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The Determinants of First-Year Academic Performance in the College of Agriculture at Kansas State University, 1990–1999

Andrew P. Barkley and Jerry J. Forst

This research identifies and quantifies the determinants of first-year academic performance in the College of Agriculture at Kansas State University, 1990–1999. Forty-eight percent of the variation in first-semester college grades was explained by high school grades, standardized test scores, socioeconomic variables, high school characteristics, credit hours completed, and major field of study. Approximately 62% of the variation in second-semester grades was explained. First-semester college grades explained 43% of second-semester grades. Several statistically significant relationships are detected, and the implications for students, advisors, and administrators are discussed.

Key Words: academic performance in Colleges of Agriculture, coefficients of separate determination, college entrance exams, grade point averages, identification of at-risk students

JEL Classification: A22

College student performance is important in our society: A student's academic record is one of the most important pieces of information used by employers in hiring decisions as a signal of ability and work ethic. As a result, students devote a large amount of time and effort toward enhancing their academic performance, instructors often encourage students to strive for higher grades, and administrators ensure that minimum academic standards are met by reviewing cumulative grade reports.

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Because of the high degree of attention given to academic performance in higher education, a great deal of research has been conducted to further our understanding of the determinants of college grades. Quantitative research has aimed at finding the determinants of student performance in college.

The primary goal of this research is to identify and quantify the determinants of first-year academic performance in the College of Agriculture at Kansas State University (KSU) during the time period 1990–1999. Econometric results indicate that high school grades and standardized admission test (American College Testing Program [ACT]) scores are significantly related to first-semester academic performance. After the first semester, however, first-semester college grades become the most significant determinants of future grades. Up-to-date knowledge of the determinants of first-year grades is useful to college students, advisors, and administrators. Quantitative

estimates of the degree to which high school grades and experiences are related to college grades provide information that is useful in helping students achieve their college and career objectives. To the degree that the estimated relations between high school performance and experiences and college grades can be applied to individual students, this information can be useful to advisors in helping students reflect upon college academic performance, and to administrators in making admissions decisions and retention policies.

Previous Literature

Statistical examination of the determinants of college grades has a long history and an extensive literature. Lincoln calculated correlation coefficients and concluded that high school work was more accurate than entrance examinations in forecasting class standing after the first 2 years of college for 253 Harvard students in 1917. Subsequent research has found that entrance exam scores typically explain a small but statistically significant amount of variation in college grades across students (e.g., Passons). Astin (1971, 1982) pioneered the field of explaining college student performance outcomes using high school grades and characteristics, socioeconomic variables, and personal characteristics. His research found that high school grades were the single best indicator of college academic performance, for all students (1971) and ethnic minorities (1982). Astin (1971) found that standardized test scores did not contribute to the explanation of college grades. However, major field of study was found to be significant, and gender, parental income, and racial composition were identified as important explanatory variables.

Aitken used multiple regression to explain academic performance and retention of freshmen at the University of Massachusetts in 1972, and found high school grade point average (GPA) to have the highest level of statistical significance. Martin used a similar methodology to study academic performance in a single course, senior-level price analysis at Purdue University, and concluded that prior

GPA was a strong indicator of course performance, together with calculus experience. Buschena and Watts found prior GPA to be a significant determinant of grades in intermediate-level economics courses and courses in agricultural economics. Townsend, McNerny, and Arnold confirmed this general result for transfer students: Higher cumulative GPA at community colleges was associated with higher GPA at universities. Devadoss and Foltz also found prior GPA to be an important factor in explaining college GPA for majors in agricultural economics.

Ethridge and Hudson used standardized test scores and college GPA to predict success in the agricultural economics graduate program at Texas Tech University, and found that previous academic achievement was a significant factor in explaining graduate school success. Baron and Norman found that at the University of Pennsylvania, Scholastic Aptitude Test (SAT) scores explained 4% of the variation in cumulative college GPA, whereas high school class rank explained 9.3%. Two previous studies have provided further evidence that high school performance was a strong predictor of college grades: Mulvenon et al. and Beecher and Fischer. Tross et al. extended traditional explanatory variables to include motivation and personality.

