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Factors explaining the choice of an economics major The role of student characteristics, personality and perceptions of the profession

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Abstract A bivariate probit model is used to predict the choice of an economics major in a sample of first-year, undergraduate business students. The paper examines the statistical significance of a number of student-related characteristics on the likelihood of choosing an economics major, along with the role of student personality and perceptions of the profession. Factors analysed include secondary studies in economics, accounting and business, grade point average and attendance pattern, along with perceptions of the economics profession arrayed along dimensions of interest, independence, structure and precision. It would appear that the primary influences on the selection of a major in economics comprise student personality and level of interest in the profession.

1. Introduction

In Australia, as elsewhere, there has been a dramatic decline in the number of students undertaking undergraduate economics degrees during the 1990s. This applies equally to both specialised economics degree programmes and more broadly based economics majors in business degrees. For example, and in terms of specialised economics degrees, Millmow (1995) used a Department of Education, Training and Youth Affairs (DETYA) survey of ten universities to conclude that the aggregate number of students enrolled fell by some 30 per cent between 1991 and 1994. However, these official statistics only included students enrolled in the "Bachelor of Economics", rather than all degree programmes which could be reasonably classified as an economics qualification.

Recognising this deficiency, Lewis and Norris (1997) surveyed 35 of Australia's 38 universities and obtained data on the more than one hundred degree programmes encompassing economics qualifications. On this basis, they concluded that the fall in total enrolments over the period 1991 to 1996 was closer to 12 per cent. In fact, Lewis and Norris (1997) found that total full-time equivalent student units (EFTSU) in economics had remained constant for much of the decade, though primarily because the decline in economics qualifications had been off-set by an increase in the number of students undertaking economics units for non-economics programmes. Alvey and Smith (1999) noted similar trends in New Zealand. These figures are then more comparable to the decline in the number of undergraduate economics degrees experienced in the USA. For instance, Siegfried (1995) documented a fall of 12 per cent in 1993 and 9 per cent in 1994, while Siegfried (2000, p. 296) commented, inter alia, on "... the precipitous 30 per cent drop in degrees awarded from 1990-91 through 1995-96".

Irrespective of these differences in measuring participation in economics programmes, the fact remains that first-year enrolment in Australian economics degrees and majors declined by more than 12 per cent over the 1990s, while enrolments in all business-related degrees (including business, administration and economics) rose by more than 40 per cent (DETYA, 2000). Importantly, the relatively modest national decrease is not evenly distributed across states or between universities within states

(Lewis and Norris, 1997). For example, while enrolments in the two most populous states of New South Wales and Victoria experienced moderate falls, enrolments in the four remaining states fell by at least 30 per cent and as much as 50 per cent. And to some extent, only the lowering of the tertiary entrance score for admission has arrested this decline in enrolments. Lewis and Norris (1997, p. 4) conclude:

A few universities have always had a high degree of excess demand and low quotas, which means they have not had to reduce their tertiary entrance score. However, most universities have experienced a consistent downward trend in entrance scores . . . This has allowed most established universities and the new universities to keep their new entrants figure at a reasonably constant level.

The impact of this decline in the quantity and quality of economics enrolments on academic staffing, the progression of students into postgraduate offerings, and the reorientation of teaching resources to “service teaching” requires no further comment.

A number of reasons have been given for the declining popularity of economics degrees/majors in Australia. Foremost among these is the massive fall in the number of secondary school students taking economics and the rising popularity of business study programmes in management, marketing, human resource management and finance. Both of these reasons encompass the perception that these subjects are more interesting and vocationally oriented than economics. Unfortunately, little empirical evidence exists concerning how these and other factors actually affect the choice of individual students to major in economics. For example, while studies of aggregated data concerning the composition of economics cohorts are increasingly commonplace, relatively few studies have directly modelled the choice of a major in economics over closely related alternatives. Furthermore, almost without exception, this literature has an exclusively North American focus. Furthermore, as far as the authors are aware, no study to date has jointly examined the role of student characteristics and perceptions of the economics profession as key factors in the choice of an economics major. Such information would be extraordinarily valuable to curriculum designers, university administrators employers of graduates and potential students, amongst others.

Accordingly, the purpose of the present paper is to investigate the role of both student characteristics and perceptions in determining the rate of participation in Australian economics majors. The paper itself is divided into four main areas. The second section briefly surveys the empirical literature concerning factors influencing students’ choice of an economics major. The third section explains the empirical methodology and data collection employed in the present analysis. The results are dealt with in the fourth section. The paper ends with some brief concluding remarks.

2. Factors explaining the decline in the economics major

In contrast to many other disciplinary areas, hypotheses to explain the choice of an economics major are relatively underdeveloped. However, several specific themes have been put forward to explain the decline in the number of economics undergraduate degrees in the 1990s, and these form a suitable basis for examining those hypotheses that have received attention. To start with, a recurrent theme in the economics literature “. . . is that the recent cycle in the number of undergraduate degrees in economics is connected with changes in the popularity of undergraduate business studies” (Salemi and Eubanks, 1996, p. 324). Salemi and Eubanks (1996), for example, account for the rise and fall in the number of economics majors with a “discouraged-business-major” hypothesis. They argue that students who were screened out of the undergraduate business programme account disproportionately for the increase in economics majors in the 1980s and for the subsequent decrease in

the 1990s (Salemi and Eubanks, 1996). Willis and Pieper (1996) also link the decline in economics majors with the changes in the popularity of undergraduate business studies. Willis and Pieper (1996) found that schools offering undergraduate business degrees have only one-quarter as many economics majors as schools which do not, and that the offering of a business economics major within the school further lowers the number of economics majors by one-half. Willis and Pieper (1996, p. 345) concluded, "the largest single factor explaining the number of economics majors in a cross-section was the presence of a competing degree in business".

