Measuring the impact of educational interventions on the academic performance of black academic development students

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Abstract

This article uses statistical analysis to estimate the impact of educational interventions in the first and second-year microeconomics courses on black academic development students' examination and final course marks. The results suggest that the educational interventions in the first and second years had a positive impact on the academic performance of the academic development cohorts, relative to a comparable group of mainstream students, in both the first and second-year courses. The results imply that the impact of interventions is more pronounced in respect of black students, and that the determinants of academic performance differ for black students relative to the student body as a whole. Finally, the implications of the results for education policy and research are considered.

Key words: academic development, academic performance, economics education, educational interventions, microeconomics, multivariate analysis, South Africa

Introduction

The poor academic performance of students at South African tertiary institutions is cause for concern and is reflected in low graduation rates across the sector (Scott et al. 2007; Yeld 2009). Of particular concern is the relatively poor academic performance achieved by students who come from socially and educationally disadvantaged backgrounds (Cross and Carpentier 2009). In response to this situation, tertiary institu-

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tions have introduced a variety of academic development (AD) programmes and courses designed to enable such students to realise their full academic potential (Scott 2009).

The purpose of an AD course in economics is to enable students to develop their learning, writing, quantitative, study and English language skills, so that they are able to achieve success in a particular course and in subsequent mainstream courses (courses that make up the standard three and four-year degree programmes in the Humanities and Commerce faculties) in Economics (Edwards 2000; Smith 2004; Smith and Edwards 2007; Smith 2009). In addition, the courses are also designed to facilitate students' understanding of the subject.

However, despite the use of educational interventions in economics courses, and other courses at South African tertiary institutions, relatively little research has been carried out to test the efficacy of these interventions in improving the academic performance of students taking AD courses (Smith and Edwards 2007; Smith 2009).

The empirical aims of this study are to measure, firstly, the impact of educational interventions in first and second-year microeconomics on the academic performance of black (according to self-declaration on the university's application form; as opposed to white, Indian, coloured and other) AD students in these two courses relative to the academic performance of a comparable group of black students drawn from the mainstream cohorts. The second empirical aim is to identify the key determinants of academic performance for black students. This makes it possible to identify the black students who are most likely to succeed in the two courses, and to enable educators to develop their course materials to improve students' academic performance. For example, if a high grade in mathematics is found to be an important determinant of academic success only for black students, then additional support can be made available to selected students who have achieved relatively low grades in this subject.

The focus on black students is warranted as they are the most affected by apartheid system that operated in South Africa until 1994 (Terreblanche 2002) and they exhibit the lowest gross participation rate (Scott et al. 2007). Also, the chief purpose of AD courses and programmes is to facilitate the access of students from socially and educationally disadvantaged backgrounds; the majority of these students are black people.

In general, previous studies (Van Walbeek 2004; Parker 2006; Parker 2007; Horn and Jansen 2009; Dlomo et al. 2011; Horn et al. 2011) have focused on the identification of the chief determinants of academic performance for mainstream students in first-year or second-year Economics. A smaller set of studies (Edwards 2000; Smith and Edwards 2007; Smith 2009; Smith and Ranchhod forthcoming) has, however, focused on measuring the impact of educational interventions on the academic performance of AD students.

This study carries forward the work reported by Smith and Edwards (2007), Smith

(2009), and Smith and Ranchhod (forthcoming). Smith and Edwards (2007) used the cohort for a single year to test the efficacy of an AD course in first-year microeconomics on students' academic performance in the first-year course and in subsequent courses in macroeconomics and microeconomics, relative to a comparable group drawn from the mainstream, conditional on a selection of control variables. The key findings were that students who took the AD course outperformed a comparable mainstream group in the first-year microeconomics examination, and by an average of 10,0 percentage points in the *second-year* microeconomics examination. The latter result suggests that the skills acquired in a first-year AD course in microeconomics persist into further years.

Smith (2009) pooled several first-year cohorts and Smith and Ranchhod (forthcoming) pooled several second-year cohorts. Both studies reported that educational interventions were effective in improving the academic performance of AD students relative to their peers in the mainstream.

That said, the proportion of black students included in these studies did not exceed 60% for AD students and 30% for mainstream students. As previously noted, it is important to confirm whether the educational interventions are effective in improving the academic performance of black AD students, and whether the same variables are as statistically significant ($p<0,05$) in explaining the academic performance of black students as they are in explaining the academic performance of the mainstream student body as a whole.

Following Smith (2009) and Smith and Ranchhod (forthcoming), the data for six cohorts including some 600 observations is pooled: this makes it possible to test the effect of the educational interventions over several years. The Heckman two-step estimation is used to account for the sample-selection problem that arises, as not all the students who started the course wrote the final examinations (Heckman 1979). The larger sample size and the Heckman two-step estimation make it possible to generate a more robust set of results than was previously the case (Parker 2007; Smith 2009). Secondly, the academic performance of each student taking the second-year microeconomics course is tracked until such time as the student passes, withdraws from or is excluded from the course. Thirdly, the effect of the educational interventions on the throughput rates achieved by the AD cohorts for both first and second-year microeconomics is calculated and compared with that achieved by the comparable mainstream group.

The study is conducted in two parts. Firstly, the academic performance of the students taking the first-year AD course in microeconomics (ECO1010H) is compared with the performance of students doing a comparable mainstream course (ECO1010S). Secondly, the effect of the educational interventions in the first and second-year microeconomics courses on the academic performance of the AD cohorts in the second-year microeconomics course is assessed relative to the same mainstream group (ECO1010S

cohorts). At the same time, the key determinants of black students' academic performance are identified.

The structure of the article is as follows. In Section 2 the AD and mainstream courses in first-year microeconomics, and the mainstream course in second-year microeconomics (ECO2003F), are described, as is the nature of the educational interventions. In Section 3 the empirical method used in this article is presented and estimation issues are discussed. Section 4 considers the data and discusses the results. Section 5 discusses the implications of the findings, and Section 6 concludes the article.

Characteristics of the academic development and mainstream courses in microeconomics

First-year courses

The AD course (ECO1010H) and the mainstream course (ECO1010S) in first-year microeconomics are described in Smith and Edwards' 2007 article. In brief, mainstream students take first-year microeconomics in the first semester (ECO1010F). If students fail this course they repeat it in the second semester (ECO1010S). In contrast the AD course is a whole-year course, the content of which mirrors that of the shorter single-semester mainstream courses, and tests and examinations are set to the same standard. Indeed, the ECO1010S and AD cohorts wrote the same final examination at the same sitting in each of the years 1999 and 2001–2005.