Standardized aptitude tests have been criticized for numerous reasons, including (1) poor predictive ability, (2) racial bias, (3) gender bias, and (4) that scores can be improved by "coaching" (Crouse and Trusheim). In spite of these criticisms, most colleges and universities continue to require applicants to take the examinations. The research presented here extends the previous literature in a number of important directions. First, the data set used is recent and extensive, including more information than has been included in previous research. High school grade data are particularly thorough. Second, estimation of coefficients of separate determination (CSD) quantifies the percentage of variation in freshman grades explained by each variable, and improves our understanding of the predictive ability of (1) high school academic performance, (2) entrance exam scores, and (3) per-

sonal characteristics. Third, econometric investigation of both the ACT composite score and four ACT subtest scores allows for greater understanding of the usefulness of the ACT battery of standardized test scores available for use in predicting college performance. Fourth, this research investigates the determinants of GPA for the first two semesters of college, measuring important changes in the explanatory ability of test scores and prior GPA as students gain college experience. These enhancements add significantly to our knowledge of the usefulness of using student records and standardized tests such as the ACT in admission decisions, student advising, and retention policies.

Conceptual Model

On the basis of previous studies, academic performance is hypothesized to be a function of individual characteristics, high school academic performance, and college experience:

$$(1) \quad FGPA_{it} = f(\text{SOCIO}_i; \text{HSGPA}_i; \text{HS EXP}_i; \\ \text{COL EXP}_i; \text{MAJOR}_i),$$

where $FGPA_{it}$ is the first-year academic performance in college of the i th student in semester t , SOCIO_i represents socioeconomic variables such as family income and ethnicity, HSGPA_i is the student's academic record in high school, HS EXP_i includes high school experience such as athletics or club leadership, COL EXP_i is a vector of college experience variables, including the number of credit hours, and MAJOR_i is college major field of study. This study provides estimates for both first- and second-semester ($t = 1, 2$) grades, to better understand how college experience affects GPA determinants.

Data

Data are from three sources (Forst): (1) ACT test results from KSU agricultural students enrolled during fall 1990 to spring 1999; (2) semester grades, number of credit hours enrolled, and major field of study data from the KSU Registrar's Office; and (3) county-level

demographic variables from State of Kansas publications. The initial number of observations was 2,103. The ACT is a standardized multiple-choice test that includes subtest scores for English, math, reading, and science reasoning. Standardized tests are required by nearly all colleges and universities to supplement high school grades in admissions decisions, since high schools may have a range of grade scales, student ability, and educational expectations. The ACT data contained 411 variables, of which 77 were self-reported by the student at the examination. Cassady found that self-reported GPA scores were remarkably similar to official records. Schiel and Noble also found high rates of accuracy in self-reported data.

Empirical Model

Sociodemographic variables (SOCIO) include birth year, gender, marital status, military experience, family income, and ethnic background (Table 1). Family income data are reported as categorical variables in the ACT report. The econometric model used here specifies family income as a continuous variable by using the midpoint of each category to approximate actual income. The educational attainment of the student's parents was not included in the ACT data. Since previous research has found this to be an important determinant of college success (Astin 1971), variables to approximate parental education were included that measure the percentage of the population in the student's county of residence with (1) less than 9 years of education, and (2) college degrees (Kansas Statistical Abstract). To capture potential differences in educational quality, average teacher salary and pupil/teacher ratios were included for the student's county of residence (Kansas State Board of Education, 1990 and 1991). The predetermined 1990 values of these four county-level variables were used to reduce simultaneity bias.

