An Investigation into the Academic Effectiveness of Class Attendance in an Intermediate Microeconomic Theory Class.

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Increasing rates of absenteeism from university classrooms raises concern about the consequent effect on student learning. This paper adds to a small but growing body of knowledge from Australia and other countries, about the extent of absenteeism and its effect on academic performance. Panel data on class attendance and academic performance in an intermediate microeconomics class at an Australian University are used to estimate several fixed-effects and random-effects models that explicitly account for unobserved heterogeneity among students. We find strong support for the proposition that class attendance has a significant effect on academic performance.

Key words: class attendance, class absenteeism, academic performance

Introduction

Australian universities are undergoing profound changes. Students have changed: larger proportions of people of all age groups are attending university, raising questions about the ability of the typical student to absorb complex and abstract ideas. The majority of students are combining full-time or part-time work with university study; not infrequently full-time work with full-time study! Increasing numbers of mature-age students are studying while working and taking care of families.[1] The learning environment is also different: material that used to be available only in the classroom is now routinely available to students in hard copy or in electronic form. Information technology has arrived in university classrooms causing tension and debate about approaches to teaching and learning. The arguments go under various guises: 'chalk-n-talk' vs. computer/web-based learning/teaching, traditional

delivery versus flexible delivery, classroom vs. student-centred learning.[2]

Concurrent with these changes many Australian academics have noticed a decline in students' attendance in lectures. The same trend has been reported in the United States and research there suggests that students who skip classes perform at a lower level than those who attend regularly (see Marburger 2001; Devadoss and Foltz, 1996; Durden and Ellis, 1995; Romer, 1993; Park and Kerr, 1990; and Schmidt, 1983). Similar evidence is beginning to emerge in Australia (Rodgers, 2001). None of these studies proves that a causal relationship exists between attendance and performance but the strong association that is consistently observed between performance and attendance, like that observed between smoking and lung cancer, is highly suggestive of a causal relationship, even in the absence of controlled experiments.

This paper adds weight to the existing body of evidence. It reports the results of research into the effect of class attendance on academic performance in a microeconomics class at a medium-sized Australian university. Unlike most previous studies, which use cross-section data on attendance and performance, our study is based on panel data, which allow us to control for unobserved heterogeneity among students. Such heterogeneity arises because of different levels of motivation, intelligence, prior learning, and time-management skills. To our knowledge the only published studies to use a panel of observations to estimate the effect of attendance on performance are Marburger (2001), who used data from a principles of microeconomics class in a U.S. university, and Rodgers (2001), who used data from an introductory statistics class in an Australian university. The nature of our panel and our methodology are different from Marburger's but similar to Rodgers'. Like both authors we also find strong evidence that performance is linked to attendance.

The Data

The data used in this study were collected from a class of 131 commerce (business and economics) students who completed an intermediate microeconomics course at a mid-sized Australian university. The class met for two 50-minute lectures and one 50-minute tutorial per week over a 14-week period. Lectures were delivered to the group as a whole and tutorials were held in groups of about 20 students. The same lecturer delivered all the lectures and the same tutor, who was not the lecturer, conducted all the tutorials.

The ideal data for a study such as this would come from a controlled experiment in which students are randomly assigned to groups with exogenously determined attendance levels, one of which is zero attendance. Such random assignment was not possible because university

policy requires that lecturers treat all students equally. The students, therefore, were free to decide which classes to attend and which classes to skip. Attendance at all lectures and tutorials was recorded. In an effort to ensure that recording attendance did not affect student behaviour, students were assured repeatedly that the attendance data would be used for research only and would have no effect on their grades.

