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COURSE LENGTH AS A DETERMINANT OF STUDENT PERFORMANCE IN THE PRINCIPLES OF MACROECONOMICS COURSE

GREGORY A. BROWN

A dissertation presented to the
Graduate Faculty of Middle Tennessee State University
in partial fulfillment of the requirements
for the degree Doctor of Arts

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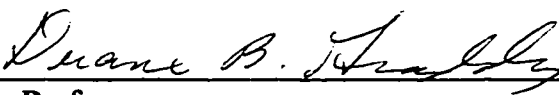
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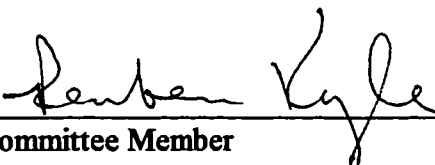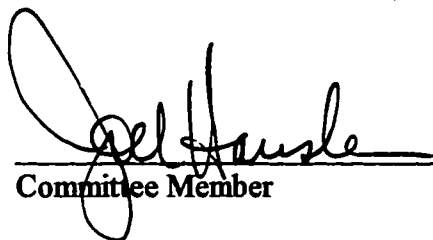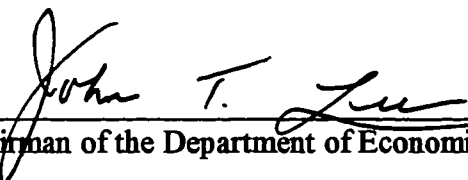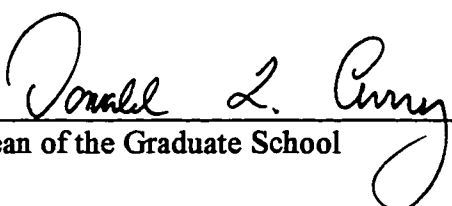
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ABSTRACT

COURSE LENGTH AS A DETERMINANT OF STUDENT PERFORMANCE IN THE PRINCIPLES OF MACROECONOMICS COURSE

by Gregory A. Brown

The primary purpose of this study was to determine if the short sessions 3 weeks, 5 weeks, and 10 weeks had an impact upon the performance of students taking the Principles of Macroeconomics course at Middle Tennessee State University.

This study sought answers to three major questions:

1. Does the natural log of the post-macro TUCE III test scores of classes taught in the 3 week (MAY) session differ from those taught in 15 week sessions.

2. Does the natural log of the post-macro TUCE III test scores of classes taught in the 5 week (SUM) session differ from those taught in 15 week sessions.

3. Does the natural log of the post-macro TUCE III test scores of classes taught in the 10 week (NIGHT) session differ from those taught in 15 week sessions.

Also, of concern, was the methodology used to estimate the production functions that modeled student performance. This study used two production functions, Cobb-Douglas and Translog, and used two estimation procedures, OLS and Heckman's two-step procedure (Select) to estimate the production function parameters. Previous researchers have used OLS procedures but in estimating parameter estimates they failed to consider the students that dropped the course. Therefore, the parameter estimates from the OLS methodology may be biased. Heckman's two-step procedure (Select) removes this bias.

This study included 72 and 183 students at Middle Tennessee State University who took the Principles of Macroeconomics courses in the summer and fall semesters of 1995, respectively.

The macro TUCE III was the instrument used to measure performance and student questionnaires were administered to gather additional demographic information. Also, the records office at Middle Tennessee State University furnished other pertinent academically related information.

Conclusions

1. It was concluded that the 3 week (MAY) time frame was positively related to the post-macro TUCE III test scores using the Translog model and for both estimation procedures (OLS and Heckman's two-step), ceteris paribus.

2. It was concluded that the 5 week (SUM) time frame was positively related to the post-macro TUCE III test scores using the Translog model and for both estimation procedures (OLS and Heckman's two-step), ceteris paribus.

3. It was concluded that the 10 week (NIGHT) time frame was positively related to the post-macro TUCE III test scores using the Cobb-Douglas model with the OLS estimation procedure. Also, the same relationship was found using the Translog model and for both estimation procedures (OLS and Heckman's two-step), ceteris paribus.

Implications

Since the demand for compressed classes is expanding, the conclusion that the 3 week (MAY), 5 week (SUM) and 10 week (NIGHT) time frames are significantly and

positively related to learning allows for the inference that the short time frame offerings at

universities aids in the learning process, ceteris paribus. This conclusion could make it

easier for university officials to expand their summer offerings. This would allow

universities to better serve the needs of an ever growing clientele of older and part-time

students.

ACKNOWLEDGMENTS

The author wishes to express his heartfelt gratitude and appreciation to those that have made this study possible. He would like to thank:

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My family, Mrs. Wanda S. Brown, Ms. Beverly L. Brown, and Mr. Millard Ray Brown whose love and personal support have been unwavering.

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My wife, Mrs. Virginia K. Rogers-Brown, who has been with me throughout this endeavor and whose personal self-sacrifice, understanding, kindness, and love has made this part of our lives a better place to be.

And finally, this writer dedicates this final paper to the memory of Mr. Millard Brown, a loving and supporting father, and Mrs. Jocie Brown, a loving and gentle grandmother.

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CHAPTER I

INTRODUCTION

The question whether a student's achievement is better in a traditional semester length course or in a compressed course is of concern to those teaching in higher education. The question of time has been debated in the contexts of mini-terms, summer sessions, semesters, quarters, night versus day, and intensive workshops. At institutions of higher education the calendar period has been altered with little regard and little research pertaining to the impact of such scheduling changes on the learning process. [1]

Part-time students and employers wanting to upgrade their employees' skills are becoming an ever increasing part of the university's clientele. From 1970 to 1990, the number of part-time undergraduate students more than doubled. [2] One-third of all undergraduate-level and two-thirds of master's-level enrollments were part-time in 1992. In the same year, thirty-nine percent of all baccalaureate-level enrollment was part-time and 42 percent of part-time students were in four year institutions of higher education. [3]

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[1]   Powell, Barbara S., Intensive Education: The Impact of Time on Learning. Newton, Mass.: Educational Development Center, Inc., 1976.

[2]   O'Brien, Eileen M., "Part-time Enrollment: Trends and Issues.": American Council on Education, One Dupont Circle, Suite 800, Washington, D.C. 1992, ERIC, ED 353872.

[3]   National University Continuing Education Association, Lifelong Learning Trends: A Profile of Continuing Higher Education. 2nd Ed., Publications Office, One Dupont Circle, N.W., Suite 615, Washington, D.C. 1992, ERIC, ED 353376.