Brasfield et al. (1996, p. 363) further examine the interaction between business studies and economics with the suggestion that ". . . the study of economics may be a market substitute for a business degree at those institutions that do not offer a degree in business and a complement at those institutions that do offer a business degree". Brasfield et al. (1996) identified two competing hypotheses. First, ". . . economics departments located at schools offering business degrees may benefit in terms of majors as a result of business student spillover (Brasfield et al., 1996, p. 363). And second, "if economics programs are viewed as a less-desirable substitute for business degrees by business-orientated students, economics programs that compete with in-house business programs may be less at risk . . . because these programs do not depend on business-orientated students for enrolments" (Brasfield et al., 1996, p. 363). On the basis of a survey of economics departments, they reasoned that flexibility in economics electives appeared to have a positive impact on the attractiveness of a major and that schools which did not offer an undergraduate business degree were more likely to lose economics majors than schools that did (Brasfield et al., 1996).

An alternative approach to this question is taken up in Lewis and Norris' (1997) survey of heads of Australian economics departments. To ascertain their views, a list of 11 possible causes of the decline in economics majors was drawn up. The most important factors identified in this survey all related to the relative position of economics majors to business majors in terms of career focus, the degree of rigour or abstraction, the extent of preparation in mathematics, and overall interest. Lewis and Norris (1997, p. 12) summarised their analysis as follows: "The reasons for declining enrolments are not fully understood but there is a general perception that the study of economics, at least in terms of specialising in economics, is regarded less favourably compared to business or some unrelated disciplines".

A second theme that has received some attention in the literature is that the decline in economics majors is connected to some long run educational or business cycle. Margo and Siegfried (1996), for example, present evidence to suggest that between 1948 and 1993 economics share of US bachelor degrees averaged 2.2 per cent and completed three full cycles. On this basis, they concluded that economics' share of bachelor degrees is a stable process that adjusts only slowly, and that it may take until 2000 for the share to rise from its 1993 low of 1.8 per cent to the long-run trend. On the other hand, Willis and Pieper (1996) show that economics' share of degrees follows a very similar path to the (declining) employment pattern in the financial services industry, while Margo and Siegfried (1996) found that the share of economics degrees moves slightly counter to the overall business cycle. Similarly, there is already much evidence suggesting a close linkage between graduate career conditions and the demand for economics majors as against closely related fields. For instance, Lewis and Norris (1997) found that the proportion of economics graduates finding full-time employment in Australia was significantly lower than accounting and business studies.

A third theme in the economics major literature is based on the almost universal observation that “female undergraduates are less likely to take an introductory economics class, to continue in economics after completing the first introductory course, and to major in economics than are male undergraduates” (Jensen and Owen, 2000, p. 466). And while much has been made of the broader “hard science”, “soft science” division between males and females, even when compared to other business disciplines, female participation in economics majors is relatively low. For example, Bauer and Dahlquist (1999) cite the female percentage of graduating US bachelor’s degrees in 1994/1995 as 30.8 per cent for economics, 33.3 per cent for finance, 56.2 per cent for accounting, 49.1 per cent for international business and 46.8 per cent for marketing. In Australia enrolment figures in 2000 indicate female participation rates are only 40.27 per cent in economics, as compared to 42.06 per cent in finance, 52.51 per cent in accounting, 52.88 per cent in management and 54.39 per cent in marketing (DETYA, 2001).

However, while these gender differences are well documented, the underlying reasons for the purported gender bias in economics education are not. Several competing hypotheses have been proposed, and duly tested in the literature. These include suggestions that the economics curriculum, along with the pedagogy and types of evaluation instruments, includes topics and methodology of less interest to women, and that the evaluation favours male learning styles (Horvath et al., 1992; Ferber, 1995; Nelson, 1995; Bartlett, 1995; Anderson and Siegfried, 1997; Richardson, 1998; Alford, 1998). Haslehurst et al. (1998) identify the importance of these issues “if more women than men hold the view that the subject matter is irrelevant and uninteresting, do we need to consider seriously the feminist critique that the overall orientation of the discipline is too masculine”? The gender bias literature also includes suggestions that female students are relatively poorly prepared for introductory economics in terms of maths preparation, and concomitantly have a lower average performance in economics classes than their male counterparts. It is argued that this is then translated into a lower level of interest in the subject matter itself, with a resultant fall in continuations in economics subjects. By way of contrast, Hughes (1998) takes the view that economics is essentially gender neutral and that the low female participation rate is instead an indicator of the domination of mathematical economics or “mathecon” in course content, poor quality teaching, and male chauvinism in academic departments. Several studies have examined the role of student gender in participation in economics majors. Dynan and Rouse (1997, p. 353), for example, examined three dimensions of gender bias in a survey of introductory economics students at Harvard University:

One of the most common hypotheses about why women are less likely to major in economics than men is that women are less proficient or less comfortable using the math needed to do economics . . . Perceived aptitude for economics may also influence the choice of major because students are presumably more likely to choose a subject in which they expect to do well . . . another determinant of a student’s choice of major might be the presence or absence of role models.

Three sets of variables were collected to help assess these hypotheses. The first hypothesis relied on students’ declaring their math SAT scores and giving an indication of their skill at interpreting graphs. The second drew upon the notion that students focused on relative, as against absolute, performance in economics in order to decide their choice of major. This was indicated by whether or not their performance in introductory economics was better, worse or about the same as their performance in all other courses. Finally, the sex of each student’s instructor and the number of females in each section was included to take account of academic and peer role models respectively.

However, after controlling for a number of other factors, Dynan and Rouse (1997) found that maths background accounted for only a limited part of the gender difference in the decision to major in economics; and that, while women generally had a lower relative performance in economics, controlling for this factor likewise diminished the gender gap in the choice of economics as a major. The proxies for instructional environment explained little of the gender gap. In explaining their results, Dynan and Rouse (1997, p. 365) concluded that several factors not taken into account in their analysis may explain the remaining gender gap:

This gap may arise from differences in tastes or other unmeasured characteristics such as knowledge about the nature of economics upon entering college . . . Women may arrive at college with preconceptions about the nature of the field, having already decided not to major in it.

Jensen and Owen (2000) also examined the role of gender bias in progression in economics with an analysis of economics students across 34 US liberal arts colleges. A large number of factors were examined, including grade point average and expected grade, math SAT scores, and interest in economics careers and entrance into graduate school. Jensen and Owen's (2000, p. 469) results indicated, "student characteristics and attitudes . . . are important determinants of the decision to continue to study economics.

