

**THE OTHER SIDE OF TEACHING:
PRIOR LEARNING, LANGUAGE SKILLS, HIGH SCHOOL ACADEMIC
PERFORMANCE, SOCIO-ECONOMIC BACKGROUND AND
MATHEMATICS UNDERTAKEN AT HIGH SCHOOL ALSO MATTER**

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ABSTRACT

Conventional wisdom about good teaching at the tertiary level tells us that teachers should use a variety of techniques to help different types of students to learn. Good teaching is making learning possible by engaging students; adapting methods to suit the students; and using reflective process by the teacher. Our paper challenges this view by exploring the impact of the students' prior learning of economics, English language competency, high school academic performance, socio-economic background and mathematics level undertaken at high school impacts on their academic performance. The aim of this exercise is to ascertain whether these variables have a positive correlation with performance in first year undergraduate economics subjects. A voluntary survey was conducted in tutorials to the large core introductory economics subject for business students enrolled in first year during the semester. Quantitative analysis showed that the variables studied (as above) have a significant impact on student results. On the one hand, this study shows that some students' literacy and numeric skills affect their performance, thus reinforcing the view that teachers can use a variety of techniques to assist a wide range of students to engage in deeper learning. On the other hand, it suggests that there are some aspects of students' performance that are beyond the lecturer's capabilities.

INTRODUCTION

The influence of external factors on student performance in economics has been reported in studies in the USA, UK and Australia. Previous high school study in mathematics has been reported as having an impact on grades at university (Mallik and Basu 2009; Mallik and Lodewijks 2010), as has previous study in economics (Durden and Ellis 1995; Birch and Williams 2006). Other factors, high school entrance score, English language background, socio-economics status and hours of paid work have also been determined as affecting student grades (Camara and Echternacht 2000; Hunt, Lincoln and Walker 2004; Win and Miller 2005; Birch and Miller 2006)

Our paper contributes to the literature by presenting data outlining the most significant variables in determining student grades in a first year economics course at a large university in Australia. We also measured a wide range of variables (about 17) compared to previous studies that usually focused on two to three. Data collection differs from other studies in that demographic and previous study information from

student surveys in tutorials was then cross-referenced with final grades creating the wide range of variables.

Our study aimed to better understand the first year business/commerce students' profile, identify factors affecting student performance in a specific first year economics subject, identify potentially outstanding/weak students and consider strategies to raise standards by providing appropriate supporting/remedial classes.

BACKGROUND AND PRIOR RESEARCH

In its seminal study, the precise effect of high school economics on tertiary economic performance was inconclusive. Saunders (1970) found students with prior knowledge of economics did not receive significantly higher marks at university, but scored higher on general understanding economics tests. Students were seen to gain an understanding and recognition of concepts, but were less well equipped to apply these concepts. Siegfried and Fels (1979) blamed the inconsistent results of prior learning on the large variance in curriculum of high school economics: that 'high school economics' could incorporate economic history, political economy or more university focused economics programs.

However later studies began to place importance on prior subject knowledge and the relationship between high school economics and marks in 1st yr. For example, a US study, (Durden and Ellis 1995) suggest prior knowledge results in a 3% higher grade. Lopus (1997) looked at previous study of economics in more detail and focused on US students who specifically studied units of microeconomics and macroeconomics at high school and found that in general these students had a greater knowledge than students who did no economics. However, if the high school curriculum did not include micro and macro there was no significant difference in performance compared to students who had no prior experience of economics. A Canadian study, Anderson, Benjamin and Fuss (2001), also looked at the effects of prior knowledge in more detail. Their study showed that it only has an effect at tertiary level if the student was relatively successful at high school.

Some Australian studies have been conducted that support the premise. Malik and Lodewijks (2010) found a positive and significant coefficient at the 1% level indicating that prior study assists tertiary grades. Birch and Williams (2006) found that previous study of economics has a higher effect on the lower end of the mark distribution as in, high school economics helps the low-scoring tertiary student the most. Their findings that students who had studied economics in high school had an estimated impact of 5.3% at the 10th quantile of the marks distribution to 1.5 for students at the 90th quantile are in line with earlier overseas studies. Birch and Williams conclude prior knowledge of the subject studied is an important variable to be included in the estimation of the determinants of academic performance.

