, DfEE, Research Report 95.

Heckman, J. (1979) Sample selection bias as a specification error, *Econometrica*, **47**, 153 – 161.

Hirschfeld, M., Moore R.L., and E. Brown (1995) Exploring the gender gap on the GRE subject test in economics, *Journal of Economic Education*, **26**, 3–15.

Huber, P.J. (1967) The behaviour of maximum likelihood estimates under non-standard conditions in *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Berkeley, CA: University of California Press*, **1**, 221 – 223.

Hurd, S., Coats, G. and A. Anderton (1997) Economics and business studies – trends in GCE A-Level, *Division of Economics, University of Staffordshire, Working Paper 97.8*

LIMDEP 7.0 (1998) *Econometric Software, Inc.* New York: USA.

Machin, S., and A. Oswald (2000) UK economics and the future supply of academic economists, *Economic Journal*, **110**, F334–F349.

Machin, S., and M. Stewart (1990) Unions and the financial performance of British private sector establishments, *Journal of Applied Econometrics,* **5**, 327–350.

McPherson, A. (1992) *Measuring Added Value in Schools, National Commission on Education, Briefing No 1*, February.

Oaxaca, R. (1973), Male-Female Wage Differentials in Urban Labor Markets, *International Economic Review*, **14**, pp.693-709.

Orme, C. (1990) The small-sample performance of the information matrix test, *Journal of Econometrics*, **46**, 309–331.

Peters, S. (2000) On the use of the RESET test in micro-econometric models, *Applied Economics Letters*, **7**, 361–365

Pratt, J.W. (1981) Concavity of the log-likelihood, *Journal of the American Statistical Association*, **71**, 389 – 390.

Ramsey, J.B. (1969) Tests for specification errors in classical linear least-squares regression analysis, *Journal of the Royal statistical Society*: Series B, **31**, 350 – 71

Sammons, P., Hillman, J. and P. Mortimore (1995) *Key Characteristics of Effective Schools: A Review of School Effectiveness Research*, London: Office for Standards in Education, April.

School Curriculum and Assessment Authority (1994) *Value-Added Performance Indicators for Schools.* A report by SCAA for the Secretary of State for Education, London.

Skinner, P. (2001), Ranks and Correction Factors for A-level Subjects 1994-2000, *Mimeo*, ALIS Project, CEM Centre, University of Durham.

STATA 6.0, StatCorp. (1999) *Stata Statistical Software: Release 6.0,* College Stations TX: Stata Corporation., Texas, USA.

Tymms P. B., and C.T.Fitz-Gibbon (1991) A comparison of examination boards: A- Levels, *Oxford Review of Education*, **17**, 17–32.

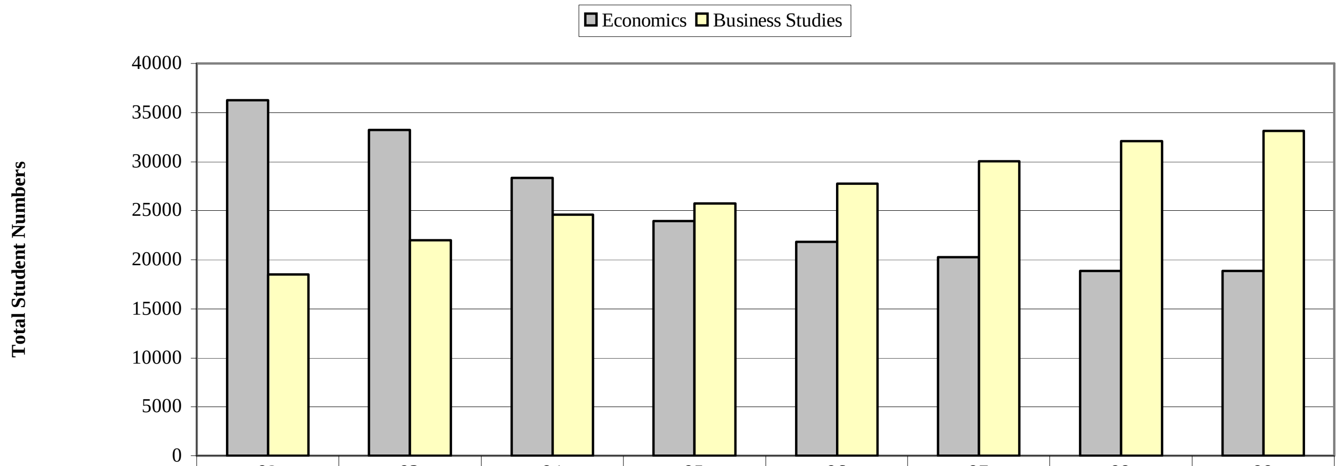
Tymms P. B. and L. Vincent (1995) *Comparing Examination Boards and Syllabuses at A-Level: A Technical Report* (Belfast: Northern Ireland Council for the Curriculum, Examinations and Assessment).

Thomas, S. and P. Mortimore (1996) Comparison of value-added models for secondary school effectiveness, *Research Papers in Education*, **11**, 5–33.

Williams, M.L., Waldauer, C. and V.G. Duggal (1992) Gender differences in economic knowledge: an extension of the analysis, *Journal of Economic Education*, **23**, 219–231.