High school experience variables (HS EXP) included student participation in elected office, athletics, and activities, as well as high school size, racial composition, and type (Ta-

Table 1. First-Semester Undergraduate GPA Regression Results

Variable	Mean	SD	Min.	Max.	Estimate	t-test	CSD
Dependent Variable							
First-semester GPA	2.62	0.90	0	4	—	—	—
Intercept ^a	—	—	—	—	-0.847	-1.20	—
Socioeconomic Variables							
Birth year (19XX) ^a	75.84	2.46	71	80	-0.004	-0.56	-0.001
Female	0.36	0.48	0	1	-0.008	-0.20	-0.001
Married	0.01	0.09	0	1	0.061	0.40	0.000
Military experience	0.004	0.06	0	1	0.550*	1.90	0.001
Family income (1,000s)	39.65	16.27	9	60	-0.001	-0.88	0.000
Ethnicity: Non-Caucasian	0.03	0.18	0	1	-0.238*	-1.88	0.006
County education: percent <9 years ^a	9.02	4.22	2.24	21.34	0.006	0.81	0.003
County education: percent college ^a	12.37	6.04	5.00	28.06	0.017***	3.03	-0.009
High School Experience Variables							
County mean teacher salary ^a	28.22	1.90	23.98	32.68	-0.019	-1.28	0.005
County mean pupil/teacher ratio ^a	15.17	2.38	8.91	18.80	-0.024**	-2.28	0.008
Elected to student office	0.46	0.50	0	1	0.038	0.92	0.005
Varsity athlete	0.78	0.41	0	1	0.073	1.52	0.001
Club/activity recognition or award	0.58	0.49	0	1	0.040	0.96	0.003
Class size	152.5	168.7	12.5	900	0.00004	0.26	-0.001
Percent same race	78.61	24.41	5.0	91.0	-0.001	-0.97	-0.002
Type: private	0.05	0.21	0	1	0.235***	2.86	0.000
High School Academic Performance Variables							
ACT composite score ^a	22.89	4.08	11	34	0.043***	7.38	0.098
GPA	3.32	0.50	1.20	3.75	0.402***	6.00	0.129
Grade: English	3.32	0.77	0	4.00	0.165***	4.84	0.071
Grade: math	3.12	0.89	0	4.00	0.089***	2.99	0.042
Grade: natural science	3.32	0.76	0	4.00	0.059*	1.70	0.022
Grade: social science	3.49	0.69	0	4.00	0.034	0.97	0.011
College Experience							
Previous college experience	0.19	0.39	0	1	0.003	0.06	0.000
Credit hours attempted	14.13	2.29	2	31	0.067***	6.58	0.065
Major Field of Study							
Animal Sciences and Industry ^b	0.28	0.45	0	1	—	—	—
Recreation and Park Majors ^c	0.06	0.24	0	1	-0.072	-0.82	0.002
Retail Floriculture and Hort Therapy ^d	0.01	0.07	0	1	0.703***	3.69	0.002
Milling Science and Management ^e	0.09	0.29	0	1	-0.235***	-3.29	0.009
Agronomy	0.05	0.21	0	1	0.111	1.32	0.001
General Agriculture	0.08	0.27	0	1	0.107	1.43	-0.001
Preveterinary Medicine	0.14	0.34	0	1	-0.110*	-1.82	0.000
Horticulture	0.06	0.23	0	1	0.156*	1.81	-0.001
Agricultural Journalism	0.03	0.17	0	1	0.325***	3.78	0.005
Agribusiness and Ag Economics	0.15	0.36	0	1	0.151***	2.79	0.006
Agricultural Education	0.03	0.16	0	1	0.109	1.11	0.001
Agricultural Technology	0.02	0.15	0	1	0.091	0.78	0.000
Management							
Food Science and Industry	0.01	0.09	0	1	-0.199	-0.78	-0.001

Table 1. Continued

Observations	1394
<i>F</i> -value	34.74***
Root MSE	0.660
<i>R</i> ²	0.480
Adjusted <i>R</i> ²	0.467

Notes: GPA is grade point average; CSD is coefficients of separate determination (Ezekiel and Fox; Burt and Finley); ACT is American College Testing Program; MSE is mean square error.

^a Degrading collinearity exists between the seven continuous variables: intercept, birth year, county education percent <9 years, county education percent college, county mean teacher salary, county mean pupil/teacher ratio, and ACT score. The coefficients remain unbiased, but significance levels may be reduced (Belsley, Kuh, and Welch).

^b Default category, omitted from the regression.

^c Includes majors in Recreation and Park Administration, Park Resource Management, Preforestry, and Pest Science Management. Preforestry and Pest Science Management were discontinued in January 1993.