Mallik and Lodewijks (2010) measure the dummy variable of birth in Australia on performance and find no significant evidence that this has any effect on score. Our survey asked students if **English** was their first language, and if they completed year 12 in Australia.

Camara and Echternacht (2000) found a positive relationship between **high school performance** and subsequent performance in tertiary economics courses. Their findings have been consistent with the body of Australian literature that has emerged since this publication, with most studies presenting high school performance as a proxy for innate student ability (see Birch and Miller 2006; Basu and Mallik 2009 and Mallik and Lodewijks 2010).

In our paper, the national tertiary admission score, the university admissions index (UAI), was not directly measured though its effect was captured by the choice of campus.

Camara and Echternacht (2000) source **socio-economic factors** as increasing tertiary performance in economics and use such proxies as the highest level of tertiary qualification attained by a parent. Similar earlier studies used parents' occupational status (for example, Rubin 1977) and Jackstadt and Grootaert 1980. An Australian study, Win and Miller (2005) found no significant relationship between academic performance and home's economic resources although they asserted that parental educational level matters. This point is consistent with findings by Marks et al (2001) who found parents' occupational stature has a positive effect on student achievement. In this study, we measure the regional locations of students in Sydney that opens up the possibility of capturing the effect of low cost living.

High school mathematics has been seen to be predictive in university economics performance. Mallik and Basu (2009) measured the effect of high school mathematics level of the individual on tertiary economic performance in 1st year microeconomics and macroeconomics performance and found that students achieve higher scores having studied 2-unit, extension I (level 3) and extension II (level 4) mathematics although their sample size was too small to gain a co-efficient for level 4 and, in that, does not show the average marginal benefit for an extra unit of mathematics.

Lagerlöf and Seltzer (2009) interpret the meaning of the coefficient on mathematical performance in high school. They posit that mathematical ability is an approximate measure of both ability and motivation, and use difference-by-difference methods to separate these factors to look at the pure effect of remedial mathematics classes.

In our paper, no such effort has been made to disentangle ability and motivation in mathematics and we instead measure the student's *level* of mathematics at high school, instead of scores. The various levels of mathematics, for the sake of our paper, represent a composite of ability and motivation and is seen as a *pre-disposition* to mathematics that enhanced university performance the higher the mathematical standard attained. The result seems unsurprising, given the level of mathematical involvement in current university teachings, and is consistent with Mallik and Basu (2009).

Confirming the significance of level of mathematics, Malik and Basu (2009) and Malik and Lodewijks (2010) found that students who had studied general mathematics did not perform as well as those who had studied higher levels. Their study concluded the coefficient of the 2 unit maths variable is positive and significant for all models. They conclude study of higher level mathematics at schools generates quantitative skills that in turn lead to better performance in tertiary economics.

Studies as early as Rubin (1977) found students in paid employment outside university hours tend to score lower grades with the assumption that their study time is more limited. More recent research, Hunt, Lincoln and Walker (2004), explored the growth in **term-time employment** and its impact upon academic attainment amongst students at Northumbria University. They conducted three large surveys to full-time undergraduates. This paper evidenced a steady rise in the number of term-time employed students, perhaps indicative of the ongoing funding required for many students to continue their studies. The authors showed that employment did affect academic attainment; particularly for those working longer hours and suggested that restoring grants and other funding obtainment schemes would improve equity and bolster academic attainment.

Metcalf (2003) explored the increasing inequality in higher education driven by the reliance that many students have upon working whilst studying. It was found that students must sacrifice time for employment in order to ease financial pressures (particularly for those students whose families do not provide financial support). As a result, McInnes and James (2000) believe there is a reduction in the quality of higher education, for example as student increase their working hours, they become less engaged in university life.