There are several important differences between the AD and mainstream courses with respect to the structure, content, teaching approach and assessment. AD classes are relatively small (80 to 120 students) relative to the size of mainstream lecture groups (150 to 400 students). Greater emphasis is placed on using the tutorials as a vehicle to develop students' essay-writing skills and their referencing and comprehension techniques. Students take double-period microeconomics, and language and communication tutorials, and tutors for both these tutorials are chosen on the basis of their subject knowledge, their ability to facilitate learning and transmit knowledge, and the degree of their commitment to enabling AD students to make a success of the microeconomics course. In contrast, the mainstream microeconomics tutorials pay less attention to the development of students' meta-learning skills. Further, no language and communication tutorials are offered, and tutors receive less training and support than the tutors running the AD tutorials.

The assessment of AD students is more varied than that of mainstream students. In addition to the tutorials, AD students are required to complete three essays during the year, and to write four tests in addition to the final examination. Tests include multiple-choice and structured/essay questions in the ratio of about 30 to 70. In contrast, mainstream students are not required to submit essays and their tests consist solely of multiple-choice questions.

Second-year course

Prior to 2003, AD students who successfully completed ECO1010H went on to the second-year mainstream microeconomics course (ECO2003F), where they received no additional academic support. In 2003 a fundamental change was made to the ECO2003F course. Although the content remained much the same, a strong emphasis was placed on the use of mathematical techniques rather than graphical analysis to solve for equilibrium conditions under a variety of circumstances.

In general, AD students have a low level of mathematical ability relative to their peers in the mainstream as measured by their grades for mathematics and physical science in the matriculation examination (Du Preez et al. 2008; Smith 2009). Therefore, voluntary workshops were offered to AD students taking ECO2003F; these workshops ran once a week for two hours. Two activities predominated: the lecturer revised the key topics and concepts and, more importantly, students were led through a series of exercises, which gave them the opportunity to practise a variety of mathematical techniques.

Empirical method and specification issues

Empirical method

This section presents the empirical method used, firstly, to identify whether the educational interventions included in the first and second-year microeconomics courses improved the academic performance of black AD students relative to a comparable mainstream group and, secondly, to identify the chief determinants of black students' academic performance. Observations are included for AD (ECO1010H) and mainstream (ECO1010S and ECO1010F) students of the 1999–2005 cohorts, registered in the Faculty of Commerce, who wrote the South African matriculation examination.

The key determinants of students' academic performance identified in the South African and international literature (Edwards 2000; Van Walbeek 2004; Smith 2004; Fraser and Killen 2005; Parker 2006; Van der Merwe 2006; Parker 2007; Smith and Edwards 2007; Horn and Jansen 2009; Dlomo et al. 2011) are used to identify the conditional relationship between membership of the AD cohorts and academic performance in the first and second-year microeconomics courses. Economics education is viewed as a production process whereby academic performance is a function of a variety of inputs (Edwards 2000). This relationship can be specified as:

$$\text{OUTPUT} \quad F(\text{AD, STUDENT, MATRICULATION PERFORMANCE, SCHOOL, OTHER}) \qquad (1)$$

where:
OUTPUT is a measure of academic performance;
AD is a dummy variable, that equals 1, for ECO1010H students;
STUDENT includes variables measuring students' characteristics;
MATRICULATION PERFORMANCE includes variables measuring performance in

school leaving subjects;
SCHOOL includes the type of school attended;
OTHER includes other relevant variables such as year of entry.

Ordinary least squares (OLS) multivariate analysis (MVA) is used to estimate the effect of the educational interventions on the academic performance of the AD cohorts relative to the mainstream cohorts in both the first and second-year microeconomics courses.

The study has two parts. In the first part of the study the aim is to identify the extent to which the AD course in first-year microeconomics was successful in improving black AD students' academic performance relative to that of a comparable group drawn from the mainstream (ECO1010S) for the 1999 and 2001–2005 cohorts. This relationship is identified by comparing the performance of the AD and mainstream cohorts using the marks achieved by the students for the multiple-choice (MCQ) and structured (SQ) questions in the final examination as the dependent variables. At the same time the chief determinants of black students' academic performance are identified and compared with those applicable to the student body as a whole.

The second part of the study has two aims. The first aim is to identify the extent to which the educational interventions incorporated in the first-year AD course improved the academic performance of AD students in the second-year microeconomics course (ECO2003F) relative to the performance of a comparable mainstream group (ECO1010S cohorts). The second aim is to measure the effect of the workshops introduced in the years 2003–2005 (second period) on the academic performance of the AD students in the second-year microeconomics course. Again, the chief determinants of black students' academic performance are identified and compared with those applicable to the student body as a whole. The academic performance of AD and ECO1010S cohorts is compared with that of the mainstream cohorts who took the first-semester course in microeconomics (ECO1010F), using the course mark obtained by the student, or the best course mark if the student did the course more than once.

Specifications

The objective of the first part of the study is to assess the effectiveness of the educational interventions on the academic performance of the AD cohorts in the first-year microeconomics course. This relationship is identified through the use of a dummy variable *AD*, which equals 1 for AD students. A positive sign for the coefficient of *AD* suggests that the educational interventions have a positive effect on students' academic performance relative to the performance of a comparable set of mainstream students, conditional on the control variables.

To obtain the conditional impact of the AD course on learning outcomes, a number of other variables that may explain students' academic performance in first-year microeconomics are included: variables for performance in school-leaving subjects, course and student characteristics.

Proxies for academic preparedness are important in explaining students' academic performance in Economics at South African universities (Van Walbeek 2004; Parker 2006; Smith and Edwards 2007; Horn and Jansen 2009; Smith 2009; Dlomo et al. 2011). Following Edwards (2000), the matriculation points score is adjusted as Mathematics (HG), English First Language (HG) and Physical Science (HG) are treated as independent variables. The points allocated to Mathematics (HG) and Mathematics (SG), English First Language (HG), English Second Language (HG), and two points for Physical Science (HG) are deducted from the matriculation points score to obtain the adjusted matriculation points score.

Dummy variables, equal to 1, are included for English First Language (HG) grades A+B+C and grades D+E+F, Physical Science (HG), Mathematics (HG) grades A+B+C, grade D and grades E+F, and Economics (HG). As regards the role of the latter variable in explaining variations in examination marks, the evidence is mixed. Edwards (2000) reports that students who took Economics as a school-leaving subject outperformed their peers who did not, conditional on the selected control variables. Van Walbeek (2004), Parker (2006), Smith and Edwards (2007), Smith (2009) and Dlomo et al. (2011) report, however, that students with prior knowledge of Economics do no better than their peers, conditional on the selected independent variables.

There are strong grounds for expecting English (home language) to have a positive impact on learning outcomes at universities where English is the medium of instruction (Edwards 2000), but for other South African studies the results are mixed (Parker 2006; Smith and Edwards 2007; Smith 2009). A dummy variable *ENGHOME*, equal to 1, is included if the student's home language is English.

Several South African studies report that males perform relatively well in multiple-choice questions and females in essay questions (Edwards 2000; Van Walbeek 2004; Smith and Edwards 2007; Smith 2009). A dummy variable *MALE*, equal to 1, is included if the student is male.