APPENDIX

Figure A1: Economics and Business Studies - Student Numbers in England 1992 - 1999



	92	93	94	95	96	97	98	99
Economics	36225	33246	28322	23943	21842	20217	18869	18865
Business Studies	18466	21982	24574	25760	27716	30047	32102	33083

Exam Year

Source: DfEE:Statistics of Education: Public Examinations GCSE and GCE, London (HMSO) – Various years.

Table A1: Distribution of Examination Grades England (1992-1999)

		A	**B**	**C**	**D**	**E**	**N/U**
1999	Business	0.09	0.19	0.24	0.20	0.13	0.14
	Economics	0.19	0.18	0.20	0.17	0.13	0.13
	All subjects	*0.17*	*0.19*	*0.21*	*0.18*	*0.13*	*0.12*
1998	Business	0.08	0.19	0.24	0.20	0.14	0.15
	Economics	0.18	0.18	0.19	0.17	0.13	0.16
	All subjects	*0.17*	*0.19*	*0.21*	*0.18*	*0.13*	*0.13*
1997	Business	0.07	0.19	0.23	0.21	0.14	0.16
	Economics	0.16	0.17	0.18	0.18	0.14	0.18
	All subjects	*0.16*	*0.18*	*0.20*	*0.18*	*0.13*	*0.14*
1996	Business	0.07	0.15	0.21	0.20	0.16	0.20
	Economics	0.15	0.16	0.17	0.17	0.15	0.20
	All subjects	*0.16*	*0.18*	*0.19*	*0.18*	*0.14*	*0.16*
1995	Business	0.07	0.15	0.20	0.21	0.16	0.21
	Economics	0.14	0.15	0.16	0.16	0.15	0.23
	All subjects	*0.15*	*0.17*	*0.18*	*0.18*	*0.14*	*0.18*
1994	Business	0.06	0.14	0.19	0.21	0.17	0.22
	Economics	0.14	0.15	0.16	0.17	0.15	0.23
	All subjects	*0.14*	*0.16*	*0.18*	*0.18*	*0.14*	*0.20*
1993	Business	0.06	0.14	0.18	0.21	0.18	0.23
	Economics	0.12	0.14	0.15	0.16	0.16	0.27
	All subjects	*0.13*	*0.16*	*0.17*	*0.17*	*0.14*	*0.22*
1992	Business	0.06	0.13	0.18	0.21	0.17	0.25
	Economics	0.12	0.14	0.15	0.16	0.16	0.27
	All subjects	*0.13*	*0.16*	*0.17*	*0.17*	*0.15*	*0.23*

Notes to Table A1:

(a) *Source*: DfEE:Statistics of Education: Public Examinations GCSE and GCE, London (HMSO) – Various years.

(b) '*All subjects*' refer to all subjects examined in the relevant year. The subjects are classed into three groups according to DfEE classification; Science, Social Science and Arts (excluding General Studies).

Table A2: Summary Statistics for Economics and Business Studies Samples

Variable	Economics	Business	z-score
A-Level Grade Performance:			
A	0.226	0.122	10.20
B	0.175	0.218	–3.86
C	0.191	0.229	–3.34
D	0.165	0.187	–2.07
E	0.110	0.130	–2.20
N/U	0.129	0.110	2.13
Gender:			
Male	0.577	0.510	4.84
Ethnic Background:			
White	0.830	0.888	–6.14
Black	0.026	0.026	0.00
Asian	0.105	0.064	5.47
Chinese	0.013	0.007	2.26
Other	0.026	0.015	2.89
Mother Tongue – English	0.915	0.944	–4.18
GCSE Background:			
GCSE Score	6.165	5.666	23.92
GCSE Maths – A/A*	0.403	0.162	19.99
GCSE Maths – B	0.397	0.385	0.89
GCSE Maths – C	0.185	0.393	–16.15
GCSE Maths – D	0.015	0.060	–7.99
School Type:			
LEA	0.309	0.222	7.20
Grant Maintained	0.203	0.116	8.82
Private	0.205	0.113	9.35
Sixth Form	0.167	0.294	–10.63
FE College	0.116	0.255	–12.47
Examination Board:			
EDEXCEL	0.467	0.098	31.29
NEAB	0.134	0.023	16.26
OCR	0.141	0.124	1.82
Other	0.016	*f*	*f*
AEB	0.242	0.755	–37.28
Other A-Levels Taken:			
Mathematics	0.328	0.176	12.96
Physics	0.068	0.028	7.11
English	0.255	0.274	–1.55
Statistics & Accounting	0.013	0.018	–1.43
Science Subject	0.166	0.196	–2.79
Social Sciences Subject	0.347	0.339	0.61
Humanities Subject	0.220	0.161	5.50
Modern Languages	0.150	0.104	5.08
Arts Subject	0.095	0.194	–9.82
Number of Observations	2086	3453	

Notes to Table A2:

(a) Z-scores are used to test differences in proportions between Economics and Business Studies and t-tests are used to test differences in means. The appropriate critical value at the 0.05 level using a two-tailed test is ±1.96.

(b) Sample averages relating to parental background variables are not reported.

(c) f denotes not applicable.

(d) Arts Subjects include Art, Communication Studies, Design and Technology, Graphical Communication, Music, Photography, Theatre Studies, and Performing Arts.

(e) Humanities Subjects include Classical Civilisation, Environmental Studies, Geography, Politics, History, Home Economics, Latin, Law, and Religious Studies.

(f) Social Sciences include Sociology and Psychology.

(g) Sciences include Biology, Chemistry, Electronics, and Computing.