DATA AND METHODOLOGY

The Subject

Economics for Business in the sample semester was a first-year introductory subject that was compulsory for students completing a Bachelor in Business. This is a combined micro and macro subject. It covers seven weeks of elementary microeconomics and five weeks of macroeconomics that involved theoretical recognition as well as application of concepts.

The assessment structure was a mid-semester examination (20%), a final exam (50%) and an individual media assignment (30%) on market structure that required students to apply a theoretical economic model to a real world example.

The survey

In the sample semester, two voluntary surveys - one conducted at the beginning of the semester and the other at the end of the semester - were handed out to students in tutorials by the tutor. The students were given about 5 minutes to respond. Of over 1100 students, 682 students responded. This led to a workable sample size of 386 students. The sample size was reduced because some students participated in the first survey at the beginning of the semester but missed the second survey due to dropping out, missing the class or deciding not to participate in the final survey.

It was decided to conduct the surveys in the tutorial classes because we anticipated higher student responses in that students would take the surveys more seriously in a smaller class environment with the support from the tutor. Previously, when we conducted surveys in the large lecture theatre, we found that students tend to pay less attention to the survey questions (although we thought that we could capture higher responses). We have also tried using electronic surveys, again with a lower response rate.

The following survey questions are relevant to this paper. The abbreviation in the brackets represents the dummy variable used in regressions

Selected Questions: Student Survey

Demographic information:

1. Did you complete your high school in Australia? (HS_AU)
2. Did you complete your high school in Australia in 2009? (HS_AU_09)
3. Did you study Economics at High School ? (HS_EC)
4. Is English your first language? (ENG)
5. Did you join UTS from another institution such as TAFE, other University or Business college (NonUAI)
6. Are you over 20 years old? (Over20)
7. Are you enrolled at the City Campus or Kuring-gai campus? (Hi_UAI)
8. How many hours do you work per week in paid employment? (HRSW)
_____ hour(s)
9. Which suburb in NSW do you live in? _____ Area code: _____

For local students only:

10. How many units of mathematics did you undertake at high school ?
a) General maths b) 2 unit maths c) 3 unit maths d) 4 unit maths

Family Name: _____

Name: _____

Student number: _____

All questions required a binary response of 'yes = 1' or 'no = 0' except for the question on hours worked in paid employment. Students were asked to provide their names and student identification numbers on the survey forms voluntarily. Once the student had completed all the assessment the survey answers could be matched to the student's final score. This variable is written as SCORE. Thus we developed a balanced one-dimensional data set of student characteristics and their performance in the subject.

REGRESSION RESULTS

Original Regression Model:

$$\begin{aligned} \text{SCORE}_i = & \beta_1 + \beta_2 \text{HS_AU}_i + \beta_3 \text{HS_AU_09}_i + \beta_4 \text{HS_EC}_i + \beta_5 \text{ENG}_i + \beta_6 \text{NonUAI}_i + \\ & \beta_7 \text{Over20}_i + \beta_8 \text{Hi_UAI}_i + \beta_9 \text{HRSW}_i + \beta_{10} \text{CBD}_i + \beta_{11} \text{N}_i \\ & + \beta_{12} \text{NW}_i + \beta_{13} \text{W}_i + \beta_{14} \text{SW}_i + \beta_{15} \text{S}_i + \beta_{16} \text{Math2}_i \\ & + \beta_{17} \text{Math3}_i + \beta_{18} \text{Math4}_i \end{aligned}$$

This analysis has been done to identify the variables that impact upon first year economics students' academic performance, and the extent to which these variables impact on the students' final grade. The overall score result (100%) was regressed against a series of variables as listed on **Table 1**:

Table 1

Variable		Coefficient	se	t-value	p-value	Adj R ²	F-stat
Constant		64.27	5.569	11.542	0.000	0.196	5.369
Students completed high school in Australia	(HS_AU_i)	- 5.161	5.107	- 1.010	0.313		
Students completed Australian high school at 2009	(HS_AU_09_i)	- 1.398	1.616	- 0.865	0.388		
Study Economics at high school	(HS_EC_i)	4.188	1.272	3.293	0.001		
English is the first language	(ENG_i)	3.459	1.531	2.260	0.025		
Non UAI score	(NonUAI_i)	- 3.560	2.457	-1.449	0.148		
Students are twenty years of age or above	(Over20_i)	1.566	2.546	0.615	0.539		
Hi UAI score	(Hi UA_i)	7.426	2.014	3.688	0.000		
Hours worked for paid employment	(HRSW_i)	0.024	0.064	0.380	0.704		
Students residing in Sydney CBD Areas	(CBD_i)	-5.926	2.561	-2.313	0.021		
Students residing in North of Sydney Area	(N_i)	-4.412	2.373	-1.859	0.064		
Students residing in NW of Sydney Area	(NW_i)	-3.546	2.734	-1.297	0.196		
Students residing in W of Sydney Area	(W_i)	-5.838	2.692	-2.168	0.031		
Students residing in SW of Sydney Area	(SW_i)	-6.635	2.379	-2.788	0.056		
Students residing in S of Sydney Area	(S_i)	-5.236	2.325	-2.252	0.025		
2 unit maths at high school	(Math2_i)	5.199	1.641	3.167	0.002		
3 unit maths at high school	(Math3_i)	6.649	1.790	3.714	0.000		
4 unit maths at high school	(Math4_i)	7.096	2.822	2.514	0.013		

The Model selection

The strength of the estimated relationships is not found just in the size of the coefficient, but also in the statistical significance of the variable. A variable is said to be significant if it is unlikely that the result occurred by chance. One measurement of significance is the P-Value. The P-Value can be interpreted as the likelihood that the alternative hypothesis is true in a two-sided null test; or, the value represents the probability that there exists no relationship at a critical level of significance.

There is little use including a variable that is insignificant at the same chosen critical level except to acknowledge that the estimated relationship was not strong. The final model that should be used should show only the variables that are significant at 10% or less. One method to achieve this is to start with the original model and eliminate the variable with the least significance and then run a regression on the new model. This process should then be repeated until all the variables included are significant at 10% or some chosen level of significance.

The original and final regression

Our original model included some variables that were seen to be less significant within the sample. So as mentioned above we eliminated the least significant variable one at a time. Consequently our model evolved from the original model to the final model whereby each variable was significant at the 10% level.

Our original model included 17 explanatory variables and the final model removed 10 of these variables. The elimination process removed the following variables in order: *hours per week in paid work; over 20 years old; completed high school in Australia; entered university through a non-UAI procedure; completed high school in 2009 in Australia; lives in North-West of Sydney; lives in the North of Sydney; lives in the CBD campus; lives in the South; lives in the West*. This leaves the following explanatory variables that are all significant at the 10% level: *Studied economics at high school; English is first language; attends the campus with the higher UAI; lives in the South-West of Sydney; completed 2-unit mathematics; completed 3-unit mathematics; completed 4-unit mathematics*.

THE FINAL REGRESSION MODEL:

$$\text{SCORE}_i = \beta_1 + \beta_4 \text{HS_EC}_i + \beta_5 \text{ENG}_i + \beta_8 \text{Hi_UAI}_i + \beta_{14} \text{SW}_i + \beta_{16} \text{Math2}_i \\ + \beta_{17} \text{Math3}_i + \beta_{18} \text{Math4}_i +$$

The Regression Results

Results for the final version of the model included the following variables:

- Studying economics at high school (HS_EC_i)
- Whether English is the first language (ENG_i)
- Higher UAI scores (Hi_UA_i),
- Areas where the student resides (SW_i)
- Level of mathematics undertaken during high school (Math2_i, Math3_i, Math4_i).

Table 2 summarises the results of the selected model that suggests the most significant variables that impact on student's performance.