Four other variables are included that were absent from Smith and Edwards' (2007) study: whether the student received financial aid (*FINAID*), student age at entry (*AGE*), education authority, and school attended. The dummy variable *FINAID*, equal to 1, is included as a proxy for socioeconomic disadvantage. Students in receipt of financial aid are more likely to come from poorer households and communities, on average. McConnell (1980) suggests that there is a positive relationship between students' age and learning outcomes in Economics; older students are more likely to have achieved the level of intellectual development necessary for mastering abstract processes. However, the evidence is inconclusive (Park and Kerr 1990; Tay 1994; Van Walbeek 2004; Parker 2006; Smith 2009). The variable *AGE* is included as a continuous variable measured in years to the first decimal place.

Dummy variables, equal to 1, are included for the two education authorities of the Eastern (*EC*) and Western Cape (*WC*). Dummy variables, equal to 1, are also included

for each of the following types of school: schools that formerly fell under the Department of Education and Training (*DET*), and schools that formerly fell under the Houses of Representatives and Delegates (*HRD*). These variables are also included as a proxy for socioeconomic disadvantage. There is little evidence, however, to suggest that students from former DET and HRD schools perform less well academically in Economics courses, conditional on the other explanatory variables (Edwards 2000; Smith 2009). Dummy variables are also included for each of the five years 2001, 2002, 2003, 2004 and 2005 to identify whether students' academic performance differs markedly from year to year.

The Heckman two-step estimation is used to account for the fact that not all students who started the course wrote the final examination. The first step is to construct a probit estimation to identify the importance of selected variables in explaining whether students wrote the final examination or not. The variables included are age, school and English as a home language. All these variables are discussed above. In addition, the mark achieved by students in their first test is included as a continuous independent variable. This is the exclusion variable, which is used in the probit but not in the OLS estimation. Older students who have English as their home language are expected to experience less difficulty in adapting to the academic demands made of them at university, and are therefore more likely to write the final examination. Students who make a success of their first test are also deemed to be more likely to qualify for the final examination and complete the course. However, students from former DET and HRD schools are expected to be less likely to write the final examination and complete the course.

The objective of the second part of the study is to assess the effectiveness of the educational interventions on the academic performance of the AD cohorts in the second-year microeconomics course. This relationship is identified through the use of a dummy variable *AD*, which equals 1 for AD students. The academic performance of the AD and ECO1010S cohorts is compared with that of the ECO1010F cohorts (students who took the first-semester mainstream course in microeconomics). Thus a dummy variable *D1010S*, equal to 1, is included for the ECO1010S cohorts. The key measure of the effectiveness of the educational interventions on students' academic performance is the difference in the sign and size of the coefficients for the AD and ECO1010S variables.

To obtain the conditional impact of the AD course on learning outcomes, the same variables as described above are also included in the specification. The variables that have not been previously considered are now briefly discussed.

Many students attend the course more than once before they finally pass, fail or are excluded from the course. A continuous variable *ATTEND*, which indicates the number of times each student attended the course, is included. The number of workshops attended by each student (*WSHOP*) is also listed as an independent variable. Finally, each of the six cohorts is listed, collected into two periods. The

reason for doing this is that the nature of the second-year microeconomics course (ECO2003F) course changed in the second period; firstly, it became more mathematical in content, and, secondly, 12 voluntary workshops were introduced for the AD students. Separate estimations are run for each of the two periods, controlling for each of the years in each period.

Again, the Heckman two-step estimation is used to account for the fact that not all students who started the course wrote the final examination. The same set of independent variables is used as for the first-year estimations discussed above, with one exception; a dummy variable, equal to 1, is included if the student passed the first ECO2003F test. This is the exclusion variable.

Specification issues and limitations

A number of specification issues identified in the literature remain unresolved (Parker 2006; Smith 2009). Important variables such as students' effort, attitude and motivation are still omitted as it is difficult to find suitable proxies. The omission of these variables may result in biased estimates of the coefficients of the AD dummy variable (omitted variable bias) if the omitted variables are correlated with the students taking the AD course. For example, AD students may have a higher level of motivation than mainstream students have, on average. Thus the better academic performance of AD students may be erroneously attributed to the AD dummy variable. Conversely, AD students may come from poorer socioeconomic backgrounds than mainstream students do, on average. In the absence of variables for socioeconomic status, the relatively poor academic performance of AD students may be erroneously attributed to the AD dummy variable.

Two sample-selection issues were identified in Smith and Edwards's (2007) article. Firstly, not all students who start the course go on to write the final examination and complete the course. The main reason is that they do not meet the requirements to do so. For example, students are generally required to write all the tests, hand in a certain number of tutorial assignments and attend a certain number of the tutorials. The exclusion of these students in the estimations may lead to sample-selection bias (Douglas and Sulock 1995; Parker 2006). This problem applies to the AD and ECO1010S (mainstream) cohorts. The Heckman two-step estimation, described above, is used to account for this sample-selection problem.

Secondly, the ECO1010S cohorts can act as a control group only if they are drawn from the same population as the AD cohorts. However, it may not be possible to assume that students undertaking the AD and mainstream courses are drawn from the same population measured across a broad range of characteristics. That said, the key variable that the two cohorts do share in common is that they both received two semesters' worth of instruction in first-year microeconomics. However, the ECO1010S cohorts may be less motivated than the AD cohorts, as they had already failed

ECO1010F in the first semester. It may also be that the better performance of the AD cohorts is due to their differing set of characteristics rather than to the effectiveness of the educational interventions embodied in the AD course (omitted variable bias). To test for the extent of the similarity between the two cohorts, differences of means and proportions tests were conducted for each of the continuous and discrete variables. The results of this analysis for the first and second-year courses are presented in Tables 1 and 2 respectively.

Table 1: Control variables first-year microeconomics

Cohorts	**1999, 2001-2005**			
	Code	**AD**	**ECO1010S**	**Tests**
Observations		358	254	
Cohort characteristics				
		% share	**% share**	**z-test**
English home language	ENGHOME	5,0	11,4	**2,93
Male	MALE	50,0	32,7	**4,26
Financial aid	FINAID	59,5	26,8	**13,99
		Mean	**Mean**	**t-test**
Age at entry	AGE	18,3	18,6	1,92
Education authority				
Eastern Cape	EC	27,9	15,4	**1024
Western Cape	WC	20,4	15,4	**6,80
School attended		**% share**	**% share**	**z-test**
Former Houses of Representatives and Delegates	HRD	2,0	3,5	**8,75
Former Department of Education and Training	DET	45,0	30,3	**9,68
Matriculation academic performance				
Matriculation points		**Mean**	**Mean**	**t-test**
Mean matriculation points score	MATPT	34,4	36,9	**8,04
Mean adjusted matriculation points score	ADJMATPT	24,1	25,4	**3,46