Assessment in the course had three components: a final examination (with a weight of 60 per cent), a mid-semester test (20 per cent), and a test based on tutorial work (20 per cent). The final examination and mid-semester test were constructed and graded by the lecturer and were based on the theory and the applications that were discussed in the lectures. The 50-minute mid-semester test (held in week 8) consisted of 20 multiple-choice questions and two short-answer questions. The three-hour final examination consisted of 70 multiple-choice questions and three short-answer questions. The 35 multiple-choice questions and the one short-answer question that examined material from weeks one through seven are referred to below as 'Part A' of the final exam and the 35 multiple-choice questions and the two short-answer questions that examined material from weeks eight through 14 are referred to as 'Part B' of the final exam. Tutorials were used to address student questions about course content and to review problems and numerical exercises of the type found at the end of each chapter in most intermediate microeconomics textbooks. The tutorial test was held at the end of the semester and the questions were a subset of the numerical problems (with slight modifications) that were discussed in the tutorials. The tutor constructed and graded the tutorial test under the supervision of the lecturer.

Ideally in a study such as this, a 'blind' assessment procedure should be used whereby someone other than the lecturer or tutor independently constructs and grades the assessment tasks. Limited resources and university assessment policy did not allow for this. Therefore, it was important for this study that actions of the lecturer or tutor did not advantage students with high attendance rates over those with low attendance rates. For several reasons, we believe that no such bias was introduced.

First, all students had equal access to the following learning resources:

- The subject outline in which topics and the corresponding chapters and sections of the textbook were listed. The subject outline also provided an explanation of the forms of assessment, and a guide to the content and scheduling of the three assessment tasks.
- The textbook, which could be purchased or borrowed from various student resource centres (such as the library). The textbook is a standard North American intermediate microeconomic theory text currently used

in many universities. All lecture and tutorial material was consistent with, and almost identical to, a subset of the content of the textbook and its study guide, except for some additional treatment on demand elasticity, market failure, and game theory, and a number of Australian examples.

- A complete set of PowerPoint handout notes generated from PowerPoint presentations used in lectures. These notes could be purchased or borrowed from various student resource centres. The additional material referred to in the previous point was included in the PowerPoint notes. The notes contained cross-references to corresponding discussion in the textbook. These notes were complete in the sense that they contained all definitions, discussions, examples and diagrams presented by the lecturer in lectures. Sections and chapters of the textbook that did not contain examinable material were indicated in the notes. Concepts, diagrams and explanations that the lecturer regarded as important (and hence might have a higher probability of being included in an examination), were clearly indicated as important in the notes. By necessity, the notes did not contain PowerPoint animation (such as diagram builds), colour and sounds, in-class gestures, jokes and the personal enthusiasm of the lecturer.
- The student study guide (companion to the textbook), which could be purchased or borrowed from various student resource centres (such as the library). The study guide provided chapter summaries, review of important concepts, and practice questions (with brief answers).
- The course Web site (WebCT) provided an open bulletin board, a class email system, various course resources such as practice questions and some answers, and hyperlinks to useful and interesting sites.
- Practice questions, which were available in various student resource centres (in hardcopy form) and on WebCT. Two weeks prior to a test or exam the lecturer made available (in the library and on WebCT) a set of practice questions which included approximately 200 multiple choice questions (with answers) and approximately twenty examples of the type of short answer questions (without answers) that might appear in the test.[3] Students were encouraged to post their own answers to, and comments on, practice questions onto the bulletin board of WebCT, and to seek help from the lecturer and/or tutor during their scheduled consultation hours.

The only three components of lectures not directly available to students who missed classes were:

- Some contemporary topical examples (for example: discussion of the US FTC case against Microsoft, privatisation of Australia's telecommunications industry, and deregulation of Australia's dairy industry).

- Discussions arising from in-class student questions and comments.
- Participation in small in-class exercises and problems.

It is possible that understanding and recall were enhanced by such classroom discussion and activity. Overall, however, the lecturer is of the opinion that all students had equal access to the examinable content of the course.