Table 2:

Variable		Coefficient	se	t-value	p-value	Adj R^2	F-stat
Constant		54.41	2.076	26.20	0.000	0.193	11.339
Study Economics at high school	(HS_EC _i)	4.151	1.217	3.410	0.000		
English is the first language	(ENG _i)	3.468	1.432	2.421	0.011		
Hi UAI score	(Hi_UA _i)	6.479	1.882	3.443	0.001		
Students residing in SW of Sydney Area	(SW _i)	-2.574	1.531	-1.68	0.094		
2 unit maths at high school	(Math2 _i)	5.681	1.571	3.616	0.000		
3 unit maths at high school	(Math3 _i)	6.977	1.736	4.018	0.000		
4 unit maths at high school	(Math4 _i)	8.258	2.748	3.004	0.003		

Variables were excluded from Table 1 based on sequential t-tests. This final model was also supported by a joint F -test where all the variables were excluded at once (p -value = 0.2726). White F -test on the original model failed to find heteroskedasticity (p -value = 0.3941).

All variables are significant at the 10% level, and this model explains 21% of variation in the total scores for the subject. The F -statistic of 11.30 indicates that the hypothesis that $R^2 = 0$ can be rejected at the 10% level. This model suggests that the overall student marks were made up of a base mark of approximately 54.41 marks plus about 4.1 marks for those who undertook English at high school, an additional 3.5 marks if English is their first language, a further 6.5 marks approximately if they scored a UAI of 92 or above, but about 2.6 marks lower for students who come from the South West Region of Sydney area. Finally, the model also suggests that the more advanced the level of mathematics studied by a student at high school, the higher the estimated score, 5.68 marks higher, 6.97 marks higher and 8.26 marks higher if students undertook 2 unit maths, 3 unit maths and 4 unit maths respectively. These variables can be used as a predictor for the students' overall scores in the subject

DISCUSSION OF RESULTS

Prior Learning

The results from the final model show that a student having studied economics at high school will on average achieve a higher score in first year tertiary economics. As mentioned earlier, Lopus (1997) showed that high school economics performance can have a significant effect on university performance if the high school curriculum included specific units of micro and macroeconomics. Accepting Lopus' findings, we may suspect that Australian high schools on the whole are offering classes similar to university-style economics courses, and that they are of good use to the student upon entering university.

Our survey indicates about 56% of students have never studied economics before joining university. It is not surprising that students who undertake economics subjects at high school performed better because these students have been introduced to some of the economics terminologies, concepts, theories and frameworks and have some pre-conceived ideas how economics works and therefore be able to tackle the subject better at university. Although some may suggest that the material is repeated for these students at university level, students are expected not only learn the economics concepts but need to be able to apply the economic theories for problem solving. Therefore, the students with prior learning experience in economics have a comparative advantage over the others.

Language competency

We find that English as a first language is significant and positive in student performance. Malik and Lodewijks (2010) found that being born in Australia had an inconclusive effect on grades. However, this variable does not capture the pure effect of language as we have captured in this study. Students may be born in Australia but may not have English as their first language, or may have been born overseas in an English speaking country. The variable in Malik and Lodewijks also captures the effects of the many other factors involved in a student's having moved countries. Our study suggests that the pure effect of English is a positive and significant determinant in student grades, even with the quantitative basis for most economics courses. This is not surprising as most economics classes incorporate some economic history, case studies and essay-style assessments. About 70% of students indicated English as their first language.

UAI scores

Attending the campus with the higher entry score has a positive and significant effect on tertiary grades. The entry score may be measuring ability and/or motivation, or we may even say the propensity to digest concepts and ideas. So there should be no surprises about the positive relationship and our result indeed is consistent with most studies of which we are aware. However, the variable is not measuring the UAI directly, due to ethical restrictions acknowledged by the authors, and may capture also the student's preference for one campus over the other based on location or convenience. Nevertheless, we cannot imagine these preferences being correlated with tertiary performance and so can infer that the UAI effect is positive and significant.