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Furthermore, half of all college students were over the age of 25.[4] The National Center

for Educational Statistics projects that in 1998, of all higher education students,

approximately 72 percent will be part-time adult learners.[5]

The projected change in the age distribution of students and the growth of part-

time enrollments has important policy, curriculum, scheduling, and class location

implications for universities.[6] Scheduling classes around work and family may determine

whether adult learners can attain a degree or not. The 1970 Gould Commission Study

reports that adult learners have a clear preference for compressed schedules.[7] Adult

learners prefer summer school because they are provided with greater flexibility, access to

courses that are not available during the regular school year, and the opportunity to

accelerate their graduation.[8] A 1992 study by the National University Continuing

Education Association determined that the primary barrier to adult learners attending

college classes was inconvenient class scheduling. Corporations want courses offered in

compressed schedules to better fit the work schedules of their employees. Because most

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[4]   Kerta, Sandra., "Part-time Students in Higher Education. Trends and Issues Alerts."
Clearinghouse on Adult, Career, and Vocational Education, Columbus, Ohio. 1992, ERIC, ED 342931.
[5]   National University Continuing Education Association, Lifelong Learning Trends: A Profile of
Continuing Higher Education. 2nd Ed., Publications Office, One Dupont Circle, N.W., Suite 615,
Washington, D.C. 1992, ERIC, ED 353376.
[6]   Conrad, Judi., "Educating Part-time Adult Learners in Transition." ERIC Clearinghouse on
Higher Education, One Dupont Circle, Suite 630, Washington, D.C., 20036, 1993, ERIC, ED 360946.
[7]   Carnegie Council on Policy Studies in Higher Education, Three Thousand Futures. San
Francisco: Jossey-Bass, 1980.
[8]   National University Continuing Education Association, Lifelong Learning Trends: A Profile of
Continuing Higher Education. 2nd Ed., Publications Office, One Dupont Circle, N.W., Suite 615,
Washington, D.C. 1992, ERIC, ED 353376.

adult learners have jobs and because their jobs must come first in priority, adult learners need classes in the early morning or at night. Part-time students have a clear preference for morning classes starting between 7 a.m. and 10 a.m. and evening classes that start between 5 p.m. and 7 p.m.[9]

More than one-half of all part-time college students worked full-time in 1992 and primarily attended classes during the morning and evening hours. Employee educational assistance is a benefit provided by employers to defray educational expenses for employees who are furthering their education. According to the National University Continuing Education Association, 86 percent of the manufacturing industry and 76 percent of the non-manufacturing industry provide such assistance to their employees. Ninety-two percent of insurance firms reported providing educational assistance to their employees; while more than 80 percent of the food, beverage and tobacco, petroleum, instrument, public utilities and banking and finance firms reported providing educational assistance. Employees receiving aid from these industries pursue course work in concentrated areas such as business, science, and technology.[10]

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[9]   Ibid.

[10]   National University Continuing Education Association, <u>Lifelong Learning Trends: A Profile of Continuing Higher Education.</u> 2nd Ed., Publications Office, One Dupont Circle, N.W., Suite 615, Washington, D.C. 1992, ERIC, ED 353376.

Buttressing the need for part-time courses, college graduates will earn approximately 27 percent more than their high school counterparts over a lifetime.[11] Additionally, real family income from 1970 to 1990 has grown slower than the cost of health-care, housing costs and college tuition. Together, the increased potential for more income and the increased real cost of college tuition combine to provide strong incentives for people to go to college on a part-time basis.[12]

In general, the clienteles of universities are older and working while attending university classes on a part-time basis. As a consequence, they prefer classes in more compressed time frames rather than the traditional 15 to 16 week semester course. Universities are responding to the change in demand by offering classes in summer sessions, at plant sites, and at night. The question whether learning is affected by alternative class scheduling is the focus of this study.

Non-traditional Scheduling and Learning

In a summer session, individual classes are typically longer than in regular term courses. However, the aggregate number of hours spent in class is the same. Instead of spending 15 to 16 weeks covering the material as in a regular semester term course, the

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[11] National University Continuing Education Association, Lifelong Learning Trends: A Profile of Continuing Higher Education. 2nd Ed., Publications Office, One Dupont Circle, N.W., Suite 615, Washington, D.C. 1992, ERIC, ED 353376.
[12] Ibid.

material is covered in 3 to 10 weeks in the summer. The question if learning and achievement is affected by expanding class contact hours per week is an important issue.

Some educational psychologists use an information processing approach to explain the impact of time compression on the learning process. According to this approach, students receive information through their physical senses (seeing, hearing, touching, smelling, or tasting) similar to a computer receiving digital impressions through its receptors (screen, modem, keyboard). Information then moves to the pattern recognition stage and on to the short-term memory. From there information passes to the long-term memory. Factors fostering the movement of information from the short-term memory to the long-term memory remain obscure. However, two factors are known to influence the transfer of data from receptors to short-term memory and the movement from short-term memory to long-term memory. The first factor is the amount of data being processed and the second is the passage of time.[13]

Psychologists have determined that the adult mind can maintain between 5 to 7 "chunks" of independent information (plus or minus two), in short-term memory at the same time.[14] While "chunks" can vary in complexity, any information received after the 5 to 7 "chunks" is lost.[15] At the point where elements or "chunks" are added to an

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[13]   Dembo, M. H., Applying Educational Psychology. New York, Longman Publishing Group, 5ed., 1994. 104-109.
[14]   Saunders, Phillip and Walstead, William B., The Principles of Economics Course A Handbook for Instructors. McGraw-Hill, Inc., 1990, 67-68.
[15]   Miller, George A., "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity For Processing Information." The Psychological Review. 63, no. 2, (March 1956): 81-97.

intellectual task confusion or inefficiency can arise leading to "mental dazzle" and the loss

of information. Because long-term memory has a relatively unlimited storage capacity for

"encoded" or "meaningful" information, capacity of the long-term memory does not seem

to be a problem with the movement of information from short-term memory to long-term

memory. However, when the short-term memory is at its maximum capacity, newly

entering information "pushes out" old items causing "mental dazzle."

The limitation of the short-term memory militates against learning in compressed

sessions. As more material is covered in longer classes, the "chunks" of information in

short-term memory increase portending the loss of information. Unless the student

studies after class "rehearses," the amount of learning may be less in a compressed session

than in a regular term course.

Another factor affecting the recall of learned material is time. After material is

learned, as the length of time increases, the recall of that material diminishes. This

observed relationship would indicate that students in the compressed sessions should

perform better than those in the regular semester courses.[16]

In summary, there are two influences on learning: the memory overloading factor

and the time factor for recall. The memory overloading factor indicates that as the amount

of information during a particular time frame increases; the short term memory becomes

overloaded. Consequently, the amount of information going into long-term memory

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[16]   Woolfolk, A. E., Educational Psychology. Boston: Allyn & Bacon, 1993, 5th Ed., 243-258.

decreases. The time factor for recall relates that as the amount of time increases from when material passes to long-term memory, the amount of the learned material that can be recalled decreases.

Classes in a compressed session are longer than in regular term (15 week) courses. Since the amount of material covered is the same, the memory overloading factor should influence learning negatively in short sessions. However, since classes are completed within a 3 to 10 week time frame instead of the traditional 15 to 16 week time frame, the time factor for recall should influence learning positively. Because Principles of Macroeconomics is taught at universities in both compressed and regular length classes and since the time factor for recall and the memory overloading factor may exert potentially conflicting influences upon learning, teachers and researchers in the field of economics will be interested in the outcome of this study.

Statement of the Problem

The question considered here is whether the time-frame in which the Principles of Macroeconomics course is offered has an impact upon student learning. The purpose of this study is to determine if students' achievement in Principles of Macroeconomics classes is different in the compressed time frames of 3 week, 5 week, or 10 week sessions versus the regular fall semester classes. Compressed course offerings may be increased without any substantive change in learning only if student performance is no different in the

compressed time frames compared to the regular session. If performance is no different or

better in the compressed time frames the ability of the university to serve its clientele of

part-time students will be increased while maintaining the quality of their educational

experience.

Hypotheses

This dissertation tests the following null hypotheses.