Matriculation subjects		**% share**	**% share**	**z-test**
English First Language (HG) ABC	ENGFLHGABC	31,0	54,7	**5,88
English First Language (HG) DEF	ENGFLHGDEF	11,5	11,4	0,04
Mathematics (HG) ABC	MATHHGABC	16,2	31,9	**4,57
Mathematics (HG) D	MATHHGD	22,6	17,3	**7,02
Mathematics (HG) EF	MATHHGEF	13,4	13,0	1,47
Physical Science (HG)	PSHG	31,3	42,9	**2,94
Economics (HG)	ECONOMICS	29,6	24,8	1,31
Cohorts				
1999	1999	13,1	22,0	**9,74
2001	2001	20,1	19,7	1,93
2002	2002	14,0	15,0	**3,51
2003	2003	12,6	18,9	**8,57
2004	2004	22,6	11,8	**10,52
2005	2005	17,6	12,6	**7,43

** statistically significant at the 1% level
The column headed 'Tests' provides the t and z statistics for the tests of equality of means and proportions between AD and ECO1010S cohorts

Turning to Table 1, it is clear that the two first-year cohorts differ markedly from one another. For example, 5,0% of the AD cohorts have English as their home language, compared with 11,4% of the ECO1010S (mainstream) cohorts. This difference is statistically significant ($p<0,01$). In general, a greater proportion of the AD cohorts are male and attended former DET schools, compared with the mainstream cohorts. However, a greater proportion of the ECO1010S cohorts took English First Language (HG), Mathematics (HG) and Physical Science (HG). Also, the ECO1010S cohorts had higher mean matriculation points scores and adjusted matriculation points scores.

Turning to Table 2, it can be seen that the extent of the differences between the two sets of cohorts is reduced for the second-year course.

For example, the differences for the variables English (home language), DET and Physical Science (HG) are no longer statistically significant ($p>0,05$). That said, it is clear that the two sets of cohorts cannot be said to come from the same population.

However, as noted by Edwards (2000), the extent of the sample-selection problem may not be such an important issue. There may be substantial random error associated with the main variable used to select students into the AD course, namely matriculation grades. During the period under consideration the matriculation examinations differed, and the articles were graded by teams of examiners, across provinces. Therefore, it is probable that some students took the mainstream course

Table 2: Control variables second-year microeconomics

Cohorts		**2000 2002**			**2003 2005**		
	Code	**AD**	**1010S**	**Tests**	**AD**	**1010S**	**Tests**
Observations		118	64		161	72	
Cohort characteristics							
		% share	**% share**	**z-test**	**% share**	**% share**	**z-test**
English home language	ENGHOME	5,9	12,5	1,55	5,6	11,1	1,49
Male	MALE	51,7	29,7	**2,86	48,4	31,9	*2,35
Financial aid	FINAID	61,0	29,7	**7,17	51,6	34,7	**5,83
		Mean	**Mean**	**t-test**	**Mean**	**Mean**	**t-test**
Age at entry	AGE	18,1	18,6	*2,06	18,3	18,9	**3,72
Education authority							
Eastern Cape	EC	38,1	17,2	**6,35	22,4	16,7	**3,94
Western Cape	WC	12,7	14,1	*2,27	28,0	11,1	**6,91
School attended		**% share**	**% share**	**z-test**	**% share**	**% share**	**z-test**
Former Houses of Representatives and Delegates	HRD	1,7	3,1	**5,20	3,1	1,4	1,31
Former Department of Education and Training	DET	38,1	20,3	**4,21	41,0	37,5	1,25
Matriculation academic performance							
Matriculation points		**Mean**	**Mean**	**t-test**	**Mean**	**Mean**	**t-test**
Mean matriculation points score	MATPT	33,0	36,7	**8,49	36,2	39,6	**8,26
Mean adjusted matriculation points score	ADJMATPT	22,0	25,2	**7,47	25,5	26,9	*2,53
Matriculation subjects		**% share**	**% share**	**z-test**	**% share**	**% share**	**z-test**
Mathematics (HG) ABC	MATHHGABC	13,6	42,2	**4,67	26,7	43,1	*2,58
Mathematics (HG) DEF	MATHHGDEF	33,9	17,2	**2,61	35,4	29,2	1,01

Physical Science (HG)	PSHG	29,7	43,8	1,91	37,9	44,4	0,94
English First Language (HG)	ENGFLHG	48,3	62,5	1,83	48,4	59,7	1,60
Course variables		**Mean**	**Mean**	**t-test**	**Mean**	**Mean**	**t-test**
Mean course attendance	ATTEND	1,73	1,56	1,47	1,45	1,56	1,15
Workshop attendance (12)	WORKSHOP	0,0	0,0		4,67	0,0	
Cohorts		**% share**	**% share**	**z-test**	**% share**	**% share**	**z-test**
2000	2000	20,3	31,3	1,66			
2001	2001	47,5	31,3	*2,12			
2002	2002	32,2	37,5	0,72			
2003	2003				23,0	37,5	*2,29
2004	2004				44,1	25,0	**2,77
2005	2005				32,9	37,5	0,68

** and * statistically significant at the 1% and 5% levels respectively
The column headed 'Tests' provides the t and z statistics for the tests of equality of means and proportions between AD and ECO1010S students

when they should have been registered for the AD course in microeconomics, and vice versa. Nonetheless, due consideration must still be given to potential sample-selection problems when interpreting the results.

Data and results

Analysis of data

Firstly, the academic performance of the AD and ECO1010S cohorts in first-year microeconomics is compared. The data is presented in Table 3.

The academic performance of the AD cohorts exceeded that of the ECO1010S cohorts. For each of the variables, with the exception of the MCQ mean mark, the difference in performance is statistically significant ($p<0,01$). For example, the mean examination mark achieved by the AD cohorts is 6,6 percentage points greater than that achieved by the ECO1010S cohorts. The AD cohorts achieved these better results despite having a lower level of academic preparedness as measured by their performance in the matriculation examination (Table 1).

In Table 4 the effects of the educational interventions in the first and second-year courses on students' academic performance in the second-year microeconomics course (ECO2003F) and on the throughput rates for the first and second-year courses are

Table 3: Academic performance in first-year microeconomics

Cohorts	1999, 2001-2005		
	AD	ECO1010S	Tests
			z-stat
Registered for course	358	254	
Write examination	353	240	
Percentage	98,6	94,5	**2,88
			t-stat
MCQ mean mark out of 100	57,7	57,1	0,50
SQ mean mark out of 100	53,9	44,3	**8,54
Examination mean mark out of 100	55,2	48,6	**6,46
Course mean mark out of 100	56,9	47,7	**7,99
			z-stat
Pass examination at first attempt	250	119	
Percentage	69,8	46,9	**5,71
Pass course at first attempt	287	146	
Percentage	80,2	57,5	**6,08

** statistically significant at the 1% level
The column headed 'Tests' provides the t and z statistics for the tests of equality of means and proportions between AD and ECO1010S students

shown for the AD and ECO1010S cohorts for each of two periods: the first (2000–2002) and second (2003–2005) periods.

