THE RELIABILITY OF ECONOMIC TEXTBOOK READABILITY INDEXES AS A MEASURE OF COGNITIVE GAIN: A COMPARATIVE ANALYSIS

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ABSTRACT

THE RELIABILITY OF ECONOMIC TEXTBOOK READABILITY INDEXES AS A MEASURE OF COGNITIVE GAIN: A COMPARATIVE ANALYSIS

by Rebecca Lynne Deel

This study sought to establish whether readability and cognitive gain are related in principles of economics textbooks, and, thus, whether readability indexes are effective measures of text learnability. The research was conducted at Middle Tennessee State University, Murfreesboro, Tennessee, during the 1995 spring semester. Five principles of macroeconomics classes were utilized involving 81 students.

In each class, students were given three readings either from a textbook judged to be difficult or from one judged to be easy to read in an alternating pattern. Before and after the three readings each student was tested on three topics treated in similar fashion in both books. The first or narrative topic covered exchange rates while the second and third topics were quantitative and graphical and involved cost analysis and monopoly profit maximization. Information gain then was measured by the difference in the pre- and posttest mean scores.

Statistical significance of the mean score difference was indicated by utilizing the standardized t-distribution test. When the statistical test was applied, no significant differences were found in cognitive gain for the books' narrative and graphical sections. This finding suggests that readability indexes are not indicative of potential information gain for textbook material presented in the narrative or graphical form. However, in the quantitative section, a statistically significant difference in information gain emerged, suggesting that readability indexes are indicative of possible cognitive gain.

A least squares regression model was also developed to explore the interaction between student demographic characteristics, readability, and cognitive gain. Of six demographic variables included in the model, only student sex and class standing were statistically significant. Textbook readability index value proved not to be statistically significant as an explanatory variable.

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CHAPTER I

INTRODUCTION

Significance of the Study

More than one million college students take principles of economics each year. Since many students retain more information by reading than by listening, a critical tool at their disposal is the textbook.[1] According to one recent study, text-book readability and student comprehension are the two most popular screening devices when choosing texts, although professors consider other characteristics.[2]

Readability refers to the aspects of a text which make it easy to understand.[3] Factors that influence readability in any selected passage include the number of long and complex sentences, the average number of words in each sentence, and the number of commonly understood words. Also influential are the average number

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[1] Michael J. Boskin, "Observations on the Use of Textbooks in the Teaching of Principles of Economics," Journal of Economic Education 19 (Spring 1988): 157-159.

[2] James Tate, "A Study of the Determinants in Selecting a Successful Principles of Economic Textbook" (DA diss., Middle Tennessee State University, 1991), 50.

[3] Colin Harrison, Readability in the Classroom, (Cambridge: Cambridge University Press, 1980), 33.

of syllables in the words and the number of abstract ideas.[4] According to W. B. Gray, Jr., a reading level between sixth and tenth grade constitutes an effective passage.[5]

Reading comprehension is difficult to define in that it involves many mental processes such as logical reasoning, verbal learning, semantic memory, and visual information processing. Although a comprehension test is assumed to measure a reader's understanding of the material read, the test score often reveals only the reader's overall language competence.

To resolve this dilemma, researchers seek to measure information gain or cognitive learning achievement rather than comprehension. An information-gain score relates how much new information is gleaned after reading a passage. One way to obtain this score is to test students for comprehension before exposure to a reading, and retest after the passage is read to see how much better they score. This type of information-gain score is related closely enough to a normal comprehension test to be considered by some as roughly the same thing.[6]

There is much written in the literature about readability as well as cognitive gain generally, but very little involves economics. The terms "cognitive gain" and "comprehension" are carelessly used in the literature interchangeably. When read-

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[4] Timothy Standal, "How to Use Readability Formulas More Effectively," Social Education 45 (March 1981): 183.

[5] W. B. Gray, Jr., How to Measure Readability, (Philadelphia: Dorrance & Company, 1975), 5-10.

[6] Harrison, Readability in the Classroom, 33-39.

ability tests are utilized appropriately, researchers find a definite relationship between readability and comprehension. In validation studies, readability formulas tend to have a correlation of between 0.6 and 0.7 with comprehension test scores.[7] But as explained later, our approach employs the more narrow idea of information gain and its relationship to readability.

Readability formulas may not be appropriately utilized in the economics text-book selection process, because such formulas were not originally designed to measure the readability of technical and scientific materials. These materials depend on the understanding of a particular discipline's terminology. Readability formulas, which are often rather mechanical, also may not measure the level of abstraction and complexity of concepts.[8] Thus, the writer of a textbook faces a dilemma. If the author utilizes simple language to enhance the readability level, his/her material may provide little new information. But if technical and specific terminologies are overly used, the reader is frustrated and does not benefit as much from the material.[9] Nevertheless, readability formulas are utilized to assess economics textbooks, and comparative readability indexes are published and noted in textbook promotional materials.

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[7] Ibid.

[8] Timothy Standal, "How To Use Readability Formulas More Effectively," 183.

[9] The World Book Encyclopedia, 1990 ed., s.v. "Reading," by Henry A. Bamman.

Statement of the Problem

The overall problem addressed in this study is how an instructor might best convey to students complex and detailed economics information. The specific problem addressed involves selecting a learnable and readable textbook which is a critical aspect of the teaching function. If a text is too readable, students may not learn the essential abstract concepts and the vocabulary associated with the science of economics. However, if the text is too ambitious with abstract concepts and vocabulary, students may find the information too difficult to learn.

The underlying assumption in this study is that the instructor desires to improve his/her pedagogical efforts in economics principles. Economists are naturally interested in efficient use of scarce resources. Good communication and time-management are also essential for both students and instructors. Improving communication between these groups and promoting time-stewardship make this study of value.

Today's economics textbooks are laden with graphic and quantitative methods, but readability formulas typically do not include graphic and quantitative elements. Thus, two books with narrative text sections that varied greatly in readability could at the same time register little variation in their graphic and quantitative sections. Reinforcing the likelihood of this outcome is the common terminology and symbolism involved in graphical and quantitative presentations. Hence, the use of a single readability index value to describe an entire book may be misleading.

The primary goal of this study is, therefore, to provide some insight for the economics instructor or department committee in selecting an appropriate principles of economics textbook. This is done by determining whether readability and comprehension (information gain) are related in an economics textbook, and thus, whether a readability index is an effective measure of text learnability.

Approach

Specifically, the study will seek to determine in which case cognitive learning or information gain is greater, when a textbook's readability is easy or when it is difficult. Readability indexes published in 1994 for contemporary economics textbooks revealed wide differences, ranging from eighth grade to thirteenth grade levels. Thus, our procedure will be to select two current books with readability indexes at each extreme (very low, very high) and have students in principles of economics classes read passages from them. In an alternate fashion, one student is given passages from the book which is judged very readable and another is given passages on the same topic from the book whose readability is judged to be difficult, and so on. Prior to reading each passage, each student is given a pretest over the passages' content. After the passages are read, an identical posttest is given. Comparisons are then made of test score improvement between the two books to determine in which book information gain is greater.