We find that some factors affect male and female students equally; others have different effects on men and women". However, using an alternative approach to the question of gender bias in ongoing economics participation Chizmar (2000, p. 116) found that ". . . after controlling for economics and economics credit hours, the hazard profiles [in terms of discontinuing study] of female economics majors are indistinguishable from their male counterparts".

A study by Dawson-Threat and Huba (1996) gives further appreciation of the difficulty of incorporating gender bias as a factor in the choice of major generally. In this study, gender bias is reflected by the interaction between student gender, whether the major is male or female-dominated, and each student's sex-role identification. When choosing a major, some students may respond more to issues related to their biological self (i.e. their gender), while others place more emphasis on their psychological self (i.e. their sex-role identity). In other words, the choice of major may depend on both societal views of male and female roles and on the sense of comfort for students that results from being with individuals who have similar views of sex roles, whether masculine identified, feminine identified, androgynous or undifferentiated. These final factors in themselves may be sufficient to enable students to "crossover" into non-traditional majors. Importantly, the study found that the vast majority of females still selected traditional majors for women, irrespective of their own sex-role identification. Dawson-Threat and Huba (1996) suggested that this might be because these students perceived that the female-dominated professions offered more viable options than those that were male-dominated.

When examining existing research on characteristics associated with student choice of a major in economics, a number of salient points emerge. First, relatively little attention has been paid in economics to models explaining a student's choice of a major, and the evidence that does exist has frequently been extracted from university level data. For example, Brasfield et al. (1996), Salemi and Eubanks (1996), Willis and Pieper (1996) Lewis and Norris (1997) and Siegfried (2000), among others, comment on the choice of an economics major from this perspective. More particularly, quite apart from the standard problems of aggregation and the fact that economic models of consumer choice are only theoretically sound at the individual level, the primary focus of studies of this type is invariably on measurable predictions for individual behaviour.

These considerations suggest that future research in this area should be based on individual or micro-level data.

Second, and in contrast to several other disciplines, relatively little attention in economics has been paid to measuring what appear to be relatively important factors in the choice of an economics major, that is, student personality and perceptions of, and interest in, the economics profession itself. For example, while some studies have used gender, grade point average, and past studies in economics, amongst others, to proxy interest, very few have concerned themselves directly with how these factors affect student's choice of major. Jensen and Owen (2000, p. 469), for example, argue "both student characteristics and attitudes that exist prior to setting foot inside an economics class and those that are formed during the class are important determinants of the decision to continue to study economics".

Harvey-Beavis and Elsworth (1998, p. 19) also found evidence concerning the role of interest in the choice of major, "the demand for tertiary education courses seems to be driven by interests. No evidence was found. . .to support a contention that pursuit of status or the use of a 'cost-benefit' strategy was important in students' choice". This is important because any policy designed to shift enrolment patterns will need to recognise that interests remain relatively stable over time, are not amenable to change, and probably weigh heavily in the decisions of most students. Becker (1997, p. 1366) cogently underlines this argument: "if building enrolment is important, then the previously uninterested students are the ones that must be attracted. We need to understand the selection process in choosing and persisting in courses, as well as in measuring learning".

Finally, there has generally been little allowance in studies to date for the complex interaction between the choice of a major in economics and one in another business-related field. This is particularly important since one of the most common themes identified in the "declining economics major" literature has been the rise of competing business studies programmes and the suggestion that potential economics majors are funnelled into these alternatives. For example, in Australia Legge (1994) has commented about the apparent irrelevance of the economics curriculum compared to the management and business curricula in this regard. Rigorous empirical analysis would therefore facilitate greater certainty on the empirical status of students' choice in majors in the context of its close competition. It is with these considerations in mind that the present study is undertaken.

3. Data and model estimation

The data used in this study are based on 345 first-year students sampled from the more than 4,000 students studying for the three-year undergraduate business degree at Australia's fifth largest university. This award consists of a set of core units in conjunction with elective majors, double majors and extended majors in accountancy, finance, economics, human resource management, international business, management and marketing. The degree's tertiary entrance score is common to all majors, and students initially matriculate to a nominated major or majors. However, after the first semester students may apply to change major provided that they satisfy the appropriate unit prerequisites and are able to complete the proposed major within the units remaining in the programme.

The analytical technique employed in the present study is to specify students' choice of major as the dependent variable (y) in a regression with student personality, perceptions and other physical and educational characteristics as explanatory variables (x). The nature of the dependent variable indicates discrete dependent

variable techniques are appropriate. Accordingly, the following binary probit model is specified:

$$\text{Prob}(y = 1) = \int_{-\infty}^{\beta'x} \phi(t)dt = \Phi(\beta'x) \quad (1)$$

where x comprises a set of student characteristics posited to influence the selection of an economics major, b is a set of parameters to be estimated and the function $F(\cdot)$ indicates the standard normal distribution. The coefficients imputed by the binary probit model provide inferences about the effects of the explanatory variables on the probability of the choice of a particular major. The requisite dataset is composed of three sets of information.

The first set of information relates to the choice of major and comprises the dependent variable in the binary probit model specified in equation (1). Students are categorised as either:

. those who have not nominated an economics major, whether as a single or extended major, or as part of a double major ($y = 0$); or . those who have nominated an economics major as part of their programme ($y = 1$).

The first group consists of all students undertaking single or extended majors in accountancy, finance, human resource management, international business, management and marketing, excluding double major students combining studies in these areas with a major in economics. A total of 314 students, or 91 per cent of cases are categorised as non-economics majors. The second group consists of students undertaking at least one major in economics. A total of 31 students, or some 9 per cent of cases, are identified as economics majors.

The next two sets of information are specified as explanatory variables in the binary probit regression model. The first of these sets of information relates to several student characteristics derived by survey. Information collected includes a personality score and perceptions of the economics profession along a range of criteria. First, much research suggests that students select majors that are seen as compatible with particular personality styles (Saemann and Crooker, 1999, p. 2). Booth and Winzar (1993), for example, showed that students who were initially attracted to accounting displayed personality traits that led them to prefer learning facts and rules applied in concrete ways, and other studies, such as Wolk and Cates (1994) have also linked specific personality traits to particular majors.