In the first period, the AD students had no additional academic support. In the second period, the AD students had the opportunity of attending the voluntary workshops, which were offered as the ECO2003F course had become more mathematical in content. In both periods, the AD cohorts achieved a higher mean course mark than the ECO1010S cohorts did, as well as a higher pass rate. For example, the pass rate for the AD cohorts in the second period is 71,4% relative to the ECO1010S cohorts' 66,7%. However, the differences are not statistically significant ($p>0,05$).

Turning to the throughput rates, a greater proportion of the AD cohorts passed the first-year microeconomics course at the first attempt, e.g. 76,8% of the AD cohorts as compared with 45,4% of the ECO1010S cohorts for the years 2000–2002. More importantly, a greater proportion of the AD cohorts who started the first-year course passed ECO2003F. In both periods, the throughput rate for the AD cohorts is greater than that for the ECO1010S cohorts and the differences are statistically significant ($p<0,01$). For example, the throughput rate for the AD cohorts in period 1 (2000–2002) is 53,6% and that for the ECO1010S cohorts is 27,7%.

Table 4: Academic performance in second-year microeconomics

Cohorts	**2000-2002**			**2003-2005**		
	AD	**ECO 1010S**	**Tests**	**AD**	**ECO 1010S**	**Tests**
			z-stat			**z-stat**
Registered for course	118	64		161	72	
Write examination	111	61		154	70	
Percentage	94,1	95,3	0,34	95,7	97,2	0,55
			t-stat			**t-stat**
Course mean mark out of 100	51,7	49,0	1,91	51,4	49,7	1,29
Std error	0,84	1,09		0,78	1,12	
			z-stat			**z-stat**
Pass at first attempt	40	20		89	27	
Percentage	33,9	31,3	0,36	55,3	37,5	*2,51
Pass course	81	39		115	48	
Percentage	68,6	60,9	1,05	71,4	66,7	0,72
Throughput rates						
Registered AD/ECO1010S	151	141		189	110	
Passed course first attempt	116	64		157	83	
Percentage	76,8	45,4	**6,00	83,1	75,5	1,59
Passed ECO2003F	81	39		115	48	
Percentage	53,6	27,7	**2,77	60,8	43,6	**2,88

** and * statistically significant at the 1% and 5% levels, respectively
The column headed 'Tests' provides the t and z statistics for the tests of equality of means and proportions between AD and ECO1010S students

This data suggests that the educational interventions incorporated in the first and second-year courses improved the academic performance of the AD cohorts relative to that of the comparable mainstream group. The evidence also suggests that an important reason for the higher pass rate and throughput rate achieved by the AD cohorts in the second-year microeconomics course (ECO2003F) is the relatively high pass rate these cohorts achieved in the first-year microeconomics course relative to the ECO1010S cohorts.

The evidence presented in Tables 3 and 4 suggests that the educational interventions incorporated in the AD course improved the academic performance of students doing the first and second-year microeconomics courses relative to a comparable group of mainstream students.

Estimation results

The statistical programme STATA is used for all the estimations.

First-year course

For the first set of estimations (Table 5) the production function represented by equation (1) is estimated using OLS to identify the impact of the AD course on students' academic performance in the first-year microeconomics course, relative to the ECO1010S cohorts.

Table 5: Results of the first-year estimations

	Heckman Probit WRITE (1)	Heckman OLS MCQ (2)	Heckman OLS SQ (3)	OLS MCQ (4)	OLS SQ (5)	OLS Exam (6)
AD		1,14	10,9	0,68	**10,5	**7,28
ADJMATPT		0,45	0,39	*0,46	*0,40	**0,42
ENGFLHGABC		2,21	0,90	3,12	1,62	2,12
ENGFLHGDEF		6,22	2,63	**7,57	3,69	**4,98
MATHHGABC		2,95	3,39	**3,77	*4,02	*3,94
MATHHGD		0,48	2,67	1,12	3,17	2,49
MATHHGEF		1,29	0,07	0,30	0,85	0,47
PSHG		4,23	0,53	**4,52	0,76	2,01
ECONOMICS	0,19	3,08	1,59	0,45	0,48	0,17
FINAID		0,29	1,07	0,25	1,10	0,65
AGE	* 0,11	1,58	1,24	0,59	0,46	0,51
ENGHOME	0,27	2,43	6,42	4,08	1,31	0,49
MALE		4,04	0,09	**4,15	0,19	1,51
EC		2,15	0,87	2,16	0,88	1,31
WC		0,22	0,98	0,65	0,64	0,21
HRD	**4,57	8,04	6,10	0,60	0,73	0,69
DET	0,32	1,83	0,27	1,87	2,63	2,38
FIRSTTIME 1010S		9,41	5,61	9,11	5,37	6,62
TEST1	*0,02					
IMR		112,6	88,5			
2001		11,1	0,59	**7,64	2,14	1,12
2002		5,05	1,42	*5,11	1,46	2,68
2003		1,56	0,28	0,86	0,27	0,11
2004		3,41	5,00	3,37	*4,97	*4,43

2005		9,40	1,16	**10,9	2,33	*5,19
C	**3,03	14,4	14,0	**44,2	**37,4	**39,7
R^2				0,154	0,186	0,162
F stat.				**4,50	**5,66	**4,79
Wald chi^2 (27)		10,9	11,8			
Prob > chi^2		0,998	0,995			
Observations	612	593	593	593	593	593

(1) MCQ examination mark (2) SQ examination mark (3) Examination mark
(4) Probit estimation for the first part of the Heckman two step estimation
** and * statistical significance at the 1% and 5% levels respectively

Turning to Table 5, the Heckman two-step estimation is now discussed. Equation 1 with a binary dependent variable *WRITE* (did write final examination) is estimated to identify the importance of selected variables in explaining whether students wrote the final examination or not. The result of this estimation is used to calculate the inverse Mills ratio (IMR), which is included as an additional explanatory variable in each of the equations (2) and (3). The probit estimation (equation 1) reveals that passing test 1 is statistically significant ($p<0,05$) in explaining whether the students wrote the final examination or not. Students from HRD schools are more likely and older students less likely to write the final examination.

The coefficients of the Heckman OLS estimations (equations 2 and 3) are statistically insignificant ($p>0,05$). The chief reason is that the standard errors are very much greater for the Heckman two-step estimation, compared with the standard OLS estimations (equations 4 and 5). Importantly, the coefficient of the IMR is statistically insignificant ($p>0,05$), as it is in all the Heckman OLS estimations that follow, implying that excluding the students who did not write the final examination from the estimation does not significantly bias the results.

Turning to the standard OLS estimations, equation 4 is for the multiple-choice questions and equation 5 for the structured questions that make up the final examination. Equation (6) identifies the variables that explain the variation in the final examination mark, which includes the marks attained by students for both the multiple-choice and structured questions. The coefficient of the AD dummy variable (*AD*) in this equation is used to calculate the premium going to the AD students.