^d Retail Floriculture was discontinued in January 1993.

^e Includes majors in Feed Science and Management, Bakery Science and Management, and Milling Science and Management.

***, significant at the 0.01 level; **, significant at the 0.05 level; *, significant at the 0.10 level. The *t*-statistics are heteroskedastic-consistent estimates (White).

ble 1). The variables for high school class size and racial composition were derived by using the midpoint of categorical variables to approximate actual values. Academic performance in high school was evaluated with the self-reported variables high school GPA and specific course grades (Table 1). Course grades were quantified using a standard four-point scale ranging from zero (F) to four (A). Five ACT test scores were used: the composite score and four subtest scores.

The two primary regressions reported here include the composite ACT score only for semester one ($t = 1$, Table 1) and semester two ($t = 2$, Table 2). Regression trials for subtest scores are also reported for both semesters (Tables 3 and 4). Incomplete observations were omitted from the sample, resulting in 1,394 observations ($t = 1$) and 1,303 observations ($t = 2$). The sample is subject to selection bias because all out-of-state students were excluded, since comparable county-level data and ACT scores were unavailable for states other than Kansas, due to data availability and different treatment of out-of-state applications.

College experience variables (COL EXP) include (1) a qualitative variable from the ACT report that measures prior college experience, and (2) the number of semester credit hours attempted, as recorded by the Registrar.

Thirteen variables were used to capture the influence of major field of study (Table 1), to account for differences in programs of study. It is difficult to place expected signs on major field variables, since more rigorous majors may have either (1) more qualified students (an expected positive relation with GPA), or (2) more rigorous grading standards (an anticipated negative relation with GPA), or both.

CSD were calculated to measure the influence of each independent variable on first-year GPA. Each CSD represents the amount of variation in the dependent variable that is explained by a given independent variable. The sum of the coefficients equals the *R*-square. Burt and Finley derived the CSD for n variables: $CSD_i = \sum_{j=1}^n \beta_i^* \beta_j^* r_{ij}$ for $i = 1, \dots, n$, where β^* is the standardized beta coefficient and r is the simple correlation coefficient. Ezekiel and Fox, and Pindyck and Rubinfeld showed that the standardized beta coefficient is the ordinary least squares (OLS) beta coefficient multiplied by the ratio of the standard deviation of the independent variable (s_{X_i}) to the standard deviation of the dependent variable (s_Y): $\beta_i^* = \beta_i(s_{X_i}/s_Y)$. Calculated CSD can be negative, depending on the relation between independent variables, and the extent to which the explanatory variable explains the variation in the dependent variable. The dependent variable (GPA) is truncated on both