In anticipation of this study, a pilot study was performed in two classes during the Spring of 1994 at Middle Tennessee State University. The procedure in that study was essentially the same as that outlined in the previous section.

In the pilot study, eight pretest and posttest questions from three different reading selections were developed by carefully examining two economics principles textbooks. The questions were common to both books. That is, they were representative of the passages' content in both books. One textbook, David Colander's Economics, had an eighth grade readability index level, while Campbell McConnell's textbook, Economics, had a thirteenth grade readability level.

Care was taken to select three topics that were identical in the two books. One passage involving straight reading covered the functions of money. Another passage was quantitative and dealt with the money multiplier, while the third selection involved graphics in an explanation of profit maximization of the monopolist. Thus, the three "languages" in which economics can be expressed were included: written, graphical, and mathematical. No topic was selected that had already been covered in either class.

Fifty-nine students were tested in two macroeconomics classes, one at 12:00 noon and the other at 6:00 in the evening. During the exam period of 45 minutes, students were allowed 15 minutes to complete each of the three sections.

Results were measured by changes in posttest mean scores. As expected, little difference was observed in the posttest mean score changes for the quantita-

tive and graphic sections in the two books, five percent for the former and zero percent for the latter. A greater difference (nine percent) in the pre- and posttest mean score improvement was observed for the straight narrative reading sections in the two books. Although the larger difference was expected, the more readable book registered the smaller increase in information gained, contrary to expectations.

These results suggested a need for some refinement in this study's methodology. Hence, a different straight narrative section more representative of each book's difficulty is selected for testing (exchange rates rather than the functions of money). A subsequent analysis of the original passages from the two books using a readability formula revealed that there was little difference in the index values for that specific topic. Subsequent analysis of the original quantitative passages also revealed that in one of the books the presentation of the money multiplier formula was embedded in written material. Thus, its significance may have been obscured by the written material surrounding the quantitative notations which occupied much more space. This would make it incompatible with the quantitative section from the other book which was more brief and used more mathematical symbols. Different quantitative topics are, therefore, used in the present study (cost analysis rather than the money multiplier).

The pre- and posttest questions were reexamined one by one to determine which needed to be revised or replaced (See Appendices A and B). A larger sample of students should have been tested. Therefore, for this study, five classes in-

stead of two are tested. These are principles of macroeconomics classes with meeting times on the same day, Thursday.

Statistical Test

After the classes are tested, the difference in the mean score between pre- and posttests for the three passages in the two books will be calculated. The degree of cognitive learning achievement will be observed by these mean-score differences. It is expected that greater differences will be noted for the narrative sections with the more readable book registering the most gain. The other two book sections are expected to show little if any variation. The measured differences in information gain between the sample means will be the basis for acceptance or rejection of the null hypotheses using the t-statistic.

Demographic information on class standing, sex, major, college math courses, ACT/SAT score, size of high school, study of economics in high school, and year of high school graduation are collected to enhance the study. The relationship between these factors and readability or information gain are examined.

Hypotheses

One primary and two secondary null hypotheses are thus examined in the study. First, it is hypothesized that no significant difference will be found in cognitive gain when the mean score improvement of students using the more readable book is compared to the same score of

those using the less readable book in the narrative section. If, however, a significant difference in such mean scores is observed and if the mean score is greater for the more readable book, the null hypothesis can be rejected relative to the alternative hypothesis.

The two secondary null hypotheses are advanced because of the expectation that the quantitative (mathematical) and graphical sections will be very similar in form and presentation (common technical terms, symbols, and so forth) from one textbook to another. Further, textbook material is increasingly presented in such a quantitative and graphic format. Therefore, it is hypothesized that for the quantitative topics, there will be no significant difference between pre- and posttest mean score information gain in the two books. Likewise, no significant difference is hypothesized between the pre- and posttest mean score improvement for the graphical sections in both books.

Constraints in the Study

In this study, the more constrained idea of information or cognitive gain and its relationship with readability is explored, rather than how readability and comprehension are related. Comprehension is a more encompassing concept than cognition, which is limited to the acquisition of empirical factual knowledge. Comprehension relates more to general understanding resulting from study, but also from insight and implication. The study also is not designed to predict student cognitive

achievement in using particular textbooks; only the reliability of readability indexes is examined. Further, the study is limited to five classes in one four-year university economics department that offers degrees in economics. Only two textbooks are used, and from these just three passages which are not selected at random are tested. The study is conducted at one specific time, during the Spring semester of the 1994-1995 academic year.

Organization of the Study

Chapter one states the purpose and significance of the study. It also provides information about the pilot study that was performed along with the hypotheses, constraints, procedures for collecting and treating the data, and the organization of the study.

Chapter two reviews the general literature on readability and comprehension or information gain. The chapter also examines the literature relevant to readability of economics textbooks.

Chapter three explains the methodology of the study, summarizes, and analyzes the data.

Chapter four summarizes and analyzes the student demographic data.

Chapter five presents the summary, conclusions, and implications that result from analysis of the data.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

A review of current literature on readability and information gain provided little enlightenment with regard to economics textbooks. Information dealing with readability made few references to economics or economics texts. The very limited offerings on information gain provided no connection to economics.

In general, readability formulas are considered inappropriate tools to use in selecting specialized textbooks. A contemporary principles of economics text contains many tables, graphs, and mathematical formulas which are difficult to incorporate into any readability index analysis. Yet, readability indexes are prepared and published for leading economics textbooks, and they are used in their promotional literature.

Readability

Although formal use of readability formulas began in 1923, few people other than reading specialists and researchers adopted the new educational tool. The popularity of readability formulas grew as formula builders such as Lorge in 1939, Flesch

in 1943, Dale and Chall in 1948, and Spache in 1953 introduced improved versions to the general public. Publishers took a greater interest in readability after instructors began inquiring about the readability of their texts.[10]

Measuring Readability

In his book entitled How to Measure Readability, W. B. Gray provides instructions concerning the process of measuring readability. To obtain a selection's readability level, the researcher calculates sentence length, the number of syllables per one hundred words, and the percentage of what are considered hard words. The average sentence length is computed by dividing the total word count by the number of sentences in the passage. The number of hard words is obtained by counting words with three or more syllables except proper nouns, compound words made of short, easy combinations, or words raised to three syllables by adding "ed," "es," "s," or "ing." Dividing total hard words by the total sample word count and multiplying by one hundred gives the percentage.[11]

The Effective Readability Formula

Hundreds of predictive readability formulas have been constructed by researchers, psychologists, and teachers. The various formulas derived their scores from methods as

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[10] Edward Fry, "Fry's Readability Graph: Clarifications, Validity, and Extension to Level 17," Journal of Reading 21 (December 1977): 243.