The coefficients of the AD variable are similar in size to those derived using the Heckman OLS estimations. For the MCQ estimation (equation 4), the coefficient of *AD* is 0,68 and statistically insignificant ($p>0,05$), conditional on the explanatory variables. However, for the SQ estimation (equation 5), the coefficient of *AD* is 10,5 percentage points and statistically significant ($p<0,01$), conditional on the control var-

iables. This implies that the educational interventions, designed primarily to improve AD students' quantitative, comprehension, writing and English language skills in first-year microeconomics, only improved their performance in the structured questions, conditional on the independent variables.

For the MCQ estimation, the coefficients for the adjusted matriculation points score (*ADJMAPT*) and mathematics (HG) ABC (*MATHHGABC*) are positive and statistically significant ($p<0,05$). For example, a one-point increase in the adjusted matriculation points score results in an increase of 0,46 percentage points in the MCQ mark, on average. Students who achieved an A, B or C grade for mathematics (HG) outperformed students who did not by 3,77 percentage points, conditional on the other independent variables, on average.

For the SQ estimation, only the coefficients for the adjusted matriculation points score (*ADJMAPT*) and mathematics (HG) ABC (*MATHHGABC*) are positive and statistically significant ($p<0,05$). The R^2 coefficients are less than 0,20 for both estimations. This implies that less than 20,0% of the variation in the value of the dependent variable is due to variations in the values of the independent variables.

As regards the examination estimation (equation 6), the coefficient of the AD variable is 7,28 percentage points, compared with the figure of 6,00 percentage points reported by Smith (2009) for all AD students. This finding suggests that the educational interventions included in the AD course had a greater impact on the academic performance of black AD students relative their peers in the mainstream than it did for all AD students relative to all mainstream students. This important finding suggests that black students benefit disproportionately from the educational interventions included in the AD course, conditional on the control variables.

The statistically significant ($p<0,05$) determinants of the examination mark for black students, and the student body as a whole, are now compared. As regards black students, the coefficients of *ADJMATPT*, *ENGFLHGDEF* and *MATHHGABC* are positive and statistically significant at, at least, the 5% level. Further, the coefficient of *ENGFLHGDEF* is also positive, but statistically insignificant ($p>0,10$). The finding as regards the importance of English is not repeated for the student body as a whole, which suggests that black students gain a particular advantage if they have taken English First Language (HG) as a school-leaving subject. The coefficients of *ADJMATPT* and *MATHHGABC* are smaller than they are for first-year students in general. Further, the coefficients of *MATHHGD, MATHHGEF* and *PSHG* are positive, and statistically significant ($p<0,01$), only for mainstream students. These findings imply that the usual predictors of academic performance are less robust for black students taking first-year microeconomics.

Second-year course: period 1:

The results of the estimations for the second-year microeconomics course (period 1) are shown in Table 6.

Table 6: Results of the second-year estimations (period 1)

Variable	Heckman Probit WRITE (1)	Heckman OLS MARK (2)	OLS MARK (3)
AD		0,41	0,12
Std Error		6,89	1,35
D1010S		4,71	** 5,34
Std Error		6,79	1,34
ADJMATPT		0,58	0,74
ENGFLHG		0,37	0,05
MATHHGAB		0,97	1,46
MATHHGC		0,29	0,58
MATHHGDEF		1,79	1,46
PSHG		1,61	*2,14
FINAID		0,35	0,23
AGE	0,03	0,44	0,03
ENGHOME	0,63	5,26	1,89
MALE		0,19	0,53
EC		0,27	0,42
WC		0,15	0,28
HRD	**4,88	4,97	1,59
DET	0,36	3,64	1,81
ATTEND		0,38	* 1,66
TEST 1	**5,31		
IMR		47,9	
2001		1,44	0,43
2002		1,19	1,86
C	*2,41	32,4	**34,2
R^2			0,208
F stat			**6,12
Wald chi^2 (27)		8,16	
Prob > chi^2		0,997	
Observations	479	462	462

(1) Final course mark

** and * represent statistical significance at 1% and 5% levels respectively

Table 7: Results of the second-year estimations (period 2)

	Without 'Workshops' variable			With 'Workshops' variable
Variable	**Heckman Probit WRITE (1)**	**Heckman OLS MARK (2)**	**OLS MARK (3)**	**OLS MARK (4)**
AD		2,25	* 2,80	** 4,65
Std Error		6,06	1,12	1,34
D1010S		5,70	** 6,03	** 6,01
Std Error		6,58	1,22	1,22
WSHOP				*0,44
ADJMATPT		0,52	**0,52	**0,52
ENGFLHG		1,21	1,19	0,90
MATHHGAB		5,28	**6,06	**6,00
MATHHGC		3,07	**3,31	*3,21
MATHHGDEF		0,84	0,69	0,69
PSHG		0,96	1,02	1,11
FINAID		1,19	1,13	1,17
AGE	0,08	1,09	* 0,78	* 0,77
ENGHOME	0,04	1,37	0,91	0,96
MALE		0,14	0,45	0,39
EC		1,79	1,77	1,76
WC		0,09	0,47	0,42
HRD	4,62	2,54	0,19	0,57
DET	0,37	2,74	1,39	1,49
ATTEND		0,88	** 1,91	** 1,92
TEST 1	**0,80			
IMR		50,2		
2004		2,02	0,77	0,84
2005		1,86	**2,77	**2,68
C	0,12	65,0	**56,8	**56,5
R^2			0,307	0,314
F stat			**13,8	**13,6
Wald chi^2 (27)		8,97		

Prob > chi^2		0,994		
Observations	627	614	614	614

(1) Final course mark (4) Final course mark
** and * represent statistical significance at 1% and 5% levels respectively

The coefficients of *AD* and *D1010S* are statistically insignificant (p>0,05) for the Heckman OLS estimation (equation 2) for reasons already identified above, as is the IMR.

Turning to the standard OLS estimation (equation 3), which excludes the students who did not write the final examination, the coefficient of *AD* is 0,12. This result implies that the AD cohorts' course mark is 0,12 percentage points more than that achieved by the ECO1010F cohorts (students who took the first-semester mainstream course in microeconomics), conditional on the explanatory variables. However, the result is statistically insignificant (p>0,05). The average course mark achieved by the ECO1010S cohorts is 5,34 percentage points less than that achieved by the ECO1010F cohorts, conditional on the independent variables. This result is statistically significant (p<0,01). The sum of the standard errors for these two variables is 2,69 percentage points, which is less than the difference between the two coefficients of 5,46 percentage points. This result is much the same as that reported by Smith and Ranchhod (forthcoming) for a study including the full complement of students – Indian, white, coloured, black and other). The finding suggests that the premium going to black AD students relative to black mainstream students does not differ from that going to all AD students relative to the student body as a whole.