Table 2. Second-Semester Undergraduate GPA Regression Results

Variable	Mean	SD	Min.	Max.	Estimate	t-test	CSD
Dependent Variable							
Second-semester GPA	2.56	0.93	0	4	—	—	—
Intercept ^a	—	—	—	—	-1.458**	-2.08	—
Socioeconomic Variables							
Birth year (19XX) ^a	75.81	2.47	71	80	-0.009	-1.21	-0.002
Female	0.37	0.48	0	1	0.043	1.19	0.003
Married	0.01	0.09	0	1	0.120	0.63	0.000
Military experience	0.003	0.06	0	1	-0.146	-0.47	0.000
Family income (1,000s)	39.44	16.30	9	60	-0.003**	2.40	0.003
Ethnicity: Non-Caucasian	0.03	0.17	0	1	-0.012	-0.10	0.000
County education: percent <9 years ^a	9.12	4.24	2.24	21.34	0.010*	1.65	0.004
County education: percent college ^a	12.25	5.98	5.00	28.06	0.0003	0.06	0.000
High School Experience Variables							
County mean teacher salary ^a	28.18	1.90	23.98	32.68	0.018	1.28	-0.003
County mean pupil/teacher ratio ^a	15.11	2.39	8.91	18.80	0.005	0.50	-0.001
Elected to student office	0.48	0.50	0	1	0.040	1.06	0.005
Varsity athlete	0.79	0.41	0	1	0.015	0.38	0.000
Club/activity recognition or award	0.59	0.49	0	1	-0.013	-0.34	-0.001
Class size	148.83	164.31	12.5	900	0.00002	0.16	0.001
Percent same race	78.74	24.45	5.0	91.0	0.0002	0.23	0.000
Type: private	0.05	0.21	0	1	0.013	0.16	0.000
High School Academic Performance Variables							
ACT composite score ^c	23.08	4.01	12	34	0.010*	1.90	0.021
GPA	3.357	0.47	1.20	3.75	0.107*	1.70	0.029
Grade: English	3.368	0.74	0	4.0	0.043	1.23	0.016
Grade: math	3.164	0.86	0	4.0	0.013	0.48	0.005
Grade: natural science	3.351	0.75	0	4.0	0.061**	1.88	0.021
Grade: social science	3.528	0.66	0	4.0	0.113***	3.13	0.036
College Experience Variables							
First-semester GPA	2.72	0.80	0	4	0.665***	21.36	0.430
Previous college experience	0.19	0.39	0	1	0.033	0.86	0.001
Credit hours attempted	14.25	2.34	2	24	0.041***	4.63	0.042
Major Field of Study							
Animal Sciences and Industry ^b	0.28	0.45	0	1	—	—	—
Recreation and Park Majors ^c	0.05	0.23	0	1	0.084	1.14	0.000
Retail Floriculture and Hort Therapy ^d	0.01	0.07	0	1	-0.231	-0.68	0.000
Milling Science and Management ^e	0.09	0.29	0	1	0.108*	1.65	-0.003
Agronomy	0.05	0.21	0	1	0.119	1.50	0.001
General Agriculture	0.08	0.27	0	1	0.116*	1.81	0.000
Preveterinary Medicine	0.14	0.35	0	1	-0.029	-0.51	0.000
Horticulture	0.05	0.22	0	1	0.074	0.90	0.000
Agricultural Journalism	0.03	0.17	0	1	0.159*	1.76	0.002
Agribusiness and Ag Economics	0.15	0.37	0	1	0.099**	2.01	0.003
Agricultural Education	0.03	0.16	0	1	0.052	0.51	0.000
Agricultural Technology							
Management	0.02	0.15	0	1	0.097	0.78	0.000
Food Science and Industry	0.01	0.10	0	1	0.225*	1.69	0.001

Table 2. Continued

Observations	1303
F-value	55.11***
Root MSE	0.582
R ²	0.617
Adjusted R ²	0.606

Notes: GPA is grade point average; CSD is coefficients of separate determination (Ezekiel and Fox; Burt and Finley); ACT is American College Testing Program; MSE is mean square error.

^a Degrading collinearity exists between the seven continuous variables: intercept, birth year, county education percent <9 years, county education percent college, county mean teacher salary, county mean pupil/teacher ratio, and ACT score. The coefficients remain unbiased, but significance levels may be reduced (Belsley, Kuh, and Welch).

^b Default category, omitted from the regression.

^c Includes majors in Recreation and Park Administration, Park Resource Management, Preforestry, and Pest Science Management. Preforestry and Pest Science Management were discontinued in January 1993.

^d Retail Floriculture was discontinued in January 1993.

^e Includes majors in Feed Science and Management, Bakery Science and Management, and Milling Science and Management.

***, significant at the 0.01 level; **, significant at the 0.05 level; *, significant at the 0.10 level. The *t*-statistics are heteroskedastic-consistent estimates (White).

ends, since it is measured on a scale from 0 to 4. Although double-bounded Tobit estimation provides consistent estimation (Buschena and Watts), OLS estimation is used here to allow for calculation of CSD, providing valuable information regarding the marginal influence of each variable on first-year agricultural college GPA determination.