Hypothesis 1:   There is no difference between the natural log of the post-macro
TUCE III test scores of classes taught in the 3 week (MAY)
session and those taught in 15 week sessions.

Hypothesis 2:   There is no difference between the natural log of the post-macro
TUCE III test scores of classes taught in the 5 week (SUM) session
and those taught in 15 week sessions.

Hypothesis 3:   There is no difference between the natural log of the post-macro
TUCE III test scores of classes taught in the 10 week (NIGHT)
session and those taught in 15 week sessions.

This study uses student characteristics, professor characteristics, time frames, and

other variables to develop a production function to predict the post-macro TUCE III test

score.

Limitations and Assumptions of the Study

1. Student learning is measurable.

2. The macro Test of Understanding in College Economics (TUCE III), is an appropriate measure of student academic achievement in Principles of Macroeconomics.

3. The higher the score on the post-macro TUCE III test, the greater the student's learning.

4. The procedures used in selection of sample groups of students is valid.

5. The content of the classes is representative of the content of other similar classes and is therefore appropriate for generalization.

6. All extraneous variables affecting the experiment have been provided for through the experimental design and statistical treatments.

7. Student self reports are accurate.

8. The teaching methods for each instructor were assumed to remain the same regardless of calendar schedule.

9. Students at Middle Tennessee State University were the sample; therefore results will be generalizable to schools that are similar to MTSU.

Definitions

Throughout the study the following definitions will apply.

Achievement. Learning attainment as measured by post-macro TUCE III scores.

Adult student. A student who has been out of high school for at least one year without attending college.

Compressed classes. A class lasting less than 15 weeks.

ECON 241. The prefix and number used at Middle Tennessee State University for the Principles of Economics semester course in Macroeconomics.

Instruction. The formal process of teaching in an institution of learning.

Learning. The acquisition and retention of knowledge and habits of thought in a way that permits them to be employed in a useful way after the initial exposure has been terminated.

Macro TUCE III. The name of a test (Test of Understanding in College Economics) published by the National Council on Economic Education which measures the learning in macroeconomics courses.

Nontraditional student. An adult, part-time student.

Part-time student. A student who is enrolled in fewer hours than the institution requires for full-time students.

Post. The designation means activities that occur after the completion of all lectures in the course.

Pre. The designation means activities that occur before any formal lectures.

Regular semester. A sixteen-week semester.

Retention. The process of maintaining the availability of a replica of previously learned materials.

Traditional student. A full-time student who enrolls in college directly from high school.

Organization of the Study

Chapter 2 reviews the literature pertaining to the course length and student performance in Macroeconomics courses. Chapter 3 describes the data collection process, experimental design, and the measurement instruments used along with the statistical techniques used in the evaluation and analysis of the data. Chapter 4 interprets the statistical results obtained in this experiment. Chapter 5 summarizes the study and makes recommendations for further research.

CHAPTER II

LITERATURE REVIEW

Few studies have addressed the question of time and its effect on learning in economics. The results of studies that have considered the question are generally inconsistent. Also, none of the studies considered the sample selection bias caused by students dropping the course. The following is a review of previous experiments and their results. A summary of the following may be found in Table 1 at the end of this chapter.

Dennis Murphy reported on the results of an intensive two-week Economics Institute conducted in June 1978 at Emory University. He found no statistical difference between the performance of the Institute's students' scores on the TUCE exam and that of the normed scores for the TUCE exam. This was statistically true for both the micro and macro tests. At the Institute, the amount of actual contact time was reduced to less than twenty hours each for micro and macro. Students in the Institute were faculty from local high schools however most had no prior formal education in economics (Murphy, 1979).[17]

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[17]   Murphy, D. R. "Learning and Intensive Instruction." Journal of Economic Education. 11, no. 1, (Fall 1979): 34-36.

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These results suggest that the time factor for recall offsets the short-term memory overloading factor.

In 1985, Joyce Gleason conducted research using data from students in seven sections of Principles of Macroeconomics courses. Achievement was defined as the post-test score on the RTUCE. OLS methodology was used to determine the parameters' values.[18]

The production-function model treated the calendar period as one of several independent input variables and economics achievement as a dependent output variable. The hypothesis that there was no difference between students' performance in the five-week summer course and regular semester classes was not rejected. The same model rejected the hypothesis of no difference between students' performance in three-week compressed course versus regular semester classes. A positive influence on achievement was found for students enrolled in the more intensive three-week short course.

From an information processing perspective, the positive influence of the three-week time variable on the post-test score on the RTUCE suggests that the short-term memory overloading factor was dominated by the time factor for recall. Since the five-week time variable had no effect on learning versus the regular semester students, neither short-term memory overloading nor the time factor for recall was a factor in determining performance in the five week session. This finding coupled with the results of hypothesis

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[18]   Gleason, Joyce P., Economic Models of Time in Learning. Unpublished Ph.D. Dissertation. Lincoln: University of Nebraska, 1985.

testing suggest that intensive courses may require less time and therefore may be less costly for the student to obtain the same or better achievement levels.

Michael Watts and Gerald Lynch concluded that academic achievement as measured by a student's grade in the Principles of Macroeconomics Maymester course (3 week classes) was significantly positively related to the May time frame using traditional OLS analysis.[19] Their results suggest that the short-term memory overloading factor was less influential than the time factor. These results parallel Gleason's findings.

In Watts and Lynch's study, academic achievement in the Principles of Macroeconomics summer term course (8 week classes) was found to be negatively related to the compressed time frame when OLS methodology was used; whereas, Joyce Gleason found no relationship between the 5 week summer time frame and performance. In the same study no difference in performance was found in the 3 or 5 week microeconomics courses compared to the traditional semester length course.

In another study Lee Scyoc and Joyce Gleason compared the academic achievement of two levels of microeconomics students (principles and intermediate) at the University of Wisconsin-Oshkosh. The time frames compared were a 3-week period where students met five times a week for three hours each day and a more traditional 14-week semester where students met twice a week for one and one-half hours each meeting.

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[19]   Watts, Michael and Lynch, Gerald, J. The Principles Courses Revisited. American Economic Association Papers and Proceedings. 79, no. 2, (May 1989): 236-241.

The score on the RTUCE was the dependent variable and OLS methodology was used to analyze the data.

Students in the 3-week course did better than the students who took a traditional semester-length course. Statistical results revealed that the 3-week students scored 10.5% better on the RTUCE than the 14-week students (a statistically significant difference). The researchers also looked at the exams administered by the professors and found that the 3-week students scored 10.4% higher than the 14-week students (a statistically significant difference). These results suggest that the short-term memory overloading factor may be less significant than the time factor in determining student recall. However, when knowledge retention was measured (by the score on the RTUCE from a sample of intermediate students who had been in the Principles of Microeconomics courses), no significant difference was found between those who had taken Principles of Microeconomics in the 3-week or the 14-week sessions.[20]

To summarize, (refer to Table 1) Dennis Murphy found no difference between normed TUCE scores and his 2 week summer Institute's scores in both the micro and macro sections. Gleason found that the 3 week macro student's performance exceeded that of the fall students; but, found no difference in performance in her 5 week macro student's performance and falls students. Watts and Lynch found a statistically positive relationship between the 3 week time frame and the performance of students in Principles

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[20]   Scyoc, L. J. Van, & Gleason, J. "Traditional or Intensive Course Lengths? A Comparison of Outcomes in Economics Learning." Journal of Economic Education. 24, no. 1, (Winter 1993): 15-22.

of Macroeconomics; but, found a statistically negative relationship between student performance and the 8 week time frame. Watts and Lynch found no difference in performance between the 3 week or 8 week microeconomics students' performance compared to the fall classes. Scyoc and Gleason found a positive relationship between the 3 week time frame and performance in the microeconomics classes.