[11] Gray, How to Measure Readability, 11-16.

extreme as multiple regression or pure intuition. Despite the variety of formulas, the effective formulas have two critical attributes: validity and reliability.

Validity

Validity in a readability formula requires that there be a high correlation between the predicted formula score and text difficulty measured by some other criterion such as comprehension test scores. In his research, Harrison has concluded that readability formulas have good predictive validity.[12] As stated in the first chapter of this study, readability formulas tend to have a correlation of between 0.6 and 0.7 with comprehension test scores.

Reliability

Harrison also observes that the second major requirement of a formula is that it be reliable. According to him, there are three crucial aspects of reliability: sampling adequacy, analyst reliability, and age level accuracy.[13]

Sampling adequacy. In most cases, formula users take a minimum of three samples, each with one hundred words. If an instructor is interested in one particular chapter, all samples should come from that chapter. Evaluating readability for an entire text requires that a sample should be drawn from near the beginning, one from the middle, and a

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[12] Harrison, Readability in the Classroom, 51-52.

[13] Ibid., 53-54.

final sample from near the end. Researchers have noted a tendency in some books for the author to use a more difficult language and style of writing early in a book or chapter. This introductory material often is more philosophical and generalized, and could lead to an inaccurate assessment of readability level for the rest of the information.

Analyst reliability. Professors analyzing the same passage with an identical readability formula are expected to obtain the same results. However, this is not always the case. Some formulas include variables that are difficult to judge consistently, such as the ratio of abstract to concrete words. Other variables which may produce inconsistency are different ideas per one hundred words, the number of indeterminate clauses, or a simple counting error.

Vocabulary variables present special reliability problems. There are two methods of estimating vocabulary difficulty: measuring the proportion of words on a word-frequency list or counting the number of syllables per word in a selection. Word-frequency lists may present reliability problems if the user has trouble interpreting the rules which govern whether a word is familiar. Those who utilize readability formulas also can be inaccurate simply in counting the number of syllables.[14]

Age level accuracy. The third aspect of readability is the formula's adaptability to proper age level of the reader. Even though a readability formula has a high correlation with comprehension tests, high validity is no guarantee of accurate age-

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[14] Ibid., 55-56.

level prediction for any classroom use. Harrison has noted that at present no formula is correct for all age levels. If a formula were devised to estimate text difficulty at a certain age level, that level is where the formula would be most accurate, otherwise it could give results that are not reliable.[15]

Readability Formula Weaknesses

Readability formulas are popular educational tools for instructors in selecting textbooks and a marketing tool for publishers in selling textbooks. However, these formulas have significant weaknesses when used as a basis for textbook selection. These weaknesses stem not only from their statistical validation techniques but are inherent due to the technical nature of some subject matter. The fact that syntax, sentence complexity, and word difficulty are not dealt with qualitatively by readability formulas also is a contributing weakness.

Deficient Statistical Basis

When readability formulas were developed, they typically were not marked for validation studies. McConnell has noted that the earlier formulas were legitimized in terms of reading practice exercises never intended to test student comprehension. The more recent readability formulas were authenticated only in terms of the earlier formulas. In other words, the predicted readability (or age) and comprehension level

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[15] Ibid., 58.

for students has never been tested during formula development. The validation studies reported are after the fact.[16]

Technical Material

Most readability formulas are not designed to analyze technical material such as economics. Such information is highly dependent upon understanding a special terminology and vocabulary. In some studies, according to McConnell, the researchers assumed that instructors acquainted students with new vocabulary and thus counted those technical terms as one-syllable words. The readability index level was reduced by three or four grades. This same technique was applied to various other textbooks with the same results.[17]

Syntax and Sentence Difficulty

Word order in a sentence is crucial to understanding and readability. However, mechanical readability formulas count only words, syllables, and the number of sentences in a selected passage with no regard for word order. The words in any given sentence may be rearranged at random causing no change in readability.[18]

Frequently, longer sentences are more difficult. But as Perera has pointed out, short and terse sentences can be incomprehensible if needed connectives like "because,"

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[16] Campbell McConnell, "Readability: Blind Faith in Numbers?" Journal of Economic Education 2 (Winter 1983): 67.

[17] Ibid.

[18] Ibid.

"although," or "but" are omitted. Meanings often must be inferred in short statements, whereas the longer sentences explain meaning with greater repetition and more clues.[19]

Word Difficulty

Another weakness is that readability formulas assume that long words are harder to understand than short words. While it is often true that long words are more technical and difficult to comprehend, short words such as "gneiss" and "adze" present a challenge to any reader.

Some formulas assume that familiar words are easier to understand than unfamiliar ones. These methods of evaluating word difficulty depend on a word list which contains frequently used words in writing. Any word not appearing on the list is assumed to be unfamiliar and therefore difficult. The two word lists used most often are the Dale-Chall and the revised Spache. The Dale-Chall list was compiled in 1948 and is out of date. The Spache list was revised in 1974, and it is exclusively an American list.[20]

Different Types of Written Material

Perera has also observed that the reliability of readability formulas decreases dramatically when applied to some types of written material. She notes that the formulas cannot be properly applied to small samples of language such as exam questions, instruc-

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[19] Katharine Perera, "The Assessment of Linguistic Difficulty in Reading Material," Educational Review 32 (June 1980): 156.

[20] Ibid., 154.

tions, and chapter titles. Researchers also find misleading results when poetry is evaluated. Most formulas also fail to note any extra difficulty associated with unusual sentence structures or compressed or telegraphed language.[21]

Readability formulas do not give any indication of the type of rewriting required to reduce a passage's level of difficulty. These formulas are shown in research to be of little use as style guides to adjust the reading level. Revised selections utilize often unnatural and jerky language which makes the new version harder to understand than the original.[22]

Level of Abstraction

The level of abstraction (LOA) of a passage cannot be taken into account by readability formulas. In their recent study of scientific reading material, Vachon and Haney state that:

> The LOA of a sample of printed material is defined as the ratio of the number of concepts having no concrete exemplars to the total number of concepts in the passage . . . . concepts whose referents cannot be experienced directly or with the aid of instruments are called non-concrete concepts. They are understood in terms of other concepts, functional relationships, inferences, and/or idealized model.[23]

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[21] Ibid., 152.

[22] Ibid., 153.

[23] Myra K. Vachon and Richard E. Haney, "A Procedure for Determining the Level of Abstraction of Science Reading Material," Journal of Research in Science Teaching 28 (April 1991): 344.

A high LOA score implies that the selection is difficult. As can be inferred from Vachon and Haney's definition, the LOA in an economics text would necessarily be high. Therefore, a readability index level would be of questionable value in determining an economics textbook's level of difficulty with regard to abstract concepts.