Results

The regression model explained 48% of the variation in first-semester GPA (Table 1). This result is higher than previous studies, due to the extensive data set, and large number of significant explanatory variables. The regression is subject to degrading collinearity (Be-

Table 3. First-Semester Undergraduate GPA Regression Results: ACT Subtest Scores^a

Subscore	Mean	SD	Min.	Max.	Estimate ^c	<i>t</i> -test	CSD	F-value ^c	R ²	AjR ²
Regression One: Single Regression Including Four ACT Subtest Scores ^b										
English	22.13	4.81	6	36	0.024***	3.77	0.063	32.55***	0.484	0.469
Math	22.10	4.29	11	36	0.020***	3.24	0.047	32.55***	0.484	0.469
Reading	23.52	5.69	8	36	-0.001	-0.16	-0.002	32.55***	0.484	0.469
Science	23.34	4.16	11	36	0.006	0.86	0.047	32.55***	0.484	0.469
Regressions Two-Five: Four Separate Regressions for Each ACT Subtest Score										
English	22.13	4.81	6	36	0.035***	7.39	0.091	34.62***	0.479	0.465
Math	22.10	4.29	11	36	0.036***	6.72	0.084	34.05***	0.475	0.461
Reading	23.52	5.69	8	36	0.019***	5.04	0.044	33.14***	0.468	0.454
Science	23.34	4.16	11	36	0.028***	5.55	0.052	33.40***	0.470	0.456

Notes: GPA is grade point average; ACT is American College Testing Program; and CSD is coefficients of separate determination (Ezekiel and Fox; Burt and Finley).

^a The regression trials in this table include all of the independent variables listed in Table 1, with the exception of the ACT composite score. Only the estimated coefficients for the ACT subtest scores are reported here (*n* = 1,394).

^b Degrading collinearity exists between the continuous variables: intercept, birth year, county education percent <9 years, county education percent college, county mean teacher salary, county mean pupil/teacher ratio, and ACT subtest scores. The coefficients remain unbiased, but significance levels may be reduced (Belsley, Kuh, and Welch).

^c ***, significant at the 0.01 level; **, significant at the 0.05 level; *, significant at the 0.10 level. The *t*-statistics are heteroskedastic-consistent estimates (White).

Table 4. Second-Semester Undergraduate Regression Results: ACT Subtest Scores^a

Subscore	Mean	SD	Min.	Max.	Estimate ^c	<i>t</i> -test	CSD	<i>F</i> -value ^c	<i>R</i> ²	Aj <i>R</i> ²
Regression One: Single Regression Including Four ACT Subtest Scores ^b										
English	22.36	4.74	9	36	0.015**	2.57	0.036	51.26***	0.619	0.607
Math	22.29	4.23	11	36	0.004	0.65	0.008	51.26***	0.619	0.607
Reading	23.69	5.65	8	36	-0.001	-0.27	-0.003	51.26***	0.619	0.607
Science	23.50	4.09	11	36	-0.006	-1.07	-0.010	51.26***	0.619	0.607
Regressions Two-Five: Four Separate Regressions for Each ACT Subtest Score										
English	22.36	4.74	9	36	0.012***	2.99	0.031	55.43***	0.619	0.607
Math	22.29	4.23	11	36	0.008	1.47	0.016	55.03***	0.617	0.606
Reading	23.69	5.65	8	36	0.004	1.25	0.010	54.97***	0.617	0.605
Science	23.51	4.09	11	36	0.003	0.59	0.005	54.89***	0.616	0.605

Notes: GPA is grade point average; ACT is American College Testing Program; and CSD is coefficients of separate determination (Ezekiel and Fox; Burt and Finley).

^a The regression trials in this table include all of the independent variables listed in Table 2, with the exception of the ACT composite score. Only the estimated coefficients for the ACT subtest scores are reported here ($n = 1,303$).

^b Degrading collinearity exists between the continuous variables: intercept, birth year, county education percent <9 years, county education percent college, county mean teacher salary, county mean pupil/teacher ratio, and ACT subtest scores. The coefficients remain unbiased, but significance levels may be reduced (Belsley, Kuh, and Welch).

^c ***, significant at the 0.01 level; **, significant at the 0.05 level; *, significant at the 0.10 level. The *t*-statistics are heteroskedastic-consistent estimates (White).