TABLE 1

Studies relating performance and time frame by author.

Study	Dennis Murphy 1979		Joyce Gleason 1985		Watts and Lynch 1989		Watts and Lynch 1989		Scyoc and Gleason 1993
Class	Micro 2 Week	Macro 2 Week	Macro 3 Week	Macro 5 Week	Macro 3 Week	Macro 8 Week	Micro 3 Week	Micro 8 Week	Micro 3 Week
Independent Variable	TUCE	TUCE	RTUCE	RTUCE	Course Grade	Course Grade	Course Grade	Course Grade	RTUCE
Statistical Difference between normed scores and actual @ 5% alpha?	No	No	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested
Statistical Difference between fall and compressed time @ 5% alpha?	Not Tested	Not Tested	Yes compressed better.	No	Yes, compressed better.	Yes, compressed better.	No	No	Yes, compressed better.

CHAPTER III

RESEARCH PROCEDURES AND METHODOLOGY

Research Model

Following Douglas and Sulock,[21] the theoretical basis of this analysis is a

production function model of student learning in the Principles of Macroeconomics

classes. Each student i, that perseveres in the course, achieves a level of performance, p_i,

measured by their score on the post-macro TUCE III exam.[22] The individual's

performance is determined by characteristics specific to the individual, their motivation,

and their level of effort. Thus,

$$p_i = f(x_i; \beta) + \varepsilon_i \tag{1}$$

where x_i is a vector of student characteristics such as age, gender, and gpa and factors

relating to the course such as professor and time frame; f is the student's production

function for the course; β is a vector of parameters, and ε_i is the disturbance term.

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[21] Douglas, Stratford and Sulock, Joseph. "Estimating Educational Production Functions with Correction for Drops." Journal of Economic Education. 26, no. 1 (Spring 1995): 100-112.

[22] Siegfried, John J. and Fels, Rendigs. "Research on Teaching College Economics: A Survey," Journal of Economic Literature. 17, no. 3 (September 1979): 923-969.

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Performance, p_i, is measured at the end of the course and thus only if the student completes the course.

Student i's probability of staying in the class is determined by the student's characteristics, their expected performance in the course, and time constraints on the student. That is,

$$\upsilon_i = u\,[w_i, E(p_i); \gamma] + \delta_i \qquad\qquad (2)$$

where υ_i is the utility the student expects from completing the class, γ is a vector of unobserved utility function parameters, w_i is the vector of student characteristics, and δ_i is a random disturbance. The student will continue in the class if their expected utility, υ_i, is sufficiently high.

Since υ_i is not directly observable, an indicator variable, χ_i, equals one if student i stays in the class, or zero otherwise. Thus,

$$\chi_i = \begin{cases} 1 \text{ if } \upsilon_i > d_i \text{ student stays in class} \\ 0 \text{ if } \upsilon_i < d_i \text{ student drops class} \end{cases}$$

where d_i is the student's expected utility if the class is dropped. The artificial variable χ_i is created as a proxy for γ_i and is used as the dependent variable in a probit equation. The probit model is estimated as the first step in the procedure discussed below.

Heckman's[23] two-step estimation procedure is used to estimate the parameters in the post-macro TUCE III production function. The first step involves the estimation of a probit model by maximum likelihood to estimate γ, the vector of parameters in the utility function.[24] For each observation in the sample of students beginning the course, the Inverse Mills Ratio (IMR) is computed by:

$$\hat{\lambda} = \frac{\phi\left(\hat{\gamma}w\right)}{\Phi\left(\hat{\gamma}w\right)}$$

Where ϕ is the standard normal probability density function and Φ is the standard normal cumulative density function.

In the second step, two stage least squares is used to estimate the production function:

$$p \mid \upsilon > d = f(x,\beta) + \beta_2 \hat{\lambda} + \varepsilon \qquad\qquad (3)$$

(the subscript $_i$ is dropped for ease of exposition) where the inclusion of the IMR term will correct for the bias that would have otherwise occurred.[25]

Also, ordinary least square (OLS) regression will be used to estimate equation (1). Since all prior research pertaining to academic performance and time frames has used OLS multiple regression estimation techniques to arrive at parameter values (refer to Chapter

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[23] Heckman, J., "Sample Selection bias as a Specification Error," Econometrica, 47, (1979): 153-161.

[24] Greene, William H. Econometric Analysis. MacMillan Publishing Company, 1993, 744.

[25] Ibid.

II), OLS results along with the bias corrected results from Heckman's two-step estimation procedure hereafter labeled (*Select*) is presented. By presenting the results from both estimating procedures a determination can be made as to whether the statistical method used makes a difference in determining which factors influence the performance and may help to explain inconsistencies in past studies as well as, the direction of the influence (positive or negative).

The Cobb-Douglas and translog models were chosen to model learning as they are widely used in the literature [26] and their properties are well known. Researchers such as: Guilkey, Lovell, and Sickles [27] and Caves and Christensen [28] have investigated the ability of these forms to approximate more complex forms.

The functional form of the Cobb-Douglas production function is:

$$\ln p_i = \sum_{i=1}^{k} \beta_i \ln x_i + \pi_i \qquad (4)$$

The functional form of the Translog production function is:

$$\ln p_i = \sum_{i=1}^{k} \beta_i \ln x_i + \sum_{i=1}^{k} \sum_{j=1}^{k} \beta_{ij} \ln x_i \ln x_j + \kappa_i \qquad (5)$$

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[26]   Refer to Chapter 2 for examples of empirical use of these models.
[27]   Guilkey, D. K., Lovell, C. A. K., and Sickles, R. C., "A Comparison of the Performance of Three Flexible Functional Forms." International Economic Review, 24 (October 1983): 591-616.
[28]   Caves, D. W., and Christensen, L. R., "Global Properties of Flexible Functional Forms." American Economic Review, 70 (June 1980): 422-432.

Where ln p_i is the natural log of the post-macro TUCE III test score, x_i is a vector of student characteristics and factors relating to the course, β is a vector of parameters, and π_i and κ_i are disturbance terms. IMR is added to the Cobb-Douglas select and translog select models as an additional regressor [29].

The Sample

The present study analyzes data on 72 and 183 students who took the Principles of Macroeconomics course at Middle Tennessee State University in the summer and fall semesters of 1995, respectively.

Student questionnaires and the pre-macro TUCE III exams were administered the first day of class. The post-macro TUCE III was administered the last day of class. The time required for the administration of the exam and questionnaire was 55 minutes. The student questionnaire is included as Appendix I. To be considered for the sample, the professor had to be teaching the same class in both the summer and fall and the classes had to be ECON 241.

Student ID numbers were submitted to the Middle Tennessee State University records office and that office supplied data on the student's: cumulative GPA, cumulative

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[29]   In this study a modified form of the translog model is used, only first and second order terms are included.

hours attained, current semester number of hours completed (current semester is the semester in which the economics course was taken), transfer status, gender, and age.