Socio-economic background

In our study, each regional location had a positive correlation on score. So students living in the Northern, Western and Southern regions outside of Sydney seemed to score slightly higher. Our study used these three locations as a composite as the omitted dummy variable and looked to see if any other location inside Sydney performed better or worse. The result was that students living in South-West Sydney performed worse on average at the 10% significance level. It is unlikely that this result is capturing the inconvenience of living further away from campus, as other regions would experience the same problems. We can imagine distance being a potential problem with travel time, money spent on transport and the impediment of distance to integrating into university life. Our study produced no such result as each outer region seemed to perform the same except South-West Sydney. One effect that we are perhaps capturing is that of lower socio-economic areas, or areas with inherent

social problems. Studies in similar areas that use (perhaps vague) proxies for socioeconomic standing have shown significant relationships in tertiary economics test-scores, like the aforementioned Camara and Echternacht (2000), and are suggesting a need for universities to address these areas directly.

Mathematics level

Our study concludes what Basu and Malik (2009) suspected in that the more mathematics studied by a student at high school the higher the grade in university economics classes. Our study clearly shows that each successive unit of mathematics results on average in a higher university economics grade. Note that this variable was not measuring pure performance, but rather the amount of mathematics previously attempted. Thus the variable is not a good measure of ability or motivation alone, but rather, the variable is a fairly good proxy for *exposure* to mathematical principals and problem solving. These results then are rather unsurprising given the level of quantitative grounding in university economics courses in Australia, and are consistent with similar studies here and overseas.

Certain variables unexpectedly were found to be insignificant or with a weak coefficient. One such variable was the student's number of paid working hours each week. We could say that an hour at work may come at the expense of an hour of study and that this would cause a negative change in performance. Our result might suggest that this effect is offset by aspects of work that are favourable to student grades. Perhaps work has a motivating effect on the individual, and that less free time may mean more productivity and higher quality study hours. While the motivating component of work might be a possibility, we can imagine it having a diminishing effect on grades as the student works more and that we should see a negative effect on students who work a considerable amount. In our study we find a negative correlation between hours of work and student performance when work exceeds 18 hours/week. However, including a non-linear effect of hours of work per week in the regression produced an insignificant result.

CONCLUSION

Thus our findings show that there are aspects of students' performance that are influenced by experiences beyond the university classroom. How these external factors affect grades can be seen in the following where student A has all the variables positively affecting grades, thus scoring almost 20% more than the base grade and Student B has none of the positive variables and one negative variable thus reducing the base score by 3%.

Student A:

$$54.41 + 4.151 (\text{Eng.}) + 6.479 (\text{Campus A}) + 0 (\text{Not from SW}) + 8.258 (4 \text{ level Maths}) \\ = 73.29$$

Student B:

$$54.41 + 0 (\text{Non-English}) + 0 (\text{Campus B}) - 2.574 (\text{from SW}) + 0 (\text{General maths}) \\ = 51.8$$

In effectively demonstrating the variables influencing grades we could assume measures may be taken to raise standards for selected students. Such measures may include using a variety of techniques to assist lower scoring students to engage in

deeper learning, or Mallik and Lodewijks 'enriched delivery mechanisms' (p. 85) or providing support in the form of remedial classes. However, provision of remedial classes may not be adequate in bringing these students to the level of their classmates. For example, a previous study (Lagerlof and Seltzer 2009) shows that there is little evidence on the effectiveness of these programs. We are currently researching the effectiveness of our trial economics remedial classes on student grades.

Some studies call for the necessity for higher literacy and numeric skills to be undertaken at high school level before studying economics at university (e.g., Mallik and Basu 2009) but unless university admissions policies change that is also out of the control of university teaching staff. Additionally and importantly, our findings and those from other studies apply to current students but are particularly worrying in view of the government policy of widening participation, a issue put forward by Malik and Lodewijks (2010). It can be assumed students targeted by this policy will not have undertaken the high school study shown in our findings and those of others documented in this paper as necessary for successful tertiary performance.

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