Second, empirical evidence also suggests that a more basic issue behind students' choice of major may be their level of interest and perceptions of the profession. Dynan and Rouse (1997), Lewis and Norris (1997) and Jensen and Owen (2000) have identified the importance of interest and perceptions of the profession as factors determining the choice of an economics major, and Easterlin (1995) has identified preferences as the key factor in the generational switch to business studies.

The survey included two instruments to measure students' inherent creativity and perceptions of the economics profession. The first instrument required students to complete Gough's (1979) 30-item Creative Personality Scale. Possible scores on this simple adjective checklist range between 212 and +18 with a higher score indicating a more creative individual. The specification of the personality variable (PRS) is identical

to that specified by Saemann and Crooker (1999) in a recent study of the decision to major in accounting. Table I lists the adjectives surveyed and the scoring mechanism applied following the survey. No particular a priori sign is hypothesised when economics major is regressed against personality score.

—	Clever	—	Capable	—	Cautious ^a
—	Commonplace ^a	—	Confident	—	Conservative ^a
—	Conventional ^a	—	Dissatisfied ^a	—	Egotistical
—	Honest ^a	—	Humorous	—	Individualistic
—	Informal	—	Insightful	—	Intelligent
—	Inventive	—	Mannerly ^a	—	Narrow interests ^a
—	Original	—	Pompous ^a	—	Reflective
—	Resourceful	—	Self-confident	—	Sexy
—	Sincere ^a	—	Snobbish	—	Submissive ^a
—	Suspicious ^a	—	Unconventional	—	Wide interests

Note: ^a Items are scored - 1, all other items + 1

Table 1. personality score checklist

The second measure required students to assign ordered preferences on a five-point scale between 36 opposing adjectives on the basis of their perceptions of the economics profession. Saemann and Crooker (1999) surveyed perceptions of the accounting profession using a similar instrument. These items are arrayed along four dimensions of perceptions relating to the economics profession (number of items in brackets); namely, interest (INT) (five), the level of individuality (IND) (four), precision or thoroughness (PRE) (13) and structure or rule-orientation (STR) (14). The pairings for “interest” include boring vs interesting, dull vs exciting and monotonous vs fascinating, while for “individuality” they embrace solitary vs people-oriented and introvert vs extrovert. These terms are thought to capture student’s overall perceptions of the profession and the relationships of persons working within the profession.

The items for “structure” relate to students’ perceptions of the way in which economists deal with problems and tasks. Pairings include structured vs flexible and routine vs unpredictable. Finally, “precision” is captured by pairings including accurate vs imprecise, challenging vs easy and mathematical vs verbal. These items address students’ perceptions about the nature of the types of problems and their solutions in the economics profession. Table II lists the items by dimension and from left to right by increasing strength in each dimension (i.e. less interest to more interest), although in the survey itself these items were randomised by category and coding.

In order to examine the underlying patterns of relationships among this large number of variables more accurately, and given that the study is primarily concerned with prediction, the items within each dimension are reduced using principal components analysis. The latent root criterion is employed to extract the significant factor scores within each dimension (those with eigenvalues greater than unity). Using this criterion, 11 factor scores are derived from the surveyed items as replacements for the original variables. One factor is selected for the interest dimension, two for individuality, five for precision and three for structure. These account for 56, 67, 59 and 49 per cent of cumulative variance within each dimension, respectively. Table III provides details on the extracted components, eigenvalues, and percentage of variance and cumulative percentage of variance for these factor scores.

The hypothesis underlying the factor score for interest (INT) follows the suggestion that students interested in a particular profession are more likely to select a major in that area. A positive coefficient is hypothesised when economics major is regressed

against interest. The three remaining sets of factor scores relate to students' perceptions of the degree of individuality (IND), precision (PRE) and structure (STR) in the economics profession. Siegfried et al. (1991) Becker (1997) and Salemi and Siegfried (1999), amongst others, have commented in depth on the goals of economics education and the realities of the economics major in this regard. Conceptually speaking the factor scores specified as explanatory variables represent the degree to which each student scores high on the group of items that load high on the factor. For that reason, students who score highly on the several variables that have heavy loadings on the factor will obtain a high factor score on that factor. Thus the factor scores for interest, individuality, precision and structure can be interpreted as composite measures within each dimension, and therefore the ex ante signs on the estimated coefficients will be identical to that hypothesised for the original raw data. However, it is not known what influence the various perceptions of the economics profession will have on the choice of an economics major. For example, the economics profession may be seen as highly individualistic, although whether this encourages students to select an economics major will depend on the interaction with each student's own personality. Accordingly, no particular a priori sign is hypothesised when economics major is regressed against IND, PRE and STR.

<i>Interest</i>		
Boring	1 ... 5	Interesting
Dull	1 ... 5	Exciting
Monotonous	1 ... 5	Fascinating
Ordinary	1 ... 5	Prestigious
Tedious	1 ... 5	Absorbing
<i>Individuality</i>		
Benefits society	1 ... 5	Profit-driven
Extrovert	1 ... 5	Introvert
People-oriented	1 ... 5	Number crunching
Interaction with Others	1 ... 5	Solitary
<i>Precision</i>		
Ambiguity	1 ... 5	Certainty
Analytical	1 ... 5	Conceptual
Dynamic	1 ... 5	Stable
Easy	1 ... 5	Challenging
Imprecise	1 ... 5	Accurate
Intuition	1 ... 5	Facts
Novelty	1 ... 5	Methodical
Originality	1 ... 5	Conformity
Overview	1 ... 5	Details
Spontaneous	1 ... 5	Planned
Superficial	1 ... 5	Thorough
Theoretical	1 ... 5	Practical
Variety	1 ... 5	Repetition
Verbal	1 ... 5	Mathematical
<i>Structure</i>		
Abstract	1 ... 5	Concrete
Adaptable	1 ... 5	Inflexible
Alternative views	1 ... 5	Uniform standards
Changing	1 ... 5	Fixed
Creative solutions	1 ... 5	Cut and dry
Decision making	1 ... 5	Record keeping
Effectiveness	1 ... 5	Efficiency
Flexible	1 ... 5	Structured
Imagination	1 ... 5	Logic
Innovation	1 ... 5	Compliance
New ideas	1 ... 5	Established rules
New solutions	1 ... 5	Standard procedures
Unpredictable	1 ... 5	Routine