Textbook Characteristics

Readability of a text may be markedly improved by use of graphs, tables, frequent headings and subheadings, early statement and repetition of basic themes, and book layout/format. Yet none of these items can be directly incorporated into the readability formula calculations.[24]

Textbook Challenge

According to Dearman and Davis, the past fifteen to twenty years have witnessed a decline in the reading ability of college-age students.[25] Thus to assist college students in their learning endeavors, instructors and publishers began to utilize readability levels in choosing textbooks. Selecting a readable text with the lowest readability index value seemed to be the logical choice. One difficulty with this approach is that a text which is too easy to read will present no challenge to a student who

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[24] McConnell, "Readability: Blind Faith in Numbers?", 67.

[25] Catherine N. Dearman and Debra C. Davis, "Reading Abilities of Master's Students Versus Readability of Textbooks," Journal of Nursing Education 29 (November 1990): 406.

could then fail to develop his or her language skills. The overall result is that the most widely used textbooks have declined in readability level over the past thirty years.[26]

Value of Readability Analysis

Utilizing readability analysis allows an instructor to evaluate his or her students. Assuming that each college freshman reads at the twelfth grade level is unrealistic. In 1981, Gruber performed a readability analysis on the reading section of a practice test for the high school equivalency diploma. The average readability level from his analysis was about tenth grade. Some of these students may attend college. Instructors of these students could find readability formulas helpful in choosing a textbook that will challenge but not discourage them in developing their reading skills and learning the material.

Theoretically, a textbook with an appropriate readability level will keep a student's interest and prevent frustration. According to Schneider, a poor reader needs a textbook at a lower readability level to aid in his or her comprehension or information gain. An accomplished reader, on the other hand, would benefit from a more challenging text to prevent boredom.

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[26] McConnell, "Readability: Blind Faith in Numbers?", 70.

Schneider has noted that another reason to analyze the readability level of a textbook is to help a teacher avoid information overload or underload in class.[27] The readability index value at least allows a professor to eliminate some textbook choices without wasting time in reviewing texts his or her students cannot comprehend or that provide an inadequate challenge.

Information Gain

As explained in the first chapter, information gain is the difference between the pretest and posttest examination score after exposure to a reading passage. The information gained from reading written material can be divided into two categories: word-for-word verbatim learning and substance learning.

Verbatim Versus Substance Learning

Verbatim learning includes rote memorization of a passage or part of a passage, and learning facts in words taken directly from the passage. Substance information gain requires that students organize, interpret, and paraphrase information. Studies by Mosberg and Shima have been conducted which found that substance learning is superior to verbatim learning.[28]

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[27] David F. Schneider, "An Analysis of Readability Levels of Contemporary Textbooks That Employ a Hybrid Approach to the Basic Communication Course," Communication Education 40 (April 1991): 166.

[28] Ludwig Mosberg and Fred Shima, Comprehension of Connected Discourse (Inglewood: Southwest Regional Educational Laboratory, 1969), 7-9, DHEW, TR-12.

Information Gain and Pretest Neutrality

Studying information gain represents a departure from traditional comprehension research. As noted, information gain is measured by the difference between pretest and posttest scores after reading a passage, while comprehension generally is concerned only with posttest scores. With the pretest and posttest procedure, the researcher assumes that the pretest is a neutral event. In other words, the posttest performance is based solely on exposure to the selected passage.

However, Mosberg has observed that the pretest is not neutral and could potentially influence the passage reading and posttest results.[29] For example, the pretest may cue the student as to the relevant information in the forthcoming passage and thus improve posttest performance. It is also possible that instead of improving posttest performance, exposure to the pretest fixated incorrect responses in the student's mind, thus impeding his or her posttest results.

Variables Affecting Multiple Choice Responses

A typical method of measuring comprehension or cognitive gain is to use the traditional multiple-choice test. As popular as this procedure is, there are pitfalls which must be considered. Mosberg and Shima have noted several such difficulties.[30]

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[29] Ludwig Mosberg, Measurement of Information Gain from Written Discourse (Inglewood: Southwest Regional Educational Laboratory, 1970), 4, DHEW, TR-29.

[30] Mosberg and Shima, Comprehension of Connected Discourse, 13-14.

Response Biases

One response bias is a student's tendency to guess when a correct answer is not known. Students' propensity to guess varies, so most instructors either encourage students to always guess whenever in doubt or not to guess at all. Students who tend to guess score higher than those who do not.

Another bias is position preference. Research shows that students prefer to guess alternatives (a) or (b) rather than (c) or (d) in a four-alternative decision. Generally, the correct responses are randomly ordered to deal with this bias. The randomization, however, only guarantees that students will guess incorrectly on the average.

Response Alternatives and Distractors

As the number of alternatives increase, students' tendency to guess the correct answer decreases. Students also find it more difficult to eliminate the incorrect responses as the number of choices increase. Mosberg and Shima also note that students tend to eliminate incorrect alternatives first and then guess randomly from the remaining options.[31]

If multiple choice distractors are obviously incorrect, then students easily eliminate those choices. Ideally each choice should be such that if students do not know the correct answer every alternative looks equally appealing.[32]

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[31] Ibid., 14.

[32] Ibid.

Specialized Information and Examination Questions

Hunsaker reported that researchers Funkhouser and Maccoby found information gain was positively correlated with information presented in a special format such as in graphs.[33] According to Howard Wainer, information presented in specialized forms such as graphs, tables, and mathematical equations enhance the reader's cognitive gain more than identical information conveyed through narrative text.

Graphs

In his research, Wainer observed that graphics work well in textbooks because many people excel at seeing spatial relationships. A well-drawn graph is instructive and invites deeper study.

Graphics questions usually fall into three categories, according to Wainer. First are elementary level questions which involve extracting data from a graph. Second are questions at the intermediate level which ask the observer to identify trends in the presented data. The final level of questions requests the student to demonstrate his or her understanding by way of trend comparison.[34]

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[33] Alan Hunsaker, "Enjoyment and Information Gain in Science Articles," Journalism Quarterly 56 (Fall 1979): 617.

[34] Howard Wainer, "Understanding Graphs and Tables," Educational Researcher 21 (January-February 1992): 15-16.

Tables

Exam questions involving tables almost always are first level or elementary level questions. Typical usage of tables in a test situation is to ask four or five questions about specific entries in a tabular presentation. Question difficulty is increased simply by mandatory multiple steps at the same question level.[35]

Graphs Versus Tables

Graphs communicate information using space while tables use a specific iconic representation. Wainer has suggested that information gain improves as tables become more like graphs in utilizing space.[36] But recent research reported by Kelly indicates that there is little difference in information processing between the two displays.[37]

Mathematical Equations

Many readers encounter problems in processing quantitative information when the information is presented in equation form. According to studies by Dee-Lucas and Larkin, it is probable that novice readers find the decoding of symbols to be too tedious and difficult, and favor the easier solution of rote memorization of written material. But while verbal statements are fully decoded, they are difficult to mem-

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[35] Ibid., 18.