The second reason for believing that the lecturer or tutor did not advantage frequent attendees was that all students, including those with low attendance rates, had equal access to information about the form and content of tests and the examination. It is a standard policy of this lecturer that he does not respond to questions from students, or engage in conversations with students about the specific content of any test or examination, other than during the regular class period immediately prior to the test or exam. This policy was announced on WebCT as well as in class. The tutor was informed of this policy and asked to adhere to it. Students with questions about the form and/or content of a test/exam were encouraged to submit their questions in writing (hardcopy or email). Appropriate questions were answered in the last class prior to the test/examination and the lecturer posted the questions and his responses to the bulletin board of WebCT. Three weeks prior to each assessment task, the test/exam instruction page was provided in hardcopy and posted on WebCT. It is likely that the high volume of information provided about form and content of the tests and the final examination was sufficient to swamp any small hints that the lecturer may have inadvertently uttered in class.

Finally, students were made aware that the questions on the tutorial test would be based on problems discussed in the tutorial classes. Students were informed of this verbally, in hardcopy form in the subject outline, and were reminded of this on WebCT. Problem sets and review questions for tutorial discussion were made available in class (hardcopy), on the lecturer's and tutor's office doors, and on WebCT. Tutorial problems and questions were selected from the study guide accompanying the textbook and from end-of-chapter problems and exercises in the textbook. Students were encouraged to work together on the problem sets and to post their answers to WebCT's bulletin board. Answers to these problems were presented and discussed in the tutorials. Answers were not made available to students in hardcopy form although the study guide provided brief answers to the problems. However students who missed a tutorial could visit the lecturer and/or tutor during scheduled consulting times (which totalled about 12 hours per week), or by appointment, to obtain explanations of the answers to problems. It was casually observed by both the lecturer and tutor that the students who made most use

of office consultations were those who had high rates of class attendance.

The data set used in this study includes attendance at 10 of the 14 lectures in each of the first and second halves of the semester and at 12 of 13 tutorials. Lecture attendance during the first two weeks was not included in the data set because of noise associated with class time devoted to administrative matters, review of basic concepts and definitions, and student 'shuffling' as they made final 'drop/add' choices. Lecture attendance in week eight was not included in the data set because one class period was used for the test and much of the previous class period was devoted to organizational matters relating to the test. For similar reasons lecture attendance in week 14 was not included. Attendance at tutorials was recorded in weeks two though seven and weeks nine through 14. There was no tutorial in week one and the tutorial in week eight was used for review. All measures of attendance were expressed as percentages of the maximum possible number of classes.

Of the 131 students who completed the course, 118 took the final examination, the mid-semester test and the tutorial test at the scheduled times. The remaining 13 students missed one or more of the regular assessment tasks and so took different tests/exams or performed other make-up tasks. All observations relating to these 13 students were excluded from the data set because their assessment tasks were not identical to those of the major group. There may be some validity to the argument that students who attended only a few classes cannot be regarded as legitimate members of the class for the purpose of this study. To accommodate this view two different data sets were constructed:

- Data set A included all 118 students who completed all regular assessment tasks.
- Data set B included only the 82 students who completed all regular assessment tasks and attended at least nine out of 20 lectures and at least five out of twelve tutorials.

The variables used in the analysis are listed and their descriptive statistics are reported in Table I.

On average, the 118 students attended 68.4 per cent of lectures in the first half of the semester and 54.5 per cent of lectures in the second half of the semester. Tutorial attendance throughout the semester was higher than lecture attendance: the 118 students attended, on average, 72.5 per cent of tutorials. Performance on the mid-semester test was lower than performance on the final exam: the average score on the mid-semester test was 54.6 (out of 100) while the average scores on parts A and B of the final examination were 61.4 and 64.3 (out of 100), respectively. On average students performed better on the multiple-choice components of the mid-semester test and final examination than on the corresponding test

or examination as a whole. The average score on the tutorial test was 65.2 (out of 100). The 82 students with better attendance records had higher levels of performance than all 118 students on the corresponding assessment task. Like the group as a whole these frequent attendees, on average, attended more tutorials than lectures, attended more lectures in the first half of the semester than in the second half of the semester, performed better on the final examination than on the mid-semester test and performed slightly better on multiple-choice questions than on multiple-choice and short-answer questions combined. Their average score on the tutorial test was 70.2 (out of 100).