Table II Perceptions of the economic profession

The final set of information includes recorded student characteristics that are cross tabulated with the survey data. Selected descriptive statistics are detailed in Table IV. Characteristics recorded include each student's sex, nature of secondary school studies, grade point average to date and attendance mode. The first variable specified is a qualitative variable indicating whether the student is female (SEX) (192 cases or 55.65 per cent of the sample). There is generally strong evidence to suggest that female undergraduates are less likely to take an introductory economics class, to continue in economics after completing the first introductory course, and to major in economics than are male undergraduates.

Variable set	Component	Eigenvalue	Percentage of variance	Cumulative percentage of variance
Interest (5)	INT1	2.747	56.123	56.123
Individuality (4)	IND1	1.464	39.743	39.743
	IND2	1.010	27.405	67.148
Precision (14)	PRE1	2.755	20.807	20.807
	PRE2	1.538	11.614	32.421
	PRE3	1.428	10.787	43.207
	PRE4	1.096	8.279	51.486
	PRE5	1.010	7.626	59.113
Structure (13)	STR1	3.809	30.625	30.625
	STR2	1.327	10.667	41.292
	STR3	1.004	8.073	49.365

Notes: The number of principal components extracted from each set of questions is determined by the latent root criterion where only components having eigenvalues greater than unity are considered significant. The number of original variables for each dimension is in parentheses

Table III. Total variance explained by extracted principal components

Description	Variable	Non-economics majors		Economics majors	
		Mean	Standard deviation	Mean	Standard deviation
<i>Personality and perception characteristics</i>					
Personality score	PRS	1.8662	3.2422	3.2258	2.8833
Interest factor score (1)	INT1	-0.0731	0.9783	0.7412	0.9249
Individuality factor score (1)	IND1	0.0249	1.0047	-0.2527	0.9281
Individuality factor score (2)	IND2	-0.0089	0.9932	0.0908	1.0788
Precision factor score (1)	PRE1	0.0085	0.9908	-0.0868	1.1023
Precision factor score (2)	PRE2	-0.0480	0.9996	0.4868	0.8781
Precision factor score (3)	PRE3	0.0142	1.0174	-0.1444	0.8010
Precision factor score (4)	PRE4	-0.0221	0.9896	0.2248	1.0915
Precision factor score (5)	PRE5	0.0009	0.9987	-0.0092	1.0295
Structure factor score (1)	STR1	0.0270	0.9948	-0.2742	1.0272
Structure factor score (2)	STR2	-0.0260	0.9988	0.2640	0.9886
Structure factor score (3)	STR3	-0.0215	1.0134	0.2179	0.8343
<i>Other characteristics</i>					
Female	SEX	0.5732	0.4953	0.3870	0.4951
Secondary accounting studies	ACC	0.5095	0.5007	0.2580	0.4448
Secondary business studies	BUS	0.1305	0.3374	0.1612	0.3738
Secondary economics studies	ECO	0.3694	0.4834	0.4516	0.5058
Part-time attendance	ATT	0.1656	0.3723	0.1612	0.3738
Grade point average	GPA	4.6227	0.9531	4.2948	1.0112

Table IV. Descriptive statistics for explanatory variables

For example, Dynan and Rouse (1997) used descriptive statistics to indicate that female economics students generally received lower grades, had lower levels of mathematical preparation, had more difficulty in interpreting graphs, felt less comfortable asking questions in class and were generally less-interested in the subject matter than males. Dynan and Rouse (1997, p. 358) used a regression of the decision to major in economics against gender to conclude that “. . . women were 7.7 percentage points less likely to major in economics than men, a difference that was statistically significant at the 5 per cent level”. Conversely, Chizmar (2000) concluded, “the evidence suggests that, after controlling for relative grades in economics and economics credit hours, the hazard profiles of female economics majors are indistinguishable from their male counterparts”. Nevertheless, a negative sign is hypothesised when economics major is regressed against student gender.

The second set of student characteristics specified relate to experiences in secondary education. It is generally acknowledged that secondary school preparation for university study is linked with the choice of an economics major. One dimension of this work relates to mathematical preparation in calculus, especially in regard to the purported gender bias in economics majors. For instance, Dynan and Rouse (1997) included a maths SAT score, along with dummy variables for pre-calculus, first semester calculus, second semester calculus, multivariate calculus, and linear algebra or higher as indicators of student preparation and aptitude for an economics major.

An alternative dimension of this work, especially in Australia, relates to students continuing study in economics first taken up in secondary school. For example, Lewis and Norris' (1997, p. 9) survey of academic departments reflected a consensus opinion that “school students are taking ‘easier’ courses such as business studies and legal studies rather than economics” and this was eventually reflected in declining enrolments in economics degrees and majors. Anderson and Johnson (1992) touched on this argument with an analysis of economics in Australian secondary schools. They found that while the number of students taken secondary-level economics had declined in all Australian states and territories, the decline had been less in those states where “economics has few alternative business-related courses with which to compete”.

In order to examine the interaction between studies in business-related disciplines at the secondary level and the choice of an economics major three qualitative variables are specified. These are whether the students undertook elective secondary studies in accounting (ACC) (168 students or 48.70 per cent of cases), business studies (BUS) (46 or 13.33 per cent of cases) or economics (ECO) (130 or 37.68 per cent of cases). As an alternative, Dynan and Rouse (1997, p. 356) included a number of questions on their survey “designed to shed some light on the role of tastes and, to some extent, knowledge about economics before arriving at university”. As business-related studies, all three variables could potentially be associated with an increase in the probability of selecting an economics major if the sample included non-business-related disciplines.