Isley, Kuh, and Welch) among the seven continuous variables: intercept, birth year, the four county-level education variables, and the ACT composite score. The estimated coefficients remain unbiased, but the level of statistical significance may be reduced for these variables. The CSD values are unaffected by collinearity, and thus provide useful information about the explanatory ability of these variables. Interestingly, first-semester GPA was statistically unrelated to age (birth year), gender, marital status, and family income in the College of Agriculture at KSU during 1990–1999. Birth year is subject to collinearity, but the CSD is negative, indicating lack of explanatory power. Military experience provided a small, statistically significant positive (0.1%) impact on GPA, perhaps due to the maturity and discipline (or both) that characterize experience in the armed forces. Non-Caucasian students had slightly lower GPAs than the default category (Caucasian). The ethnicity CSD is equal to 0.006, reflecting a relatively small influence on the variation in first-semester college GPA.

High school experiences such as elected student offices, athletic participation, and club/activity were not statistically significant ex-

planatory variables for first-semester GPA. Many institutions use this type of information for admission criteria and others use it for freshman scholarship selection. Interestingly, the results reported here do not support use of these data for these purposes. The percentage of college-educated persons in the student's county of residence was positive and statistically significant, although the CSD is negative, indicating that the marginal impact of the variable is positive, but that the variable explains very little of the variation in first-semester GPA.

The significant negative coefficient estimated for the pupil/teacher ratio provides evidence that larger individual high school classroom size was associated with lower college grades. The CSD is equal to 0.008, perhaps reflecting that the amount of financial resources available to high schools influences the quality of preparation for higher education. High school graduating class size and racial composition were not statistically significant determinants of first-semester college academic performance. Interestingly, and as expected, private high schools had a positive association with first-semester GPAs. However, the CSD was equal to zero, indicating a small impact

of high school type on overall college grades in the first semester of college.

As anticipated, academic ability and prior performance had the most significant impact on first-semester college GPA: Composite ACT score explained 9.8% of GPA. The vector of five high school grade variables explained 27.5% of college grades. Overall high school GPA was the variable with the greatest explanatory ability of first-semester college GPA: 12.9% of the variation in college GPA was explained by this variable. High school grades in individual subjects also contributed to higher college GPA: English (7.1%), math (4.2%), and natural science (2.2%). High school social science grades, however, were not statistically significant. The number of credit hours attempted was positively associated with first-semester college GPA, and explained 6.5% of dependent variable variation. The direction of causality of this variable is difficult to assign, since weaker students likely enroll in fewer credit hours each semester. Six of the 12 major field of study variables had significant coefficients: four positive and two negative. Two rigorous majors (Prevet and Milling Science) were associated with lower grades relative to the default category (Animal Sciences), although it is difficult to ascertain any other pattern. These variables are important to include in the regression, however, since they hold constant differences in programs of study, and together explain 2.3% of variation in GPA.

The CSD for groups of variables provide a useful summary of the first-semester GPA regression results. The variables included in the model explained 48% of the variation in GPA. High school GPA has the most predictive ability (CSD = 0.129). Variables available from the ACT report explained 38.5% of GPA variation, whereas the non-ACT variables (the four county-level education variables, credit hours attempted, and major field) together accounted for 9.5%. Thus, the ACT report provides a large amount of data that are potentially useful in the identification of the determinants of first-semester academic performance for KSU agricultural students.

Approximately 62% of second-semester

GPA variation was explained by the model for the 1,303 students who continued their college education beyond the first term (Table 2). First-semester college grades were highly significant, and explained 43% of the variation in second-semester grades. In the second semester, the ACT score was small, positive, and statistically significant at a low level relative to the first-semester regression results. The CSD for the composite ACT score equals 0.021. High school grades are similarly less important in explaining second-semester academic performance, with the exception of the social science grades, which become statistically significant at a high level in the second semester. This may reflect curricula that require social science courses during the second semester.