[36] Ibid., 21.

[37] James D. Kelly, "The Effects of Display Format and Data Density on Time Spent Reading Statistics in Text, Tables and Graphs," Journalism Quarterly 70 (Spring 1993): 149.

orize. However, these researchers conclude that typical students will more easily be able to apply the knowledge and information gained because of a deeper understanding made possible with the verbal statements.[38]

Chapter Summary

The discussions presented here suggest that readability formulas can be poor gauges of a textbook's difficulty. Such formulas are not always suitable for analyzing technical material or material with the level of abstraction found in some textbooks. Specialized sciences necessitate the use of long, difficult words and concepts which often are not part of the reader's personal experience. Specialized information presented in graphs, tables, and equations cannot be taken fully into account by mechanical readability formulas.

The study thus now turns to an investigation of whether these readability formula weaknesses also apply when they are used to judge economics textbooks. Specifically, the study will seek to determine whether readability indexes are reliable predictors of student performance.

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[38] Diana Dee-Lucas and Jill H. Larkin, "Equations in Scientific Proofs: Effects on Comprehension," American Educational Research Journal 28 (Fall 1991): 674.

Chapter III

STATISTICAL ANALYSIS OF DATA

Statistical Testing of Primary Data

Statistical testing of the null hypothesis involved comparisons of mean test score differences of students taking the exams from the easy book with those using the hard book. The degree of cognitive learning achievement was analyzed using the standard statistical *t*-test procedure.

The *t*-test ascertains whether the measured difference of sample means is due to mere chance, or to the textbook readability level. As stated earlier, the primary null hypothesis is that in the books' narrative sections no significant difference will be found in cognitive gain when the mean score improvement of students using the more readable (easy) book is compared to the same score of those using the less readable (hard) book. The two secondary null hypotheses are that there will be no significant difference between the pre- and posttest mean score information gain in both books for the quantitative and graphical sections.

To test these hypotheses, the degree of information gain registered by students using both the easy and difficult textbooks was determined by calculating an

arithmetic mean improvement score for each group in the narrative, quantitative, and graphical sections. The mean was computed by measuring the score differences between the pretest and posttest for each of the three sections.

Statistical statements were made by using the following method: (1) Reject the null hypothesis if the calculated t was greater than the critical value of t or if the calculated t was less than the critical value of -t, or (2) fail to reject the null hypothesis if the calculated t was less than the critical value of t or if the calculated t was greater than the critical value of -t.[39]

The various t-test values utilized were based on the different mandatory degrees of freedom.

> The concept of degrees of freedom refers to the number of independent deviations used in the determination of the estimated value of the standard deviation . . . . there are n - 1 [n = number of participants in the sample population] independent deviations because $\bar{x}$ [the sample mean] has been calculated from the sample and therefore, n - 1 degrees of freedom are associated with its use.[40]

The two sample populations for this study consisted of 81 students, therefore resulting in 79 degrees of freedom. As shown in Table 1, there were 41 students reading selections from the more readable textbook and 40 students studying the more difficult textbook. Calculating the mean improvement score for each section

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[39] Mark L. Berenson and David M. Levine, Basic Business Statistics (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1986), 359-363.

[40] Donald R. Plane and Edward B. Opperman, Business and Economic Statistics (Plano, TX: Business Publications, Inc., 1986), 212.

revealed that for the narrative and graphical sections the difficult text group scored slightly higher information gains (.335 and .04, respectively) than the easy text group. In contrast, the quantitative section disclosed a much higher gain of 1.151 points for the easy text group over the difficult text group.

Table 1

Test of Differences Between Textbook Pretest and Posttest Scores

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	41	1.390	4.044	1.895	79	-.790
Hard	40	1.725	3.128			
Difference		.335				
		Quantitative				
Easy	41	1.976	3.424	1.865	79	2.780
Hard	40	.825	3.533			
Difference		1.151				
		Graphic				
Easy	41	.585	2.098	1.532	79	-.120
Hard	40	.625	2.599			
Difference		.040				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

The standard t-test procedure was used to ascertain if the various differences between the two textbook groups were statistically significant. The results of the t-tests are presented in Table 1.

An evaluation of the mean difference in information gain between the narrative pretest and posttest scores proved to be statistically insignificant. The calculated t-value of -.790 which is less than the critical t-value of 1.991 supports this conclusion. Since the critical value of t α=.05 confidence level is 1.991, the calculated t-value was not significant and the hypothesis was accepted as stated. Acceptance of the hypothesis indicated that for the narrative topic no significant difference was found in cognitive gain when comparing mean improvement scores of those students reading the difficult book and those reading the easy book.

For the quantitative section, the pre- and posttest mean score difference between the two groups was found to be statistically significant. A calculated t-value of 2.780 which exceeds the critical t-value of 1.991 prompts rejection of the null hypothesis. There was a significant difference in the information gain between the easy book group and the hard book group.

In the graphical topic, the calculated t-value of -.120 was less than the critical t-value of 1.991, and resulted in an acceptance of the null hypothesis as stated. Hence no significant difference was found in graphical information gain when comparing mean improvement scores of those students reading the difficult book and those reading the easy book. Since the score difference was so slight (.04 in Table 1), no further analysis on this passage will be presented here.

The results obtained thus far are mixed. The narrative and graphical sections reveal no significant difference in information gain between the more readable or easy book and less readable or hard book groups. However, the quantitative section showed a significant difference in information gain. But the mean score was greater for the more readable (easy) book, leading one to conclude that readability level did play a role in cognitive gain in this topic.

Statistical Testing of Secondary Data

As noted, the narrative selections demonstrate no significant difference between the average mean score improvement of the easy text and hard text groups. An examination of the mean scores more closely in Table 1 discloses that the students reading the more difficult text showed a numerically higher information gain than those reading the easy text.

To possibly identify a reason for this unexpected difference, a Fog Index was computed on the narrative selection of the two textbooks. The results revealed an index value of 14 (a college sophomore reading level) for the easy book and an index value of 17 (graduate school) for the difficult book.[41] These results also sug-

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[41] Malra Treece, Successful Communication for Business and the Professions (Needham Heights, MA: Allyn and Bacon, 1991), p. 81, explains the Gunning Fog Index as being a readability formula for samples of at least 100 words. To get the Fog Index readability level, one calculates the average sentence length, counts the number of words with three or more syllables which is divided by the total number of words, adds the average sentence length to the percentage of hard words, and multiplies by .4. (See Appendix C for an illustration.)

gest that for these passages readability and information gain are inversely related contrary to expectations. Students using the hard rather than the easy book gleaned more information from reading. Perhaps a textual factor such as layout, print size, heading, or the like offers an explanation. More likely, the explanation is that the two sections were not representative of the level of rigor of either book.