However, within the narrower context of a business degree it is expected that secondary school studies in accounting and business will be reflected in an increased likelihood of a non-economics major, while studies in secondary economics will be associated with a higher probability of selecting an economics major. The *ex ante* sign on ACC and BUS is negative, while that for ECO is positive.

The final two variables specified in the analysis relate to additional student characteristics concerned with current attendance and performance. These are whether the student is attending on a part-time basis (ATT) (57 cases or 16.52 per cent of the sample) and their grade point average to date (GPA). To start with, little is known

about any systematic difference between a student's attendance pattern and the choice of major. No particular a priori sign is hypothesised when the choice of an economics major is regressed against a qualitative variable indicating attendance pattern. And second, a number of studies have hypothesised a link between student performance at the tertiary level and the choice of the (more difficult) economics major. Chizmar (2000) and Dynan and Rouse (1997), for example, included allowance for overall student performance in their studies of persistence and choice of major respectively. A positive coefficient is hypothesised.

4. Empirical results

The estimated coefficients, standard errors and p-values of the parameters detailed are presented in Table V. To facilitate comparability, marginal effects are also calculated and included in Table V. These indicate the marginal effect of each outcome on the probability of the choice of an economics major. In order to provide the marginal effects for the continuous variables, the standard normal density function is used with the index predictions evaluated at the sample means. Also included in Table V are statistics for joint hypothesis and likelihood ratio (LR) tests, the McFadden R² as an analogue for that used in the linear regression model, and a Hannan-Quinn (HQ) model specification criterion. Four separate models are estimated. The estimated coefficients and standard errors employing the entire set of student personality, perceptions and other characteristics are shown in Table V columns 1 to 4. The results of estimations using first, the set of personality and perception variables and then the set of other characteristics alone are detailed in columns 5 to 8 and 9 to 12 respectively. A final specification incorporating selected variables from both of these sets of characteristics and personality and perceptions is detailed in columns 13 to 16.

The estimated models are all highly significant, with likelihood ratio tests of the hypothesis that all of the slope coefficients are zero rejected at the .05 level or lower using the chi-square statistic. The results in these models also appear sensible in terms of both the precision of the estimates and the signs on the coefficients. In the full specification, the estimated coefficients for personality (PRS), interest (INT1), precision (PRE2), accounting (ACC) and grade point average (GPA) are significant and conform to a priori expectations. The estimated coefficients indicate that students with a higher personality score or with a higher level of interest in the economics profession are more likely to select an economics major, while those that perceive the profession as being precise or who have completed studies in accounting at secondary school are less likely to select an economics major. The two largest marginal effects on the decision to undertake an economics major are interest in the economics profession (6.8 per cent) and past studies in accounting (27.4 per cent).

These results are generally consistent with the estimated coefficients in the second regression where only the set of personality and perception characteristics are included. However, they differ to the results in the third regression where the model is re-estimated with only the set of other student characteristics. In the third regression past studies in business (BUS) and economics (ECO) are significant, along with part-time attendance (ATT). An incremental contribution of variables F-test is employed to reject the null hypotheses that the economics major model could be estimated on the basis of the nested "no other characteristic effect" [F $\frac{1}{4}$ 4:2617] and "no personality/perception effect" [F $\frac{1}{4}$ 5:2709] models at the 0.01 level, and we may conclude that students' choice of an economics major is a function of both student personality and perceptions of the economics profession, along with the more readily observed student characteristics such as past secondary studies, GPA, gender and attendance pattern.

Variable	Full specification			No other characteristic effect			No personality/perception effect			Final specification			
	Estimated coefficient	Standard error	p-value	Estimated coefficient	Standard error	p-value	Estimated coefficient	Standard error	p-value	Estimated coefficient	Standard error	p-value	Marginal effect
CONS	-0.6380	0.5726	0.2652	-1.7200	0.1467	0.0000	-0.4418	0.4847	0.3620	-1.5243	0.2051	0.0000	
PRS	0.0576	0.0264	0.0289	0.0687	0.0259	0.0082				0.0671	0.0272	0.0137	0.0092
INT1	0.5300	0.1564	0.0007	0.0680	0.4765	0.1459	0.0011	0.0660		0.4982	0.1304	0.0001	0.0685
IND1	0.0248	0.1130	0.8264	0.0032	0.0363	0.1217	0.7649	0.0050					
IND2	0.1416	0.1057	0.1804	0.0182	0.1035	0.1009	0.3051	0.0143					
PRE1	-0.0360	0.1452	0.8041	-0.0046	-0.0690	0.1422	0.6237	-0.0097					
PRE2	0.2130	0.1159	0.0661	0.0273	0.2239	0.1128	0.0472	0.0310					
PRE3	-0.0409	0.1063	0.7007	-0.0052	-0.0627	0.1063	0.5551	-0.0087					
PRE4	0.0840	0.0980	0.3913	0.0108	0.1026	0.0901	0.2547	0.0142					
PRE5	-0.0453	0.1078	0.6740	-0.0058	-0.0071	0.1073	0.9466	-0.0010					
STR1	0.1192	0.1516	0.4317	0.0153	0.0878	0.1469	0.5501	0.0122					
STR2	0.0768	0.1029	0.4553	0.0099	0.0682	0.1017	0.5026	0.0094					
STR3	0.0886	0.1054	0.4007	0.0114	0.0946	0.0999	0.3435	0.0131					
SEX	-0.1298	0.2137	0.5437	-0.0166					-0.2898	0.2048	-0.1150	0.1570	-0.1258
ACC	-0.5781	0.2481	0.0198	-0.0741					-0.5497	0.2143	-0.2180	0.0103	-0.5625
BUS	0.3119	0.3155	0.3228	0.0400					0.1748	0.2784	0.0693	0.5301	0.4050
ECO	0.2390	0.2394	0.3180	0.0307					0.1809	0.2099	0.0718	0.3888	0.2072
ATT	0.0942	0.2996	0.7531	0.0121					0.0700	0.2643	0.0278	0.7910	0.1729
GPA	-0.2110	0.1201	0.0788	-0.0271					-0.1454	0.1069	-0.0577	0.1739	0.3483
l	-81.4693				-87.8400								-87.0021
l(0)	-104.2598				-104.2598								-104.2598
LR	45.5808	0.0003			32.8395	0.0010				14.0638	0.0289		34.5154
HQ	0.6667				0.6422					0.6352			0.5759
R ²	0.2185				0.1574					0.0674			0.1655