TABLE I
Descriptive Statistics

Variable	Mean %	Standard Deviation
Based on all 118 students.		
Lecture attendance, 1st half of semester	68.4	24.5
Lecture attendance, 2nd half of semester	54.5	31.7
Tutorial attendance	72.5	25.7
Score on mid-semester test	54.6	17.6
Score on final exam, Part A	61.4	16.4
Score on final exam, Part B	64.3	17.7
Score on multiple-choice of mid-semester test	63.3	19.2
Score on multiple-choice of final exam, Part A	63.7	14.8
Score on multiple-choice of final exam, Part B	69.3	17.2
Score on tutorial test	65.2	24.5
Based on the 82 students who attended at least 9 out of 20 lectures and at least 5 out of 12 tutorials.		
Lecture attendance, 1st half of semester	78.7	19.0
Lecture attendance, 2nd half of semester	70.0	21.7
Tutorial attendance	81.8	16.0
Score on mid-semester test	56.7	17.3
Score on final exam, Part A	63.3	15.1
Score on final exam, Part B	67.6	16.5
Score on multiple-choice of mid-semester test	66.0	18.8
Score on multiple-choice of final exam, Part A	65.8	13.0
Score on multiple-choice of final exam, Part B	72.1	16.0
Score on tutorial test	70.2	19.6

The Model

We hypothesize that academic performance in this microeconomic theory course is a function of the student's class attendance and other variables some of which are unobservable, such as the student's motivation

and aptitude for the subject matter. The unobserved heterogeneity among students is modelled using both fixed-effects and random-effects regressions in which the dependent variable is performance by student i on assessment task t measured as a score out of 100 (P_{it}) and the independent variable is student i's percentage of classes attended on which assessment task t is based (A_{it}). Dummy variables for all but one of the T assessment tasks, D_2, D_3 ...D_T, were included as independent variables.

The fixed-effects model (FEM) is:

$$P_{it} = \alpha_i + \beta A_{it} + \gamma_2 D_2 + \gamma_3 D_3 + \ldots + \gamma_T D_T + \varepsilon_{it} \qquad (i=1,2,..n;\ t=1,2,..T) \qquad (1)$$

where ε_{it} is an error term that is identically and independently distributed with $E(\varepsilon_{it}) = 0$, $Var(\varepsilon_{it}) = \sigma_\varepsilon^2$. The fixed-effects model was estimated using LIMDEP's least-squares-dummy-variable routine (Greene, 1998, pp.318-325).

The random-effects model (REM) is:

$$P_{it} = \alpha + \beta A_{it} + \gamma_2 D_2 + \gamma_3 D_3 + \ldots + \gamma_T D_T + \varepsilon_{it} + u_i \qquad (i=1,2,..n;\ t=1,2,..T) \qquad (2)$$

where $\varepsilon_{it} + u_i$ is an error term with $E(\varepsilon_{it}) = E(u_i) = 0$; $Var(\varepsilon_{it} + u_i) = \sigma^2 = \sigma_\varepsilon^2 + \sigma_u^2$; $Cov(\varepsilon_{it}, u_j) = 0$ for all i, t and j; $Cov(\varepsilon_{it}, \varepsilon_{js}) = 0$ for $t \neq s$ or $i \neq j$; and $Cov(u_i, u_j) = 0$ for $i \neq j$. $Cov(\varepsilon_{it} + u_i, \varepsilon_{is} + u_i) = \rho = \sigma_u^2 / \sigma^2$ for $t \neq s$, that is, for a given student the errors on different assessment tasks are correlated because of their common component, u. The random-effects model was estimated using LIMDEP's generalized-least-squares routine (Greene, 1998, pp.318-325).

In both the FEM and the REM, β measures the effect of attendance on performance in any given assessment task. The null hypothesis is that β equals zero, which means that attendance has no effect on performance.[4] Five different versions of the FEM and REM were estimated, each with a different set of assessment instruments that were used to obtain the observations on performance, P_{it}. In the various versions of the model that were estimated, T=2 or T=3 depending upon the number of performance-attendance observations per student in the data set.