As noted above, only the quantitative section revealed a statistically significant difference between the average mean scores of the more readable and less readable texts. The mean score improvement for those reading the easier text was 1.976, while the mean score improvement for the difficult text was .825, a difference of 1.151 as shown in Table 1.

In an effort to explain this difference, an additional t-test was done, again using comparative data for both groups. The test was to ascertain if the students using the easier text came to the test with a greater facility with quantitative methods, which gave them an advantage in this testing. A t-test was completed using only the pretest data for the quantitative exam. The results are presented in Table 2.

The calculated t-value from this test was -2.441. Since the critical t-value for 79 degrees of freedom at α=.05 confidence level is -1.991, the difference between the two means was significant. But as further reference to Table 2 shows, students reading the more difficult book scored an average of .776

points higher than the students reading the easier book. This suggests that the group reading the harder rather than the easier text had a better knowledge of

Table 2

Test of Quantitative Section Pretest Scores

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	41	3.049	1.197	1.474	79	-2.441
Hard	40	3.825	2.917			
Difference		.776				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

quantitative methods before the testing. Pretest score differences, therefore, do not offer an explanation of the reason for higher performance in the easy book (refer again to Table 1). A review of student demographic information, however, reveals that those reading both books had already completed an average of almost two college mathematics courses (1.8 courses). Hence their performance in the quantitative area was facilitated.

Summary of Statistical Results

These statistical results suggest that the alternative hypothesis that readability indexes are reliable indicators of student information gain and are, therefore, trustworthy tools in textbook selection cannot be accepted. Rather, the null hypoth-

esis that there is no significant difference in cognitive improvement between more readable and less readable textbooks is sustained. The one exception involves quantitative book passages where the narrative text material appears to matter.

A Statistical Model

The demographic data collected for this study are also used in a simple Ordinary Least Squares regression model to explore the interaction between student demographic characteristics, readability index values, and information gain. Of primary interest is the discovery of any relationship between cognitive gain and textbook readability in the model. The following is the ordinary least squares regression model in general terms:

$y = B0 + B1X1 + B2X2 + B3X3 + B4X4 + B5X5 + B6X6 + E$, where y is mean improvement score or total gain, B_i are the coefficients of the independent varibles, X_i are the independent variables and E is the value of the random error term. The data are regressed using the Econometrics Toolkit, Version 3.[42]

The independent variables used in the model are INDEX, ACT, CLASS, SEX, MAJOR, and SIZE. The variable INDEX is the readability level index value published for each textbook. The easier text has a readability level of eighth grade and the harder text's readability level is thirteen. The variable ACT is the American

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[42] The Econometrics Toolkit, Version 3, is a general statistics and econometrics software package, Econometric Software, Inc., 2nd ed, William Green, Macmillan Publishing Co., 1993.

College Test (ACT) score for each student. CLASS is the student class standing. This variable is a dummy variable with "0" entered for a freshman or sophomore student and "1" for an upper-class student. SEX is a dummy variable which separates the students participating in this study by gender. A "0" is entered for males and "1" for females. MAJOR is a dummy variable which denotes the students' majors in college as being business, "0", or nonbusiness, "1". The last variable, high school size, is also a dummy variable and enters a "0" for those students graduating from a class of up to three hundred, or enters a "1" for those graduating from a class of over three hundred.

Total gain, or TLGN, is the composite mean improvement score of the narrative, quantitative, and graphical sections. In the initial regression model, y is assumed to be linearly related to the demographic data according to the following model:

$$TLGN = B0 + B1INDEX + B2ACT + B3CLASS + B4SEX + B5MAJOR + B6SIZE + error$$

Regression Analysis

Table 3 presents the initial results of the regression analysis. The fit of the regression is poor, as indicated by the R^2 of 0.19768, but the global F-test of 2.3406 is significant at α=.05 level of significance. This indicates that at least one model coefficient is statistically significant.

Table 3

Estimated Initial Equation for Mean Information Gain (TLGN)

Variable	Coefficients (t-value)	P-Value
Constant	4.843 (1.725)	.084
INDEX	-.201 (-1.241)	.215
ACT	.044 (.407)	.684
CLASS	2.941 (3.337)	.001
SEX	-1.563 (-1.968)	.049
MAJOR	-.091 (-.094)	.925
SIZE	-.476 (-.474)	.636
N	64	
Std.Err.	3.3794	
R^2	0.19768	
Adj. R^2	0.11322	
F-Test	2.3406	

All the coefficients except CLASS and SEX were statistically insignificant at α=.05 level of significance. To determine if the other variables should remain in this model, another regression was run restricting INDEX, ACT, MAJOR, and SIZE to "0". For testing these restrictions, the F-value was 0.2941 and was not significant at α=.05 level of significance. The null hypothesis could not be rejected,

Table 4

Ordinary Least Squares of Mean Information Gain (TLGN): Restricted Model

Variable	Coefficients (t-value)	P-Value
Constant	3.452 (5.74)	.000
CLASS	3.149 (3.297)	.001
SEX	-1.563 (-1.930)	.054
N	64	
Std.Err.	3.3003	
R^2	.18112	
Adj. R^2	.15427	
F-Test	6.7459	

and it was concluded that INDEX, ACT, MAJOR, and SIZE do not belong in the model. The final model was run with t-ratios corrected for heteroscedasticity and the data are presented in Table 4.[43] The global F-test of 6.7459 is significant at the P=0.00 level of significance. The results in Table 4 indicate that the upper-class students tend to gain more information than the freshmen or sophomores, and that male students tend to gain more information than female students, given any read-

[43] Robert S. Pindyck and Daniel L. Rubinfeld, Econometric Models and Economic Forecasts (New York, NY: McGraw-Hill, Inc., 1991), p. 48, and 127-128 defines heteroscedasticity as an error term with a changing variance. When heteroscedasticity is present, the ordinary least-squares estimation places more emphasis on observations with larger variances.

ability level. But notably absent from the model as a statistically significant explanatory variable is textbook readability index.

Chapter Summary

One primary and two secondary null hypotheses are set forth in this study. The primary hypothesis states that no significant difference is found in cognitive gain when the mean score improvement of students reading the easier book's narrative section is compared to those reading from the harder book. The two secondary hypotheses state that there will be no significant difference between pretest and posttest mean score information gain in both books for the quantitative and graphical sections.