Notes: l - log-likelihood, l(0) - restricted slopes log-likelihood, LR - likelihood ratio statistic; p-value of LR calculated using $\chi^2(p)$ where p = number of explanatory variables; HQ - Hannan-Quinn criterion; R² - McFadden R squared; marginal effects calculated at means

Table V. Binary probit model maximum-likelihood estimates

In order to refine the overall specification further, F tests were used to test combinations of coefficients for redundancy and on this basis the variables for IND (F ¼ 1:2276, p value ¼ 0:2943), PRE (0.8391, 0.5226), STR (1.6114, 0.1865), ATT and GPA (1.1669, 0.9999) were excluded from the final specification. Each of the remaining variables was tested in a similar manner, though they failed to be excluded from the final specification. The refined model is presented in columns 13 to 16 of Table V. The likelihood ratio for the refined model is significant at the 1 per cent level of significance, and we may conclude that the explanatory variables as a group can be used to investigate the choice of an economics major. While the R² of the final specification (0.1655) is lower than that of the full specification (0.2185) the Hannan-Quinn (HQ) criteria, reflecting the trade-off between goodness of fit and model complexity, indicates that the final specification is more appropriate (a lower HQ value). It would appear from the final specification that the primary influences on the selection of a major in economics are personality, level of interest in the profession and past studies in accounting. Of these variables, the most significant marginal effect on a choice of an economics major occurs with past studies in accounting. In addition, while several other variables were individually insignificant, including gender and secondary studies in business and economics, they could not be excluded from the model under any conventional criteria.

Finally, the ability of the various models to predict outcomes in students' choice of major accurately is examined. Table VI provides the predicted results for each different model specification. The correct and incorrect percentage figures for the estimated models are in terms of the observed (or actual) value of economics and non-economics majors, total percentages for correct and incorrect percentages are in terms of total observations. Comparisons are made with a constant probability model. Observations in the constant probability results are classified using the predicted probability given by the sample proportion of economics and non-economics majors. These probabilities, which are constant across individuals, are the values computed from estimating a model that includes only an intercept term. The absolute gain is the percentage change of correct predictions of the estimated models over the percentage of correct predictions in the constant probability model. The relative gain is the absolute gain as a percentage of the

incorrect predictions in the constant probability model. These provide a measure of the predictive ability of the estimated models.

For example, of the 314 students who selected a non-economics major, the full model specification predicted 290.45 cases (92.5 percent) correctly, and identified 23.55 students (7.5 per cent) as economics majors. This represented an absolute gain of 1.49 per cent (increase in correct predictions) and a relative gain of 16.52 per cent (improvement over the incorrect predictions) as compared to the constant probability model. For the 31 students who selected an economics major, the model correctly identified 7.35 (23.72 per cent) as economics majors and 23.55 (75.90 per cent) as non-economics majors. Overall, the full specification correctly identified 297.80 (86.32 per cent) as either economics or non-economics majors and incorrectly identified 47.10 students as either economics or non-economics majors (13.68 per cent). This reflected an absolute improvement of 2.68 per cent and a relative improvement of 16.36 per cent over the constant probability model. The Hosmer-Lemeshow goodness-of-fit test statistic in Table VI fails to reject the null hypothesis of no misspecification for the full specification.

	Non-economics majors		Economics majors		Total		Hosmer-Lemeshow	
	Number	Per cent	Number	Per cent	Number	Per cent	Statistic	p-value
<i>Constant probability model</i>								
Correct	285.79	91.01	2.79	8.99	288.57	83.64	NA	NA
Incorrect	28.21	8.99	28.21	91.01	56.42	16.36		
Absolute gain	NA		NA		NA			
Relative gain	NA		NA		NA			
<i>Full specification</i>								
Correct	290.45	92.50	7.35	23.70	297.80	86.32	7.0633	0.5298
Incorrect	23.55	7.50	23.55	75.97	47.10	13.68		
Absolute gain	4.66	1.49	4.56	14.71	9.23	2.68		
Relative gain		16.52		16.16		16.36		
<i>No other characteristic effect</i>								
Correct	289.05	92.05	6.15	19.84	295.20	85.57	4.2880	0.8302
Incorrect	24.95	7.95	24.85	80.16	49.80	14.43		
Absolute gain	3.26	1.04	3.36	10.86	6.63	1.92		
Relative gain		11.56		11.91		11.75		
<i>No personality/perception effect</i>								
Correct	286.93	91.38	3.90	12.57	290.83	84.30	16.1578	0.0402
Incorrect	27.07	8.62	27.10	87.43	54.17	15.70		
Absolute gain	1.14	0.37	1.11	3.58	2.25	0.65		
Relative gain		4.04		3.94		4.00		
<i>Final specification</i>								
Correct	289.09	92.07	6.12	19.76	295.21	85.57	7.2387	0.5111
Incorrect	24.91	7.93	24.88	80.24	49.79	14.43		
Absolute gain	3.30	1.05	3.33	10.77	6.64	1.93		
Relative gain		11.70		11.85		11.77		

Table VI. Observed and predicted values for the binary probit models

These results are broadly comparable to the number and percentage of correct predictions for the no other characteristic effect and no personality/perceptions effect specifications. However, the Hosmer-Lemeshow goodness-of-fit test statistic for the model containing excluding student personality and perceptions rejects the null hypothesis of no functional misspecification and we can conclude this model is functionally misspecified. This provides further support for the argument that students' choice of major is very much a functional of individual personality and perceptions about the profession in which they are considering entry. Overall, the

models examined successfully predict the major that some 86 per cent of students will take, comprised of 92 per cent of non-economics majors and up to 23 per cent of economics majors. Interestingly, the model that excludes the personality and perception effects scores approximately the same number of correct predictions for non-economics majors as the full and final specification (approximately 92 per cent).