The fall semester classes were 15 weeks in length and met either 30 or 46 times. The May term class (MAY) was 3 weeks in length (15 meetings) and met Monday through Friday. The summer classes (SUM) were five weeks long (19 meetings). The summer night class (NIGHT) met twice a week for 10 weeks (20 meetings).

Model Variables

Listed below are the variables used in the estimating equations.

LNPRE   The natural log of the predictive variable pre-macro TUCE III score.

BMAJ   The predictive dummy binary variable area of study which takes the value of 0 if the student is not a business major and 1 if the student is a business major.

CAMPUS   The predictive dummy binary variable which takes the value of 0 if the student lives on campus and 1 if the student commutes.

TRANSFER   The predictive binary variable which takes the value of 0 if the student is not a transfer and 1 if the student is a transfer.

DEV   The dummy binary variable distinguishing between developmental and non-developmental students. The variable takes on a value of 1 for developmental students and 0 otherwise.

MAR   The dummy binary variable distinguishing between single and married students. The variable takes on a value of 1 for married students and 0 otherwise.

GEN   The predictive dummy binary variable for gender which takes the value of 0 if male and 1 if female.

FAST   The predictive dummy binary variable measuring motivation which takes the value of 0 if the student responds no to the question "Are you taking the class to graduate faster than normal?"

RETAKE   The predictive dummy binary variable measuring motivation which takes the value of 0 if the student responds no to the question "Are you retaking the class to better the grade which you received before?"

LNALLGPA   The natural log of the predictive variable cumulative grade point average.

LNNOWHRS   The natural log of the predictive variable current course load.

LNAGE   The natural log of the predictive variable age.

LNALLHRS   The natural log of the predictive variable cumulative hours taken at the university level.

NIGHT   The dummy binary variable which takes the value of 1 if the student was enrolled in the summer night class (10 weeks); 0 otherwise.

PROA   The predictive variable for instructor. A dummy binary variable used to distinguish Professor A. The variable takes on the value of 1 if the student is in Professor A's class and 0 otherwise.

PROB   The predictive variable for instructor. A dummy binary variable used to distinguish Professor B. The variable takes on the value of 1 if the student is in Professor B's class and 0 otherwise.

PROC   The predictive variable for instructor. A dummy binary variable used to distinguish Professor C. The variable takes on the value of 1 if the student is in Professor C's class and 0 otherwise.

MAY   The predictive dummy binary variable indicating the time frame in which the course was taken. Takes the value of 1 if the course was taken in the May (3 week) intersession and 0 otherwise.

SUM   The predictive dummy binary variable indicating the time frame in which the course was taken. Takes the value of 1 if the course was taken in the summer (5 week) term and 0 otherwise.

LNPOST   The natural log of the dependent variable post-test score on the macro TUCE III exam.

IMR   The Inverse Mills Ratio. The variable created in the Probit MLE regression and included in the Cobb-Douglas Select and Translog Select production function estimations to correct for students dropping out of the class.

SQALLGPA The square of the natural log of cumulative grade point average.

SQALLHRS The square of the natural log of cumulative hours taken.

SQNOWHRS The square of the natural log of hours of current enrollment.

SQAGE   The square of the natural log of the age of the student.

Selection of Research Instrument

The instrument used to measure student achievement in the Principles of

Macroeconomics classes is the macro TUCE III (Test of Understanding of College

Economics). Since teacher-made tests constructed from textbook test banks are not

acceptable for research work,[30] the macro TUCE III was chosen because of its validity

and reliability.[31]

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[30]   Siegfried, John J. and Fels, Rendigs. "Research on Teaching College Economics: A Survey," Journal of Economic Literature. 17, no. 3 (September 1979): 923-969.
[31]   Saunders, Phillip and Walstead, William B., The Principles of Economics Course A Handbook for Instructors. McGraw-Hill, Inc., 1990, 271.

Validity assesses whether a test measures what it is supposed to measure and is perhaps the most important characteristic of any test.[32]   In this study it is assumed that the macro TUCE III has content validity. This however may not be the case for particular professors.[33]

Test reliability refers to consistency of measurement. Any test score contains a certain degree of error of measurement. For this reason, if a student were tested a number of times, the scores would be expected to vary. A reliability coefficient may be thought of as an estimate of the correlation between scores obtained on one test at one time and those obtained on a similar test at different time.[34]

A statistical measure used to establish the macro TUCE III reliability is the Kuder-

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[32]   Carmines, E. G., and Zeller, R. A., Reliability and Validity Assessment. Beverly Hills, CA: Sage Publications, 1979: 17-27.
[33]   Soper, John C. and Brenneke, Judith, Staley, "A Note on Economic Content and Test Validity." Journal of Economic Education, 18, no. 3 (Fall 1987): 420-424.
[34]   Saunders, Phillip, Test Of Understanding In College Economics, Examiner's Manual. 3d ed., Joint Council On Economic Education, 1991, 7.

Richardson Formula 20.[35] The reliability coefficient for the 33 question Macro test is .75.[36] The higher the coefficient, the more consistent is the measure. The macro-TUCE III is designed to be a norm-referenced test that can be used to discriminate among students across a broad range of intellectual ability and knowledge.

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[35] The formula for the K-R 20 is: $r_{20} = K/(K-1) \ [1-(\Sigma pq/S_x^2)]$ where K = number of test items; p = number of students who answer an item correctly divided by the total number of students in the norming group, and S_x^2 = variance for the total test scores.

[36] Saunders, Phillip, Test Of Understanding In College Economics, Examiner's Manual. 3d ed., Joint Council On Economic Education, 1991, 7.

CHAPTER IV

STATISTICAL FINDINGS AND INTERPRETATIONS

The data for this study were processed using the LIMDEP program.[37] The results are presented in this chapter. Refer to Tables 2-5 at the end of this chapter for a compilation of statistical results.

Descriptive Statistics

The average pre-macro TUCE III test score for all finishing or staying students in the 3 week, 5 week, 10 week, and 15 week time frames were: 10.08, 9.26, 11.36 and 9.39 respectively. The standard deviation of the sample means were: 3, 3.02, 3.23, and 2.98 respectively. The number of students in the sample were: 12, 27, 14, and 104 respectively. The combined average for all MTSU classes was 9.6 with a standard deviation of 3.04. The number of students in the sample was 157. The normed mean score for comparison is 10.57 with a standard deviation of 3.45.[38] A *t* test was

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[37]   Greene, William H. LIMDEP, Version 6.0, Econometric Software, Inc. 43 Maple Avenue, Bellport, NY 11713.

[38]   Saunders, Phillip, Test Of Understanding In College Economics, Examiner's Manual. 3d ed., Joint Council On Economic Education, 1991, 19.

calculated to test for differences in means (refer to Table 2 at the end of this chapter). Statistically significant differences were found between the pre-macro TUCE III normed average and the 5 week class average (these classes were significantly below), 10 week class average (these classes were significantly higher), and the MTSU combined average (this average was significantly below). The 10 week average was significantly higher than the 5 week, 15 week and combined MTSU average.