Further, the result implies that the educational interventions, designed primarily to improve black AD students' quantitative, comprehension, writing and English language skills in first-year microeconomics, also improved their academic performance in the second-year microeconomics course, relative to a comparable group of mainstream students, where the assessment is conducted using multiple-choice and structured questions in tutorials, tests and examinations.

As regards the other explanatory variables, only the coefficients of *PSHG* and *ATTEND* are statistically significant (p<0,05). Smith and Ranchhod (forthcoming) reported positive and statistically significant (p<0,01) coefficients for the variables *ADJMATPT*, *MATHSHGABC* and *PSHG*. Smith and Edwards (2007) also obtained a positive and statistically significant result (p<0,05) for *PSHG*, for students taking a second-year microeconomics course. The coefficient for *ATTEND* is -1,66. This implies that each time a student repeated ECO2003F, the student's course mark decreased by 1,66 percentage points, on average.

These findings imply that the usual predictors of academic performance are less robust for black students taking second-year microeconomics than they were for first-year microeconomics.

Second-year course: period 2

The results of the estimations for the second-year microeconomics course (period 2) are presented in Table 7 (see previous page).

The first set of estimations (equations 1 to 3) excludes the variable *WSHOP*. These estimations make it possible to quantify the effect of the educational interventions included in the AD course and in ECO2003F, in the form of workshops, on the academic performance of the AD cohorts in ECO2003F, relative to the ECO1010S cohorts. The coefficient for the variable *IMR* in the Heckman two-step estimation (equation 2) is -50,2, and is statistically insignificant (p>0,10).

The coefficient of *AD* (equation 3) is -2,80 percentage points and is statistically significant (p<0,05). This result implies that the course mark achieved by the AD cohorts is 2,80 percentage points less than that achieved by the ECO1010F cohorts, on average. However, the coefficient of *D1010S* is -6,03 percentage points, and is also statistically significant (p<0,01). The sum of the standard errors is 2,34 percentage points, which is less than the difference between the two coefficients of 3,23 percentage points. The corresponding difference between the coefficients for all mainstream and AD students, as reported by Smith and Ranchhod (forthcoming), is 2,85 percentage points, which is less than for black students.

These results imply that the educational interventions incorporated into the first-year AD course, and the voluntary workshops for the AD cohorts taking ECO2003F, improved the academic performance of the AD cohorts relative to the ECO1010S cohorts, conditional on the independent variables.

These findings also suggest, as did the finding in respect of the first-year micro-economics course, that black students derive a small disproportionate benefit from the educational interventions directed at AD students, relative to their peers on the mainstream.

Of the other explanatory variables, *ADJMATPT*, *MATHHGAB*, *MATHHGC*, *AGE* and *ATTEND* are statistically significant at, at least, the 5% level. These variables are also statistically significant (p<0,05) in explaining the academic performance of the student body as a whole. The increased importance of mathematics (HG) as a determinant of academic performance is not surprising, given that the second-year course became more mathematical in nature in the second period.

Equation 4 is estimated to determine the effect of workshop attendance (*WSHOP*) on the academic performance of the AD cohorts in the second period. The coefficient for workshop attendance is 0,44, and is statistically significant (p<0,05). This implies that the students' ECO2003F course mark increases by 0,44 percentage points, on average, for each of the 12 workshops attended, conditional on the independent variables. This result is similar to that reported by Smith and Ranchhod (forthcoming).

The difference between the coefficients of *AD* and *D1010S* is no longer statistically

significant (p>0,10). This suggests that the educational interventions included in the AD course no longer prepared the students for the increased demands of the ECO2003F course, conditional on workshop attendance.

In summary, the results imply that the educational interventions included in the workshops, specifically the focus on improving students' understanding of mathematical concepts and the application of mathematical techniques, enabled those students who attended the workshops to outperform their peers in the mainstream, conditional on the independent variables. However, it is possible that workshop attendance is a function of the students' level of motivation: motivated students are more likely to attend the workshops and they may have achieved the same results irrespective of the workshops. In this regard it is worth noting that the correlation coefficient between students' final ECO1010H course mark and the number of workshops attended is 0,24, which is relatively low. This weakly suggests that it is those students who experienced greater success in the first-year AD course (ECO1010H) who were more likely to attend the voluntary workshops.

Effect of the educational interventions on pass rates

In this section the effects of the premiums earned by the AD cohorts on the overall pass rates in the first and second-year microeconomics courses is described.

The premium earned by the AD cohorts in the first-year final examination is 7,28 percentage points (Table 5, equation 6). The final examination accounts for 50,0% of the final mark. Therefore, the size of the premium in terms of the final mark is 3,64 percentage points. The effect of this premium on the pass rate achieved by the AD cohorts is shown in Table 8.

Table 8: Pass rates in first-year microeconomics

	AD	ECO1010S
Number of students	358	254
Pass (no premium)	251	146
Percentage	70,1	57,5
Pass (premium of 3,64 percentage points)	287	
Percentage	80,2	

Without the premium, 70,1% of the AD cohorts pass, as opposed to 57,5% of the ECO1010S cohorts. The effect of the premium is to raise the pass rate for the AD cohorts to 80,2%, an improvement of 11,2 percentage points. Smith (2009) reports that the effect of the AD course is to raise the pass rate of all AD students by 8,9 percentage

points, which again suggests that the AD course has a small positive and disproportionate effect on the academic performance of black students.

Table 9 shows the effect of premiums earned by the AD cohorts on pass rates for ECO2003F in each of the two periods, relative to the ECO1010S cohorts.

Table 9: Pass rates in second-year microeconomics

	AD	ECO1010S
2000-2002		
Number of students	118	64
Pass (no premium)	44	39
Percentage	37,3	60,9
Pass (premium of 5,46 percentage points)	81	
Percentage	68,6	
2003-2005		
Number of students	161	72
Pass No workshops attended (no premium)	85	48
Percentage	52,8	66,7
Pass 4,67 workshops attended (premium of 2,1 percentage points)	115	
Percentage	71,4	

The pass rate for the AD cohorts in the first period (2000–2002) without the premium is 37,3%, compared with that achieved by the ECO1010S cohorts of 60,9%. However, the addition of the premium of 5,46 percentage points (Table 7, equation 3) increases the pass rate achieved by the AD cohorts to 68,6%, a difference of 31,3 percentage points. This result is similar to that reported by Smith and Ranchhod (forthcoming), which suggests that black AD students performed on a par with their peers who also took the first-year AD course in microeconomics.

In the second period, AD students had the opportunity to attend one or more of the 12 voluntary workshops; 161 AD students took ECO2003F in the second period and they attended an average of 4,7 workshops each. The premium per workshop is 0,44 percentage points (Table 7, equation 6). Therefore, the average premium per student is 2,1 percentage points. The effect of the removal of the workshop premium is to reduce the pass rate from 71,4% to 52.8%, a difference of 18,6 percentage points, which

is identical to that reported for all AD students. It is clear that relatively small increments in the course mark have a disproportionate effect on the pass rate achieved by AD students, as they lack the requisite skills to achieve above-average results.