To test these hypotheses, the study participants were required to complete a 24-question multiple choice pretest. There were eight questions each for the narrative, quantitative, and graphical sections. After reading selections from the assigned texts, the students took the same exam as a posttest. The difference between the pretest and posttest was the information gain. The average of the mean score improvement was calculated for each group and the statistical significance of the score difference was measured utilizing standardized t-distribution tests. The t-tests indicated that no significant differences existed in the narrative and graphical sections. This resulted in acceptance of the null hypothesis and rejection of the alternative hypothesis that readability index values are indicators of poten-

tial cognitive achievement. The quantitative section, however, did prove to be statistically significant. The null hypothesis was, therefore, rejected. Thus, for the quantitative section, readability index values are suggestive of potential information or cognitive gain.

An Ordinary Least Squares regression model was also employed to explore the interaction between student demographic characteristics, readability, and cognitive gain. Of the six demographic variables presented as candidates for the model, only sex and class standing proved to be statistically significant. Notably rejected as a statistically significant explanatory variable was the text-book readability index value.

Chapter IV

STATISTICAL ANALYSIS OF DEMOGRAPHIC DATA

Analysis of Student Demographic Data

As noted earlier, students also provided demographic information. These data were used in Chapter 3 to explore the feasibility of developing a Least Squares regression model to show the interaction between student demographic characteristics, readability, and total cognitive gain. In this chapter, those demographic characteristics are tested one by one and section by section against readability using the pre- and posttest procedures. Thus statistical comparisons are made of the difference between pre- and posttest scores as they might be influenced by class standing, sex, major, college math courses, and ACT score. In addition, the size of high school graduating class, study of economics in high school, and the year of high school graduation are analyzed to ascertain if any significant difference might exist when sections from the two textbooks are read.

Analysis Based on Class Standing

Student performance based on their classification was divided into two categories: Freshman/Sophomore and Upper Level. These two groups were

then compared using the format explained before: narrative, quantitative, and graphical sections. Then t-tests were used to evaluate mean score improvement. The results follow in Tables 5 and 6.

Table 5

Test of Differences Between the Pretest and Posttest Scores for Freshman/Sophomore Students

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	29	1.069	5.067	2.050	59	-.814
Hard	32	1.500	2.250			
Difference		.431				
		Quantitative				
Easy	29	1.586	3.823	1.827	59	2.320
Hard	32	.500	2.903			
Difference		1.086				
		Graphical				
Easy	29	.621	2.316	1.556	59	.613
Hard	32	.375	2.563			
Difference		.246				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

For the Freshman/Sophomore group in Table 5, the numerical difference of .431 for the narrative section was not statistically significant. The calculated t-value was -.814. With 59 degrees of freedom the critical t-value is 2.001.

Since -.814 is less than 2.001, there appeared to be no statistically significant difference between the easy book and hard book groups' information gain.

The graphical section also revealed a statistically insignificant cognitive gain difference. Comparison of the calculated t-value of .613 with a critical t of 2.001 confirms this conclusion.

Further reference to Table 5 will, however, reveal that the difference in the mean improvement score of 1.086 is statistically significant in the quantitative section. The calculated t-value is 2.320, and the critical t-value is 2.001. Students exposed to the more readable book registered the greatest gain in scores, 1.586 as opposed to a .500 information gain for those reading the difficult book. These results are consistent with those for the overall groups presented in Table 1.

The results of the pre- and posttest evaluation for the upper-level students revealed no statistically significant difference between the easy book and hard book groups at α=.05 significance level for the narrative section. As displayed in Table 6, the calculated t-value of -.307 with 18 degrees of freedom was less than the critical t-value of 2.101.

The calculated t-values for the quantitative and graphical sections also were less than the critical t-value, $1.650 < 2.101$ and $-1.339 < 2.101$, respectively. Neither mean information gain score was significant.

Examining the difference in the sample mean scores among classification levels in Tables 5 and 6 discloses an interesting fact. The mean information gain for the upper-level students was higher in all three sections than for the lower-level students. The one exception involves the graphical section for the easy book upper-level students whose score of .621 was greater than the .500 registered for the other group. Perhaps exposure of juniors and seniors to more business classes or real-world experiences and economic conditions explains the differences in sample mean scores for the two classification groups.

Analysis Based on Gender

Students studying the easy book and those reading the hard book were divided by gender, male and female. Then the easy book male information gain was compared to the hard book male score. The female students were compared to each other in a similar manner. The resulting data are reported in Tables 7 and 8, and they parallel the results for lower-level students in the previous section.

Table 7 shows that for the males in the narrative section, the mean difference of .104 is found to be statistically insignificant. The calculated t-value of -.199 with 41 degrees of freedom is less than 2.019, the critical t-value at α=.05 level of confidence.

Similar results occur in the graphical section. The mean improvement difference for males was .141, not statistically significant with a calculated t-value of -.306, and a critical t-value of 2.019 at α=.05 level of confidence.

However, data in the quantitative section unveiled a statistically significant difference in the mean information gain between the easy and hard book for male readers. The calculated t-value for the pre- and posttest score for males was 2.250. At α=.05 level of significance, the critical t-value was 2.019. This result supports the earlier conclusion that readability is a factor in the information gain in the quantitative section.

Table 6

Test of Differences Between Pretest and Posttest Scores for Upper Level Students

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	12	1.917	3.675	1.451	18	-.307
Hard	8	2.125	4.516			
Difference		.208				
		Quantitative				
Easy	12	2.917	1.356	1.713	18	1.650
Hard	8	1.625	5.411			
Difference		1.292				
		Graphical				
Easy	12	.500	1.727	1.461	18	-1.339
Hard	8	1.375	2.554			
Difference		.875				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Table 7

Test of Differences Between Pretest and Posttest Scores for Male Students

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	23	1.696	2.586	1.692	41	-.199
Hard	20	1.800	3.327			
Difference		.104				
		Quantitative				
Easy	23	2.304	4.858	2.115	41	2.250
Hard	20	.850	4.028			
Difference		1.454				
		Graphical				
Easy	23	.609	2.611	1.489	41	-.306
Hard	20	.750	1.882			
Difference		.141				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Table 8 exhibits the test for the female members of the easy and hard book groups.

None of the mean information gain scores proved to be statistically significant. The calculated t-values for the narrative, quantitative, and graphical sections were -.870, 1.930, and .191, respectively, and all were less than the critical t-value of 2.028 at α=.05 level of confidence. Even though the calculated t-value for the

quantitative section was not statistically significant, it can be noted that the females studying the easier textbook posted the greater information gain, just as the males. This implies that the easier text's readability level was somewhat of a factor in information improvement of the female students.

Table 8

Test of Differences Between Pretest and Posttest Scores for Female Students

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	18	.833	5.909	2.175	36	-.870
Hard	20	1.450	3.733			
Difference		.617				
		Quantitative				
Easy	18	1.556	1.438	1.521	36	1.930
Hard	20	.600	3.095			
Difference		.956				
		Graphical				
Easy	18	.500	1.560	1.589	36	.191
Hard	20	.400	3.516			
Difference		.100				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Female Students Versus Male Students

To determine if there was a significant difference in information gain between male and female students, a series of additional t-tests were conducted. Here

the data are not only separated as to easy or hard books, but also as to gender reading each book. Hence in Table 9, the entry is Easy "F" and Easy "M", and so on.