The post-macro TUCE III test scores for the 3 week, 5 week, 10 week, and 15 week time frames were: 14.75, 13.15, 16.5, and 11.51 respectively. The standard deviation of the sample means were: 5.05, 4.7, 4.72, and 4.07 respectively. The number of students in the sample were: 12, 27, 14, and 104 respectively. The combined average for all MTSU classes was 12.48 with a standard deviation of 4.56. The number of students in the sample was 157. The normed mean score for comparison is 15.15 with a standard deviation of 5.40.[39] A t test was calculated to test for differences in means (refer to Table 3 at the end of this chapter). The post-macro TUCE III normed scores were significantly higher than the 5 week, 15 week, and combined MTSU averages. The combined MTSU average was significantly lower than the 3 week and 10 week averages. However, the combined MTSU average was significantly higher than the 15 week average. The 10 week average was significantly higher than the 5 week and 15 week averages. It is also interesting to note that the fall class average was significantly below

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[39]   Saunders, Phillip, Test Of Understanding In College Economics, Examiner's Manual. 3d ed., Joint Council On Economic Education, 1991, 19.

the post-macro TUCE III normed score, combined MTSU average, 3 week, 5 week, and 10 week averages.

Each session's post-macro TUCE III average score significantly exceed the pre-macro TUCE III average score (refer to Table 4 at the end of this chapter). However, the pre-macro TUCE III average score for the 10 week (NIGHT) time frame was equal to the post-macro TUCE III average score for the 5 week (SUM), 15 week fall and the overall MTSU average (refer to Table 4). Also, there was no statistical difference in the average pre-macro TUCE III score of the 3 week (MAY) summer time frame and the average post-macro TUCE III average for the 15 week fall time frame.

In every time frame, taken as a group, students who dropped the course caused the average grade point average in that time frame to increase. In the May session, the beginning average GPA was 2.42 and after drops it increased to 2.68, a 10.75% increase. In the summer time frame, the beginning average GPA was 2.56 and after drops increased to 2.65, a 3.5% increase. In the 10 week time frame, the beginning average GPA was 2.54 and after drops increased to 2.83, a 11.4% increase. And finally, in the fall time frame, the beginning average GPA was 2.37 and after drops increased to 2.46 which translates to a 3.8% increase.

Results of Hypothesis Testing

The research hypotheses of interest were:

Hypothesis 1:   There is no difference between the natural log of the post-macro TUCE III test scores of classes taught in the 3 week (MAY) session and those taught in 15 week sessions.

Hypothesis 2:   There is no difference between the natural log of the post-macro TUCE III test scores of classes taught in the 5 week (SUM) session and those taught in 15 week sessions.

Hypothesis 3:   There is no difference between the natural log of the post-macro TUCE III test scores of classes taught in the 10 week (NIGHT) session and those taught in 15 week sessions.

Testing hypothesis 1 with the Cobb-Douglas OLS and Select regressions' p-values on the variable MAY, hypothesis 1 is not rejected (refer to Table 5 for statistical results). The p-value of .101 for the OLS regression and .701 for the Select regression are too large. The OLS regression results are not consistent with those of Scyoc and Gleason[40] and Gleason[41].

Testing hypothesis 1 with the Translog[42] OLS and Select regressions' p-values for the variable MAY, hypothesis 1 is rejected. The p-value of .056 for the OLS regression and .066 for the Select regression allows for the rejection of hypothesis 1. Looking at the sign on the estimated coefficient which is positive, one may conclude that those students

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[40]   Scyoc, L. J. Van, & Gleason, J. "Traditional or Intensive Course Lengths? A Comparison of Outcomes in Economics Learning." Journal of Economic Education. 24, no. 1, (Winter 1993): 15-22.
[41]   Gleason, Joyce P., Economic Models of Time in Learning. Unpublished Ph.D. Dissertation. Lincoln: University of Nebraska, 1985.
[42]   The translog models are restricted by limiting cross-product terms.

who took the Principles of Macroeconomics course in the 5 week (May) time frame scored higher on the post-macro TUCE III than those students taking the same course in the Fall time frame. Again, these results are intuitively satisfying since the students in the May time frame scored on average 28% higher than those in the fall time frame.

Testing hypothesis 2 with the Cobb-Douglas OLS and Select regressions' p-values on the variable SUM, hypothesis 2 is not rejected. The p-value of .164 for the OLS regression and .655 for the Select regression does not allow for the rejection of hypothesis 2. Since the p-value for SUM exceeds .10 the regression coefficients are not significantly different from zero. This result suggests that the 5 week summer time frame had no significant effect upon student performance, ceteris paribus.

Testing hypothesis 2 with the Translog OLS model's p-value on the variable SUM which is .09 allows for the rejection of hypothesis 2. Inspecting the sign on the coefficient which is positive, this suggests that the summer (5 week) time frame had a positive effect upon performance, ceteris paribus.

The Translog Select model's p-value on SUM of .066 also permits for the rejection of hypothesis 2. Since the sign on the SUM coefficient is positive; one can conclude that those students which took the Principles of Macroeconomics course in the summer scored significantly higher on the post-macro TUCE III exam, ceteris paribus. These results are more in keeping with the average performance on the post-macro TUCE III exam; since those students taking the Principles of Macroeconomics course in the

summer scored 14% higher on the post-macro TUCE III test than those students taking the same course in the fall. The sign on the summer variable is the opposite to that found by Watts and Lynch[43]

Testing hypothesis 3 with the Cobb-Douglas OLS regression's p-value on the variable NIGHT, hypothesis 3 is rejected. The p-value of .09 for the OLS regression and the positive sign on the coefficient permits the inference that the 10 week time frame had a positive influence on the post-macro TUCE III test scores, ceteris paribus.

Testing hypothesis 3 with the Cobb-Douglas Select regression's p-value on the variable NIGHT, hypothesis 3 is not rejected. The p-value of .436 does not allow for the rejection of hypothesis 3. This result suggests that the 10 week time frame had no significant effect upon student performance.

Testing hypothesis 3 with the Translog OLS and Select models' p-values on the variable NIGHT which is .084 and .069 respectively, allows for the rejection of hypothesis 3. Inspecting the signs on the coefficients which are positive, suggests that the 10 week time frame had a positive effect upon performance, ceteris paribus.

These results are in keeping with the average performance on the post-macro TUCE III exam; since those students taking the Principles of Macroeconomics course in the summer (NIGHT, 10 week classes) scored 43% higher on the post-macro TUCE III test than those students taking the same course in the fall.

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[43]   Watts, Michael and Lynch, Gerald, J. The Principles Courses Revisited. American Economic Association Papers and Proceedings. 79, no. 2 (May 1989): 236-241.

The Cobb-Douglas Models

In both the OLS and Select regressions LNPRE and DEV were significant predictors of the post-macro TUCE III test score with at least a 4% level of significance (refer to Table 5). The variable LNPRE is positively related to the dependent variable. Table 6, found at the end of this chapter, lists other studies and their findings as related to this study. The findings for LNPRE are supported by: Charkins, O'Toole, and Wetzel[44]; Fizel and Johnson[45]; and Scyoc and Gleason[46] The variable DEV was found to be negatively related to the dependent variable as was the conclusion of Smith.[47]

In the OLS model LNALLGPA, NIGHT, and PROA were also significant predictors; however, in the Select model these variables were not significant predictors. The positive relationship between LNALLGPA and the dependent variable is supported by: Borg, Mason, and Shapiro[48]; Fizel and Johnson[49]; Raimondo, Esposito, and Gershenberg[50].

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[44] Charkins, R. J., O'Toole, Dennis M. and Wetzel, James N., "Linking Teacher and Student Learning Styles with Student Achievement and Attitudes," Journal of Economic Education, 16, no. 1, (Spring 1985), 111-121.