These results imply that the educational interventions incorporated in the AD course, to improve students' learning, English language, writing, quantitative and study skills, had a positive effect on the academic performance of the AD cohorts in first-year microeconomics, relative to a comparable group of mainstream students.

The results also imply that the educational interventions incorporated in the AD course continued to have a positive effect in the second-year microeconomics course, relative to a comparable mainstream group (ECO1010S), in the first period. Further, the results also suggest that workshop attendance in the second period enabled the AD cohorts to improve their academic performance relative to the ECO1010S cohorts: the workshops enabled AD students to overcome some of the educational disadvantages they experienced in respect of their relative under-preparedness in mathematical techniques and applications.

Implications for education policy and education research in South Africa

A variety of academic support initiatives are offered to students from academically disadvantaged backgrounds at tertiary institutions in South Africa. The findings of this study suggest that appropriate educational interventions in black AD students' first and second years have a positive impact on their academic performance relative to their peers in the mainstream.

The chief emphasis of the educational interventions described in this article was to improve students' English language, writing, quantitative, learning and study skills; these are skills that may enable students to achieve greater success in subsequent higher-level courses. That said, this study does not clarify the importance of each of the interventions in improving students' academic performance. It only suggests that the interventions, in some combination, had the effect of improving black AD students' pass rates, relative to black mainstream students. Further investigations are required to tease out the effects of the various interventions on students' academic performance through to graduation.

The findings of this study have implications for higher education policy in South Africa. Graduation rates across the tertiary sector are a grave cause for concern (Scott et al. 2007). The lowest gross participation rates and graduation rates are those exhibited by black people, who make up the major portion of South Africa's population. It is not unreasonable to assume that many of these people in mainstream courses and programmes would benefit from a similar array of educational interventions, given that many of them have barely qualified for mainstream courses (Smith 2004).

Further, this study emphasises the importance of high-school mathematics, and to a lesser extent physical science, in determining black students' academic performance

at the tertiary level, in Economics at least. The results suggest that every effort should be made to improve mathematics and science education at the secondary level.

Research is required to establish the types of educational interventions that are effective in improving students' academic performance in other courses, and the key determinants of academic performance across the curriculum. Further, it is important to establish whether AD courses are effective in improving students' academic performance in other courses, and at other tertiary institutions in South Africa.

Research of the type described in this article is a first step in identifying the key characteristics of a successful AD course. Such research can contribute to a better understanding of the principles that underlie successful AD courses and programmes, which will ultimately enable secondary and tertiary educationists to improve the academic performance of students throughout South Africa.

Conclusion

The aim of this article was to measure the effect of AD educational interventions in the first and second-year microeconomics courses, which were designed to improve students' learning, English language, writing, quantitative and study skills, on the academic performance of the black AD students, relative to a comparable group of mainstream students. Further, the chief determinants of black students' academic performance are identified.

In addition, comparisons are drawn between the effect of the educational interventions on black AD students and all AD students, who include students who have declared that they are white, Indian, coloured, black or other, on the university's admission form. The key determinants of academic performance for black students and the student body as a whole are also compared.

The method, specification and statistical analysis used in the study are designed to ensure a set of results that is more robust than is usually the case. In particular, specific attention is paid to addressing the sample-selection problem.

To the extent that the black AD cohorts outperformed a comparable mainstream group in the first-year microeconomics course, conditional on the independent variables, it is possible to conclude, leaving aside the problem of sample-selection bias, that the educational interventions included in the AD course had a positive impact on students' academic performance relative to a comparable mainstream group. The premium going to black AD students has the effect of raising their pass rate by 11,2 percentage points. The effect of the same AD course is to raise the pass rate of all AD students by 8,9 percentage points, which suggests that the first-year AD course has a small positive and disproportionate effect on the academic performance of black AD students.

The effect of the educational interventions included in the first-year AD course had a

positive impact on the academic performance of the AD students doing the second-year microeconomics course in the first period (2000–2002). Although the premium is relatively small, it has the effect of raising the pass rate in the second-year microeconomics course (ECO2003F) of the black AD cohorts by 31,3 percentage points, which is similar to the premium going to their peers in the mainstream.

The results also suggest that the educational interventions included in the AD course, along with the second-year workshops, did improve black students' academic performance relative to comparable mainstream cohorts in ECO2003F in the second period (2003–2005), when the second-year microeconomics course became more mathematical in content. As for the first-year course in microeconomics, the AD educational interventions have a small positive and disproportionate effect on the academic performance of black students, relative to all AD students. For each workshop attended by the black AD students, their final course mark increased by 0,44 percentage points, on average, conditional on the independent variables. The effect of this return to each workshop attended is to increase the pass rate achieved by the AD cohorts by some 18,6 percentage points, which is identical to that for all AD students.

The variables that may explain the relative success of the educational interventions included in the first-year AD course (ECO1010H) on students' academic performance in ECO2003F in the first period are the tutorials in economics, and language and communication, and the module designed to develop students' quantitative and graphical skills. The time that students spent in the workshops honing their ability to use mathematics in economic applications improved students' academic performance in second-year microeconomics.

The variables that are important in determining black students' academic performance in first-year microeconomics are the measures of academic preparedness, adjusted matriculation points score, Mathematics (HG) grades A, B and C, and English First Language (HG). The findings as regards the determinants of academic performance are less robust for black students than they are for the student body as a whole.

As regards second-year microeconomics, the key variables are Physical Science (HG) (period 1), and the adjusted matriculation points score and Mathematics (HG) grades A, B and C (period 2). As for first-year microeconomics, the findings as regards the determinants of academic performance are less robust for black students than they are for the student body as a whole, particularly in period 1.

These latter findings imply that other more robust determinants of academic potential should be identified for black students. Insofar as these findings are true for black students taking courses other than microeconomics, developing alternative predictors of academic performance will make it possible to identify a greater number of black students who have the potential to make a success of their university career.

The finding that the first-year AD course in microeconomics has a small disproportionately positive effect on the academic performance of black students is encouraging, given that black students make up the majority of AD students, and they are the group that exhibit the lowest gross participation rate. This finding offers some support for the view that the educational interventions are particularly helpful in enabling some of the university's most academically underprepared students to succeed in the first and second-year microeconomics courses.

The findings reported in this article suggest a rich line of further research. Firstly, it is necessary to determine whether AD interventions are successful in improving black students' academic performance in other courses and at other tertiary institutions. Secondly, it is important to identify the key characteristics of a successful AD course. Thirdly, it is important to identify the key determinants of academic performance for AD and mainstream students across a variety of courses and tertiary institutions, so as to improve the delivery of academic courses to AD and mainstream students.

Given the relatively poor graduation rates achieved by black students, it is important that every effort is made to develop AD and mainstream courses designed to improve the academic performance of educationally disadvantaged students and so enable a greater proportion of these students to obtain a degree.

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