Results

Results of estimating the fixed-effects model (FEM) and the random-effects model (REM), are given in Table II. For comparison purposes we also report the ordinary least squares (OLS) estimation of the regression of P_{it} n A_{it} and the assessment dummies. The coefficients on attendance, β, from the five versions of the FEM, REM and OLS model appear in columns 1 through 5.

TABLE II
Effect of Attendance on Performance
(Based on all 118 students)

	Measures of Performance				
	MS test; Final (B); Tut test.	Final (A); Final (B); Tut test.	MS-test- MC; Final (B)-MC.	Final (A)-MC; Final (B)-MC.	MS-test- MC; Final (A)-MC; Final (B)-MC.
	(1)	(2)	(3)	(4)	(5)
MODEL*					
FEM:					
Attendance coeff	0.1547	0.1161	0.1491	0.1109	0.1300
(P-value)	(0.0003)	(0.0036)	(0.0222)	(0.0186)	(0.0132)
R-squared	0.7337	0.7417	0.7781	0.8505	0.7085
REM:					
Attendance coeff	0.2117	0.1779	0.1951	0.1500	0.1715
(P-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R-squared	0.1884	0.1373	0.1327	0.1273	0.1188
OLS:					
Attendance coeff	0.2770	0.2614	0.2123	0.1793	0.1959
(P-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R-squared	0.1884	0.1373	0.1327	0.1273	0.1188
No. of observations	354	354	236	236	354
F test of FEM vs OLS	4.007	4.660	2.883	4.795	4.028
(P-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LM test of REM vs OLS	84.93	97.59	27.64	50.01	88.63
(P-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Hausman test of FEM vs REM	n.a.	n.a.	0.91	1.52	1.30
(P-value)			(0.6356)	(0. 4687)	(0.7299)

* Dummy variables for two of the three assessment instruments were included in the models whose results are reported in columns 1, 2 and 5. A dummy variable for one of the two assessment instruments was included in the models whose results are reported in columns 3 and 4.

In the version of the models reported in column 1 each student contributes three observations: performance on the mid-semester test, which covered lecture material from weeks one through seven, coupled with lecture attendance in the first half of the semester; performance on Part B of the final examination, which covered lecture material from weeks eight through 14, coupled with lecture attendance in the second half of the semester; and performance on the tutorial test coupled

with tutorial attendance. The coefficient on attendance in the FEM indicates that attending an extra one per cent of classes increases performance in the subject by 0.1547 percentage points. The FEM 'explains' 73.37 per cent of the variation in performance among students on the different tests. According to the REM the increase in performance is 0.2117 percentage points. Both coefficients are statistically different from zero at very small levels of significance. As anticipated, the coefficient in the OLS model (0.2770) overstates the effect of attendance on performance compared with the other two models. The F-test and Breusch and Pagan's Lagrange multiplier test indicate that the OLS model should be rejected in favour of the FEM and REM respectively. Based upon the FEM (REM), a student who attended all classes is predicted to score 5.41 (7.41) percentage points higher than a student with the average attendance rate, which was approximately 65 per cent of classes.[5]

The version of the models reported in column 2 was estimated using the same variables as those in column 1 except that the student's performance on the mid-semester test was replaced by the student's performance on Part A of the final examination, which examined lecture material from weeks one through seven. The coefficients on attendance in column 2 are statistically different from zero at very small levels of significance but are smaller than those in column 1. This apparently smaller effect of attendance on performance may have occurred because the mid-semester test was held in closer proximity to the lectures covering the examinable material than was the final examination.