However, the percentage of correct predictions for economics majors in this model is much worse (12 per cent) than either the full or final specification (23 per cent and 19 per cent respectively). This would suggest that personality and perceptions are a key indicator of the actual choice of an economics major.

These findings would initially suggest that the choice of major model employed might be more useful in identifying non-economics majors than economics majors. And at first impression, the actual number of correct predictions across all majors appears relatively small. However, it should be noted that the amount of variability in the explanatory variables across all majors is also relatively low, given they are related to very closely related disciplines. Put differently, we would expect that perceptions and interest in the economics profession would be much closer for an accounting and economics major than that between economics and a non-business related discipline in the humanities or physical sciences. This would suggest that an equivalent model applied to a sample of economics majors and, say, non-business related majors, would likely yield a higher proportion of correct predictions.

5. Concluding remarks

The present study uses a binary probit model to investigate the role of student personality, perceptions and other characteristics in determining the choice of major for Australian business students. The current paper extends empirical work in this area in at least two ways. First, and as far as the authors are aware, it represents the first attempt to apply qualitative statistical models of choice of major in Australia. The evidence provided suggests that the choice of an economics major is a function (at least in the context of models of this type) of student personality, interest in the economics profession, and non-economics secondary studies, and to a lesser extent, gender.

Second, the study analyses in detail the varying influences of personality/perception and other student characteristics. The results indicate that students' physical and educational characteristics, whilst in themselves useful indicators of a student's choice of major, may be supplemented by factors associated with student personality and perceptions of the profession. On the basis of the explanatory variables specified, the major of some 86 per cent of students can be correctly identified. Unfortunately, the results do more to identify likely non-economics majors, than to present possible ways to increase the likelihood of students selecting a major in economics.

The policy implications that may be drawn from the analysis are fourfold and are all based on the premise that the economics curriculum is neither fundamentally flawed nor beyond reproach. First, the study indicates that the students who select an economics major have a more positive outgoing personality than business students in general. The differences in personality type may therefore mean that some of the instructional techniques used in economics education may not appeal to all students, and therefore dissuades them from taking an economics major. For example, in introductory economics tutorials there is an emphasis on students presenting ideas and opinions in an open forum. Educators regard this as an integral part of the economics curriculum; but it may be better to introduce students more slowly to such tasks, and only after building the necessary skills and confidence.

Second, it has been shown that the level of student interest in the profession is seen as a major factor in the choice of an economics major. This is important because any policy change will need to recognise that interests remain relatively stable over time, they are not very amenable to change, and probably weigh heavily in the decisions of most students. One policy change may include a more concerted effort to stimulate the interest of students in introductory classes, which may encourage them to change their major to economics. Other changes could include promotional activities by the professional associations, educators and employers to highlight to prospective students the diverse and interesting roles of economists.

There could also be a more concerted effort to communicate to all business students the benefit of incorporating at least some economics into their studies. University educators and administrators can assist this process by providing degrees that incorporate double majors, sub-majors and specialisations in economics, along with double degrees with non-business areas. Of course, the onus then lies with educators to prove that economics has a role to play in these studies and to structure the curriculum accordingly.

Third, it has also been shown that subject choice in secondary school is an important influence on the choice of university major. This highlights the need for secondary school educators and careers advisors to be encouraged and assisted in promoting to students the further study of economics. However, just appealing to existing economics students may not be enough. Alford (1998), for example, links the declining participation rate in Australia, especially by female students, with the decline in secondary school economics and mathematics. This suggests that policies aimed at increasing the participation rate in these subjects in the first instance may ultimately yield benefits for university-level economics enrolments.

Finally, the analysis also found that gender has a role to play in the choice of an economics major. While at least some “gender bias” is removed when perceptions and attitudes to economics are taken into account, the fact remains that female students are much less likely to select a major in economics than their male counterparts. The suggestion that the economics curriculum along with the pedagogy and types of evaluation instruments, includes topics and methodology of less interest to women, and that the evaluation favours male learning styles, is a matter of some concern, especially as female students currently comprise more than 50 per cent of all undergraduates. Possible policy changes include a greater effort by educators to make the economics curriculum more gender inclusive and ensuring that evaluation does not favour male learning styles. More generally, there is also the requirement that teaching faculty are gender balanced and that female students are presented with female role models and mentors.

Of course, the study does suffer a number of limitations, all of which suggest directions for future research. To start with, while the results of the study are suggestive of policy changes, they are not sufficiently developed to provide an empirically feasible guide to economics departments, and mainly reinforce widely held perceptions of the causes of the recent decline in economics majors. It may be possible that other analytical techniques could be used to predict students’ choice of major. For example, some promising advances have been made in the use of neural network models to predict other qualitative outcomes. However, in many cases these have not yet been shown to exhibit any advantage over well-known statistical methods.

A second limitation is that the data used contain no information concerning the large number of other factors likely to impact upon a given student’s choice of major.

For example, Haslehurst et al. (1998) examined the gender bias in economics with specific questions about expected career financial remuneration, promotional opportunities, career path, compatibility with family commitments and the availability of role models. Rumberger and Thomas (1993) also examined future returns to the choice of college major, while Dynan and Rouse's (1997) study included valuable information on economics students' principal reasons for taking economics and the interaction between students' choice of major and the teaching environment. And in a broader context, Pearson and Dellmann-Jenkins (1997) investigated the role of parental influence on a student's selection of a college major.

A third limitation is that the sample on which this study is based is drawn from a single university. While this means that many unspecified influences are held constant, it also suggests that the results could differ from other institutional contexts. For example, in the university selected for the analysis there is a very broad range of majors available in a single business degree and no specific economics degree. The results could then differ from universities that offer economics in a Bachelor of Economics or similar. One direction for future research could therefore entail a sample drawn from several different universities, perhaps in different states.

A final limitation is that studies of students' choice of major need to incorporate more fully economic models of occupational choice. For example, Easterlin (1995) examined the switch to business majors in the 1980s in the context of preferences and the relative returns from alternative occupations. A comparable analysis could potentially be made within alternative business-related disciplines. Regrettably, detailed information of this type was not available.

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