[45] Fizel, John L. and Johnson, Jerry D., "The Effect of Macro/Micro Course Sequencing on Learning and Attitudes in Principles of Economics," Journal of Economic Education, 16, no. 2, (Spring 1986): 87-99.

[46] Scyoc, L. J. Van, & Gleason, J. "Traditional or Intensive Course Lengths? A Comparison of Outcomes in Economics Learning." Journal of Economic Education. 24, no. 1, (Winter 1993): 15-22.

[47] Smith, Kenneth W., A Comparison of the Performance of Developmental and Nondevelopmental Studies Students in Principles of Economics. Unpublished Ph.D. Dissertation. Middle Tennessee State University, 1990.

[48] Borg, Mary O., Mason, Paul M. and Shapiro, Stephen L., "The Case of Effort Variables in Student Performance." Journal of Economic Education. 20, no. 3, (Fall 1989): 309-313.

The Select coefficient estimates found only two significant predictors: LNPRE (positively related to the dependent variable) and DEV (inversely related to the dependent variable). Whereas, the OLS estimation procedure would have included in addition to the previously mentioned variables LNALLGPA, NIGHT, (both positively related to the dependent variable) and PROA (inversely related to the dependent variable).

The Translog Models

In both the OLS and Select models the variables MAY, SUM, LNALLGPA, SIZEMED, NIGHT, MAR, SQALLGPA, SQPRE, and DEV are significant predictors of the post-macro TUCE III test scores, ceteris paribus. In the Select model the variables LNPRE and SIZELGE are also significant predictors to at least the 10% level of significance.

In the OLS model the variables MAY, SUM, SIZEMED, NIGHT, SQALLGPA, and SQPRE are positively related to the dependent variable. The variables DEV, LNALLGPA, and MAR are negatively related to the dependent variable, ceteris paribus.

In the Select model the variables MAY, SUM, SIZEMED, SIZELGE, NIGHT, SQALLGPA, and SQPRE are positively related to the dependent variable. The variables

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[49] Fizel, John L. and Johnson, Jerry D., "The Effect of Macro/Micro Course Sequencing on Learning and Attitudes in Principles of Economics," Journal of Economic Education, 17, no. 2, (Spring 1986): 87-99.

[50] Raimondo, Henry J., Esposito, Louis, and Gershenberg, Irving, "Introductory Class Size and Student Performance in Intermediate Theory Courses," Journal of Economic Education, 21, no 4, (Fall 1990): 369-381.

LNPRE, LNALLGPA, DEV, and MAR are negatively related to the dependent variable, ceteris paribus.

In both the Translog OLS and Select models, summer (SUM, 5 week courses) becomes a significant positively related predictor of the post-macro TUCE III exam score, ceteris paribus. Previous researchers have either not found the summer time frame to be a significant predictor of performance or they have found a negative relationship between the summer time frame and performance (refer to Table 6). This researcher's OLS and Select results lead to the inference that summer is a significant predictor of performance.

In neither the Cobb-Douglas nor the Translog Select models was the variable IMR significant. This fact would indicate that the bias which might have been present by failing to consider students dropping out of the course was not a significant factor.

TABLE 2

Results are for pre-macro TUCE III students completing the course.
Null hypothesis : Row mean is = column mean.

	May (10.08)	Summer (9.26)	Night (11.36)	Fall (9.39)	All MTSU_pre TUCE III (9.6)
TUCE III NORMED Ha: Row > Col (10.57)	Fail	Reject p=.017	Fail	Reject p=<.001	Reject p=<.001
May Ha: Row < Col (10.08)		Fail	Fail	Fail	Fail
Summer Ha: Row < Col (9.26)			Reject p=.023	Fail	Fail
Night Ha: Row > Col (11.36)				Reject p=.012	Reject p=.020
Fall Ha: Row < Col (9.39)					Fail

Ha = Alternative Hypothesis; Col = Column; p = p-value; Fail = Fail to reject the null hypothesis; Fail occurs when p > .05. Reject = Reject the null hypothesis.

TABLE 3

Results are for post-macro TUCE III students completing the course.
Null hypothesis : Row mean is = column mean (unless otherwise indicated).

	May (14.75)	Summer (13.15)	Night (16.5)	Fall (11.51)	All MTSU_post-macro TUCE III (12.48)
TUCE III NORMED Ha: Row > Col (15.15)	Fail	Reject p=.019	Fail	Reject p=<.001	Reject p=<.001
May Ha: Row > Col (14.75)		Fail	Fail	Reject p=.006	Reject p=.05
Summer Ha: Row < Col (13.15)			Reject p=.018	Reject Ha: Row > Col p=.036	Fail
Night Ha: Row > Col (16.50)				Reject p=<.001	Reject p=.001
Fall Ha: Row < Col (11.51)					Reject p=.036

Ha = Alternative Hypothesis; Col = Column; p = p-value; Fail = Fail to reject the null hypothesis; Fail occurs when p > .05. Reject = Reject the null hypothesis.

TABLE 4

Results are for students completing the course.
Null hypothesis : Row mean is = column mean (unless otherwise indicated).

PRE / POST	TUCE III NORMED (10.57)	May (10.08)	Summer (9.26)	Night (11.36)	Fall (9.39)	All MTSU_pre-macro TUCE III (9.60)
TUCE III NORMED Ha: Row > Col (15.15)	Reject p=<.001	Reject p=.004	Reject p=<.001	Reject p=<.001	Reject p=<.001	Reject p=<.001
May Ha: Row > Col (14.75)	Reject p=.008	Reject p=.007	Reject p=.002	Reject p=.030	Reject p=.002	Reject p=<.001
Summer Ha: Row > Col (13.15)	Reject p=.004	Reject p=.01	Reject p=<.001	Fail p=.051	Reject p=<.001	Reject p=<.001
Night Ha: Row > Col (16.50)	Reject p=<.001	Reject p=<.001	Reject p=<.001	Reject p=.001	Reject p=<.001	Reject p=<.001
Fall Ha: Row > Col (11.51)	Reject p=.012	Fail p=.077	Reject p=<.001	Fail p=.494	Reject p=<.001	Reject p=<.001
All MTSU_post-macro TUCE III Ha: Row > Col (12.48)	Reject p=<.001	Reject p=.011	Reject p=<.001	Fail p=.124	Reject p=<.001	Reject p=<.001

Ha = Alternative Hypothesis; Col = Column; p = p-value; Fail = Fail to reject the null hypothesis; Fail occurs when p > .05. Reject = Reject the null hypothesis.