As in the first-semester regression, credit hours attempted was positive and statistically significant, and five of the major field variables were statistically significant. Interestingly, family income was statistically significant and negative, although only 0.3% of the variation in second-semester grades was explained by family income. Ethnicity results differ from the first-semester regression: There was no statistically significant difference between Caucasian and non-Caucasian students (Table 2). This may be due to non-Caucasian students with low first-semester GPAs not being included in the second-term regressions. The percentage of college-educated adults in the county of residence and the pupil/teacher ratio were not related to second-semester college GPA, although the percentage of individuals with a low level of education was positive and slightly statistically significant. However, the CSD was equal to 0.004, reflecting a small impact on explaining variation in the dependent variable. The marginal impact of low county education level positively influences freshman GPA, holding all else constant, but the variable contributes little to explaining the variation in GPA.

The results for major field also differ between first- and second-semester grades: The rigorous major of Prevet was no longer statistically significantly different from Animal Sciences, and Milling Science majors earned sig-

nificantly higher grades than the default category. This is likely due to the movement of students between major fields of study after one semester of experience, and adjustments in effort levels of the students who remain in rigorous fields of study.

First-semester college grades are the most important explanatory variable of semester-two GPA, overwhelming the ACT score and high school grades. Given this result, one can conclude that standardized test results such as the ACT are useful in explaining first-semester college GPA, but the college record, once it becomes available at the end of the first semester, becomes paramount in explaining grades in subsequent semesters.

Additional information was gained by including ACT subtest scores in regression trials (Tables 3 and 4). Only the results for the estimated coefficients on ACT subtest scores are reported, since the regressions are otherwise nearly identical to those reported in Tables 1 and 2. When all four subtest scores (English, math, reading, and science reasoning) are included in the first-semester regression, English and math scores were statistically significant, and together explained 11% of first-semester grades (Table 3). Since the subtest scores are subject to collinearity, four separate regressions were estimated for each subtest score. All four subtest scores were highly statistically significant and explained between 4.4% (reading) and 9.1% (English) of first-semester GPA variation (Table 3). The explanatory ability of the subtest scores diminished in the second semester (Table 4): Only the English score is statistically significant in regressions that include all subtest scores, and models that include individual subtest scores. This result highlights the dominance of prior college grades in explaining second-semester college grades, over standardized test scores and high school grades.

Implications and Conclusions

The results of this research support the findings of previous literature of college grade determination: Standardized test (ACT) scores explained approximately 10% of the variation

in first-semester college GPA, and just over 2% of second-semester college GPA variation. *High school* grades are the most important determinant of first-semester college grades, whereas first-semester *college* grades have the greatest explanatory ability for second-semester college grades. The empirical results extend our knowledge of the determinants of first-year college academic performance in several important directions. First, the recent and extensive data set yielded greater predictive ability than previous studies, because of the inclusion of a large number of statistically significant variables. Self-reported high school grade variables and standardized test scores were particularly useful in explaining first-semester college grades. One important finding is that high school activities such as athletics, membership in organizations, and elected student offices do not influence college grades during the freshman year. Admission and scholarship decisions based on these characteristics may need to be reviewed, given their lack of ability to explain student academic performance in college.

Most of the explanatory variables were available from the ACT report, suggesting that the ACT exam and data report are valuable not only for the exam scores, but also for the large and convenient data set that accompanies the test results. Colleges and universities that eliminate the use of standardized tests would give up a useful source of information about candidates for admission and enrolled students. Institutions that require the ACT exams "outsource" information collection costs to another firm, and pass direct costs of the exam to the applicant (or parents). If exams were not required, these costs would accrue to the institution, which may not have experience or expertise in testing or data collection.

Calculation of the CSD extends the usefulness of college grade determination studies by quantifying the degree to which the explanatory variables contribute to college GPA: High school GPA explained 12.9% of first-semester GPA, and the ACT score explained 9.8%. In the second semester, both of these grade determinants were overwhelmed by first-semester college grades. English, math, reading, and

science reasoning subtest scores were significant determinants of freshman grades, and English had the largest impact. Standardized test scores, together with accompanying student information, are valuable primarily before student enrollment in first-semester courses. If used appropriately, the information gleaned from the econometric results reported here could be useful to students interested in the characteristics of high school performance and experience that lead to higher college grades. College advisors and administrators could benefit from knowledge of how prior characteristics influence academic performance in colleges of agriculture.

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