As stated previously, the lecturer believes that he did not provide privileged information about the content of any test or examination during lectures. However, if any 'tips' were (unconsciously) given they would probably have had more effect on students' answers to the short-answer questions, which focus upon a few topics, than on students' responses to the multiple-choice questions, which are more diverse in their coverage. For this reason, several versions of the models were estimated in which performance was measured using only the multiple-choice components of the mid-semester test and final examination. In the version of the models reported in column 3 each student contributes two observations: performance on the multiple-choice component of the mid-semester test coupled with lecture attendance in the first half of the semester; and performance on the multiple-choice component of Part B of the final examination coupled with lecture attendance in the second half of the semester. In column 4, the variables are the same as those in column 3 except that the student's performance on the multiple-choice component of Part A of the final examination replaces performance on the multiple-choice component of the mid-semester test. In column 5, each student

contributes three observations: performance on the multiple-choice component of the mid-semester test coupled with lecture attendance in the first half of the semester; performance on the multiple-choice component of Part A of the final examination coupled with lecture attendance in the first half of the semester; and performance on the multiple-choice component of Part B of the final examination coupled with lecture attendance in the second half of the semester.

The coefficient of attendance is significant at the five per cent level in all models reported in columns 3, 4 and 5. In each of these three versions, the F-test favours the FEM over the OLS model, the Lagrange multiplier test favours the REM over the OLS model and Hausman's test suggests that the REM is preferred to the FEM. This is an interesting outcome because the REMs produce larger effects of attendance on performance than the FEMs, the coefficient ranging from 0.1500 in version four of the REM to 0.1951 in version three of the REM.

Table III provides information on the sensitivity of the attendance coefficient to the inclusion in the data set of students with atypically low levels of attendance. The same versions of the FEM, REM and OLS model as are given in Table II are estimated but only students who attended at least nine of the twenty lectures and at least five of the 12 tutorials surveyed during the semester are included in the data set on which Table III is based. The results in Table III are almost as strong as those in Table II. In seven out of ten cases the coefficient of attendance is a little smaller in Table III than in the corresponding model in Table II but it is statistically different from zero at the five per cent level of significance in all but one case. The F-test consistently favours the FEM over the OLS model, the Lagrange multiplier test consistently favours the REM over the OLS model and Hausman's test consistently favours the REM over the FEM.[6]

Summary and Conclusions

We have investigated the effect of absenteeism on performance in an intermediate microeconomics class of business and economics students at a medium-sized Australian university. We found absenteeism from lectures and tutorials to be common: on average, students attended 62 per cent of lectures, 73 per cent of tutorials and 65 per cent of all classes (lectures and tutorials) during the semester. Lecture attendance declined throughout the semester from 68 per cent in the first half to 55 per cent in the second half of the semester.

TABLE III
Effect of Attendance on Performance
(Based on the 82 students who attended at least
9 lectures and at least 5 tutorials)

	Measures of Performance				
	MS test; Final (B); Tut test. (1)	Final (A); Final (B); Tut test. (2)	MS-test- MC; Final (B)-MC. (3)	Final (A)-MC; Final (B)-MC. (4)	MS-test- MC; Final (A)-MC; Final (B)-MC. (5)
MODEL*					
FEM:					
Attendance coeff	0.1583	0.0911	0.1975	0.1100	0.1537
(P-value)	(0.0057)	(0.0775)	(0.0161)	(0.0472)	(0.0175
R-squared	0.7189	0.7304	0.7480	0.8375	0.6693
REM:					
Attendance coeff	0.1904	0.1295	0.1975	0.1108	0.1565
(P-value)	(0.0002)	(0.0061)	(0.0129)	(0.0419)	(0.0026)
R-squared	0.1592	0.0797	0.0817	0.0820	0.0694
OLS:					
Attendance coeff	0.2423	0.2085	0.1985	0.1414	0.1591
(P-value)	(0.0000)	(0.0003)	(0.0028)	(0.0114)	(0.0020)
R-squared	0.1592	0.0797	0.0817	0.0820	0.0694
No. of observations	246	246	164	164	246
F test of FEM vs OLS	3.958	4.797	2.612	4.592	3.605
(P-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LM test of REM vs OLS	59.49	73.42	16.7	34.06	53.62
(P-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Hausman test of FEM vs REM	n.a.	3.60	0.00	0.01	n.a.
(P-value)		(0.3083)	(0.9999)	(0. 9928)	

* Dummy variables for two of the three assessment instruments were included in the models whose results are reported in columns 1, 2 and 5. A dummy variable for one of the two assessment instruments was included in the models whose results are reported in columns 3 and 4.