TABLE 5

Statistical Models

VARIABLE	COBB-DOUGLAS OLS CO	T-VAL	P-VAL	SELECT CO	T-VAL	P-VAL	TRANSLOG OLS CO	T-VAL	P-VAL	SELECT CO	T-VAL	P-VAL
MAY	.209	1.65	.101	460	.38	.701	.238	1.92	.056	9.09	1.84	.066
SUM	.846	1.40	.164	.479	.45	.655	9.05	1.72	.090	8.93	1.80	.073
NIGHT	1.068	1.71	.090	.758	.78	.436	9.19	1.74	.084	9.05	1.82	.069
LNPRE	.393	4.56	.000	.415	4.16	.000	-1.16	-1.52	.130	-1.18	-1.65	.099
LNALLGPA	.243	2.29	.024	.312	1.50	.135	-1.13	-2.61	.010	-1.15	-2.47	.013
LNALLHRS	-.027	-.91	.366	-.017	-.45	.656	-.16	-1.21	.230	-.16	-1.32	.187
LNNOWHRS	.096	1.04	.299	.146	.96	.338	-.078	-.17	.869	-.084	-.19	.847
LNAGE	.201	1.23	.220	.218	1.32	.186	-3.42	-1.07	.289	-3.30	-1.05	.294
RETAKE	-.068	-0.75	.457	-.047	-.47	.637	-.088	-.99	.324	-.092	-1.04	.298
FAST	-.062	-0.84	.404	-.046	-.55	.584	-.040	-.55	.584	-.043	-.60	.551
GEN	-.055	-0.95	.344	-.085	-.94	.355	-.083	-1.43	.155	-.771	-1.05	.293
CAMPUS	.039	.60	.550	.042	.66	.509	.041	.64	.523	.040	.69	.490
DEV	-.126	-2.07	.040	-.127	-2.14	.032	-.119	-1.99	.049	-.119	-2.18	.029
SIZEMED	.687	1.16	.246	.257	.22	.830	8.95	1.69	.094	8.85	1.79	.074
SIZELGE	.444	.71	.482	-.016	-.01	.990	8.63	1.63	.106	8.53	1.73	.084
BUSMAJ	.064	1.16	.248	.087	1.12	.263	.069	1.29	.198	.065	1.01	.311
TRANSFER	-.025	-.40	.693	-.053	-.58	.565	.002	03	.973	.007	.10	.920
MAR	-.066	-.83	.411	-.047	-.52	.600	-.140	-1.75	.083	-.144	-1.75	080
PROA	-.170	-1.73	.086	-.213	-1.50	.132	-.125	-1.29	.201	-.115	-.96	.339
PROB	-.053	-.52	.606	-.062	-.61	.542	.038	.37	.712	.040	.42	.676
PROC	.036	.21	.831	.026	.16	.874	.154	.94	.349	.157	1.03	.303
SQAGE							.555	1.12	.264	.535	1.10	.271
SQNOWHRS							.033	.29	.772	.032	.31	.758
SQALLHRS							.026	1.27	.208	.026	1.38	.167
SQALLGPA							.838	3.23	.002	.847	3.41	.000
SQPRE							.363	2.03	.004	.366	2.21	.027
IMR				.177	.41	.681				-.036	-.11	.910
ADJ R^2	.275			.329			.271			.324		
R^2	.368			.437			.369			.437		
P-VAL MODEL	.000			.000			.000			.000		
P-VAL χ^2	<.05			<.05			<.05			<.05		

CO = Coefficient; VAL = Value; P-Val χ^2 is for the LM test that the MAY, SUM, and NIGHT coefficients are equal to zero, p-values of < .05 indicate that the coefficients are not equal to zero.

TABLE 6

Predictive Variables by Studies

Studies by Author	MAY	SUM	LNPRE	DEV	LNALLGPA
Scyoc and Gleason (1993)	Positive		Positive		
Gleason (1985)	Positive	No Relationship			
Watts and Lynch (1989)	Positive	Negative			
Charkins, O' Toole and Wetzel (1985)			Positive		
Fizel and Johnson (1986)			Positive		Positive
Smith (1990)				Negative	
Borg, Mason, and Shapiro (1990)					Positive
Raimondo, Esposito and Gershenberg (1990)					Positive

CHAPTER V

SUMMARY AND CONCLUSIONS

The primary purpose of this study was to determine if the short sessions of 3 weeks (MAY), 5 weeks (SUM), and 10 weeks (NIGHT) had an impact upon the performance of students taking the Principles of Macroeconomics course at Middle Tennessee State University. This chapter summarizes the findings of the study, presents conclusions based upon these findings, along with recommendations.

This study sought answers to three major questions:

1. Does the natural log of the post-macro TUCE III test scores of classes taught in the 3 week (MAY) session differ from those taught in 15 week sessions.

2. Does the natural log of the post-macro TUCE III test scores of classes taught in the 5 week (SUM) session differ from those taught in 15 week sessions.

3. Does the natural log of the post-macro TUCE III test scores of classes taught in the 10 week (NIGHT) session differ from those taught in 15 week sessions.

Also, of concern, was the methodology used to estimate the production functions which modeled student performance. This study used two production functions, Cobb-Douglas and Translog, and used two estimation procedures, OLS and Heckman's two-

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step procedure (Select) to estimate the production function parameters. Previous researchers have used OLS procedures but in estimating parameter estimates they failed to consider the students that dropped the course. Therefore, the parameter estimates from the OLS methodology may be biased. Heckman's two-step procedure (Select) removes this bias.

This study included 72 and 183 students at Middle Tennessee State University who took the Principles of Macroeconomics courses in the summer and fall semesters of 1995, respectively.

The macro TUCE III was the instrument used to measure performance and student questionnaires were administered to gather additional demographic information. Also, the records office at Middle Tennessee State University furnished other pertinent academically related information.

Conclusions

1. It was concluded that the 3 week (MAY) time frame was positively related to the post-macro TUCE III test scores using the Translog model and for both estimation procedures (OLS and Heckman's two-step), ceteris paribus.

2. It was concluded that the 5 week (SUM) time frame was positively related to the post-macro TUCE III test scores using the Translog model and for both estimation procedures (OLS and Heckman's two-step), ceteris paribus.

3.   It was concluded that the 10 week (NIGHT) time frame was positively

related to the post-macro TUCE III test scores using the Cobb-Douglas

model with the OLS estimation procedure. Also, the same relationship was

found using the Translog model and for both estimation procedures (OLS

and Heckman's two-step), ceteris paribus.

Recommendations

1.   It is recommended that further research be done to examine the effect of
time upon the performance of students in Principles of Macroeconomics.

2.   It is recommended that researchers use Heckman's two-step procedure to
correct for bias which may otherwise occur if other estimation procedures
are used.

Implications

Since the demand for compressed classes is expanding, the conclusion that the 3

week (MAY), 5 week (SUM) and 10 week (NIGHT) time frames are significantly and

positively related to learning allows for the inference that the short time frame offerings at

universities aids in the learning process, ceteris paribus. This conclusion could make it

easier for university officials to expand their summer offerings, thus allowing universities

to better serve the needs of an ever growing clientele of older and part-time students.

APPENDIX

Appendix I

Student Questionnaire
1ˢᵗ Day of Class

Your Name _____ Your Social Security Number ___ - ___ - _____
Please Print

Please answer each of the following questions by circling your response.

A. Are you a business major?
    0. no   1. yes

B. Are you a commuter or an on-campus student?
    0. campus   1. commute

C. Are you a transfer student?
    0. no   1. yes

D. Are you or have you ever been classified as a developmental studies student?
    0. no   1. yes

    If you answered yes, how many courses have you taken? _____
                                                          Write the number in this space.

E. Are you married?
    0. no   1. yes

F. What is your sex?
    0. male   1. female

G. Are you taking this class in order to graduate faster than normal?
    0. no   1. yes

H. Are you retaking this class in order to better the grade which you received before?
    0. no   1. yes

I. What was your score on the ACT? or SAT?

    ACT _____ SAT _____

J. What is your cumulative GPA?   _____

K. How many hours are you currently enrolled?   _____

L. What is your age?   _____

If you will allow me to use this information, please sign in the space provided.

_____
Your Signature Here, Your Signature Here

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