Our estimates of the effect of attendance on performance are based on fixed-effects and random-effects regression models, which were estimated using panels of observations on 118 students in the class. Each observation in a panel consists of the student's performance on a particular test and his or her attendance at those classes in which material examined on that test was taught. The methodology takes account

of unobserved heterogeneity among students, which is an improvement over the cross-section regressions that most previous studies of the effect of attendance on performance have used. A statistical test, in general, judged the random-effects model to be superior.

In all versions of the models that were estimated the coefficient of the attendance variable, which is the marginal effect on performance (as a score out of 100) of a one-percentage-point increase in attendance, was positive and statistically highly significant. Different versions of the random-effects model yielded coefficients from 0.1108 to 0.2117. Different versions of the fixed-effects model yielded coefficients from 0.0911 to 0.1975. Using these upper and lower bounds for a hypothetical student who has an average attendance rate of 65 per cent over all classes, we predict that this student's score will be 3.9 to 7.4 percentage points (based on the random-effects model) or 3.2 to 6.9 percentage points (based on the fixed-effects model) lower than if attendance had been perfect, *ceteris paribus*. This loss would certainly mean the difference of a letter grade for many students.

Our results add strong support to the conclusions of previous published research in this area. Class attendance does matter! And it matters for students who are well advanced in their university studies. In fact, the effect of attendance on performance observed for this group of students studying intermediate microeconomics is larger than that observed in the only other study of the phenomenon based on Australian data (Rodgers, 2001), which used data on students most of whom were in their first and second years of university study. This suggests that the strength of the effect is likely to differ in different situations. One direction for future research is to investigate the reasons why students absent themselves from lectures and the extent to which they can and do compensate for missing lectures through private study.

NOTES

1. In 1987, 7.7 per cent of 15–19 years olds, 9.9 per cent of 20–24 year olds and 2.2 per cent of 25–64 year olds attended university. By 1997, these figures had risen to 13.3 per cent of 15–19 years olds, 19.3 per cent of 20–24 year olds and 3.2 per cent of 25–64 year olds (Australian Bureau of Statistics (ABS), 1998, Table 5.4, p.50). In 1997, 3.1 per cent of full-time university students were employed full-time and 45.1 per cent were employed part-time. Also, 69.6 per cent of part-time university students were employed full-time and 19.5 per cent were employed part-time (ABS, 1998, Table 5.27, p.66). The most commonly stated reasons for not

completing a university qualification are work-related reasons; for females, personal and family reasons are also important (ABS, 1988, p.65).

2. Some university administrators seem to believe that information technology (IT) can be used to devise computer-based learning environments in which most, if not all, of the attributes of good teaching (except the human element) can be embedded and delivered to multitudes of students at near zero marginal cost. The problem with this position is that the human element may be crucial.
3. Students did not have prior access to any of the questions actually used in the mid-semester test or the final examination.
4. For the benefit of those unfamiliar with panel-data models we point out that differences among students in factors that affect performance (other than attendance) are captured either in the individual-specific constant, α_i, in the FEM or in the individual-specific error term, u_i, in the REM. Observable factors that remain constant for a given student, such as gender or the grade obtained in introductory microeconomics, would produce perfect multicollinearity if included in the FEM. Such observable variables could be included in the REM but the authors found that the estimated value of β changed little from those reported in this paper when various combinations of such variables were included in the REM.
5. LIMDEP was unable to compute Hausman's statistic in this version of the REM and FEM, nor in another three of the 10 sets of results presented in Tables 2 and 3. However, in all six cases where the Hausman statistic could be computed it favoured the REM over the FEM.
6. We also tested the sensitivity of our results using a third data set that included only the 63 students who completed all regular assessment tasks and attended nine through 17 lectures and at least five tutorials. Again, the REM was favoured over the FEM by Hausman's test. The coefficient on attendance in the REMs ranged from 0.1078 with a P-value of 0.0583 (version 2) to 0.2328 with a P-value of 0.0011 (version 3).

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