As shown by the data presented in Table 9, none of the t-tests disclosed a statistically significant difference in mean information gain between males and females. For the narrative section, the easy textbook calculated t-value was -1.430. At α=.05 level of significance and critical t of -2.023 with 39 degrees of freedom, the .894 difference failed to be statistically significant. The hard text group provided similar results. A calculated t-value of -.270 failed to be significant with 38 degrees of freedom and a critical t-value of 2.024. Reference to Table 9 shows that in the narrative section the females scored the higher information gain in the easy book while the males appeared to gain more from the difficult book.

Table 9 also failed to disclose a significant difference in information improvement between males and females for the quantitative section. A difference of .500 for the easy book proved to be not statistically significant at the α=.05 level with a calculated t-value of -.870, and a critical t-value of 2.023. The more difficult book also failed the α=.05 significance test with a calculated t value of -.420, and a critical t value of -2.024. Unlike the narrative section results, however, the males showed a greater information gain than the females in both books.

The graphical section in Table 9 failed to reveal any significant differences in the mean score improvement between males and females. The easy book males

Table 9

Test of Differences Between Pretest and Posttest Scores for Male and Female Students

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy F	18	1.783	2.269	1.985	39	-1.430
Easy M	23	.889	6.105			
Difference		.894				
Hard F	20	1.650	3.082	1.790	38	-.270
Hard M	20	1.800	3.326			
Difference		.150				
		Quantitative				
Easy F	18	1.667	1.059	1.839	39	-.870
Easy M	23	2.167	5.101			
Difference		.500				
Hard F	20	.700	2.958	1.899	38	-.420
Hard M	20	.950	4.261			
Difference		.250				
		Graphical				
Easy F	18	.500	1.559	1.465	39	-.330
Easy M	23	.652	2.601			
Difference		.152				
Hard F	20	.500	3.421	1.628	38	-.490
Hard M	20	.750	1.882			
Difference		.250				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

scored .152 points higher than the females. The t-value of -.330 was statistically insignificant at α=.05 confidence level and a critical t-value of -2.023.

Although the mean score improvement was statistically insignificant, Table 9 discloses that in the graphical section the male students scored higher than the female students. This finding is parallel with the results in the quantitative section. In fact, the males scored a higher mean information gain than the females for all sections except in the easy book narrative passage. To determine if there was a statistically significant difference in the level of economic understanding between males and females before taking these exams, an analysis was made of the pretest scores for all sections. The results are presented in Table 10.

All t-tests failed to be statistically significant except one. The easy book narrative section revealed a 1.099 difference in the mean score in favor of the males. At α=.05 confidence level and 39 degrees of freedom, the calculated t-value was 2.160 and the critical t-value was 2.023. The male students exhibited a greater knowledge of economics before completing the narrative reading. However, this same group of male students scored .894 points lower in information gain overall (See Table 9). This implies that although this group of female students was not as well initiated in economics, it exhibited a greater overall information gain in the easy book narrative section. Generally, as reference to Table 10 will confirm, little difference in prior economics understanding was shown based on the student's sex.

Table 10

Test of Differences Between Pretest Scores for Male and Female Students

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy F	18	2.957	.862	1.616	39	2.160
Easy M	23	4.056	4.879			
Difference		1.099				
Hard F	20	3.100	1.568	1.196	38	.130
Hard M	20	3.150	1.292			
Difference		.050				
		Quantitative				
Easy F	18	3.167	1.206	1.101	39	.490
Easy M	23	3.000	1.217			
Difference		.167				
Hard F	20	3.900	1.779	1.729	38	.270
Hard M	20	3.750	4.197			
Difference		.150				
		Graphical				
Easy F	18	3.111	1.281	1.112	39	1.060
Easy M	23	2.739	1.202			
Difference		.372				
Hard F	20	3.450	1.734	1.412	38	-.340
Hard M	20	3.600	2.253			
Difference		.150				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Analysis Based on Major

Tables 11 and 12 present a comparison of business and nonbusiness majors. Results from the t-tests on the information gain difference among business majors are presented in Table 11. The calculated t-scores of -.337, 1.310, and .180 do not prove to be significant at α=.05 level of significance.

However, in comparing these results with those in Table 12, one finds the information gain score of the quantitative section for nonbusiness majors to be statistically significant with a numerical difference of 1.889. A calculated t-value of 3.120 with 34 degrees of freedom and a critical t-value of 2.032 confirms this conclusion. Students scored 1.889 points higher on the easy book than their counterparts using the hard book, suggesting that in this area readability might be a factor among nonbusiness students.

Analysis Based on College Math Courses

Mixed results are obtained when the students' mathematical preparation is examined. These are presented in Tables 13 and 14. The narrative sections reveal no statistically significant differences in information gain for either the students who completed up to two college math courses or those who completed more than two.

But, in the quantitative section, the mean score difference for those who completed up to two college math courses was significant. Those exposed to the

less difficult book registered the larger improvement. A calculated t-value of 2.890 with 63 degrees of freedom, and a critical t-value of 1.998 imply significance at α=.05 confidence level. Even though the mean score improvement was not statistically significant, noteworthy is that both the easy and hard book students who had completed three, or more college math classes had higher mean improvement scores than those who completed only up to two math courses.

Table 11

Test of Differences Between Pretest and Posttest Scores for Business Majors

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	23	1.435	5.532	1.984	43	-.337
Hard	22	1.636	2.434			
Difference		.201				
		Quantitative				
Easy	23	1.739	3.293	1.895	43	1.310
Hard	22	1.000	3.905			
Difference		.739				
		Graphical				
Easy	23	.478	1.554	1.303	43	.180
Hard	22	.409	1.872			
Difference		.069				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Table 12

Test of Differences Between Pretest and Posttest Scores for Nonbusiness Majors

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	18	1.167	1.362	1.917	34	-.690
Hard	18	1.611	2.595			
Difference		.444				
		Quantitative				
Easy	18	2.278	3.624	1.814	34	3.120
Hard	18	.389	2.958			
Difference		1.889				
		Graphical				
Easy	18	.722	2.918	1.821	34	-.090
Hard	18	.778	3.712			
Difference		.056				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Table 13 reveals no significant difference in cognitive improvement scores for the graphical section. Table 14, on the other hand, shows the 1.482 mean difference for those who completed three or more college math courses to be statistically significant. A calculated t-value of -2.386 with 13 degrees of freedom, α=.05 significance level, and a critical t-value of -2.160 confirms this conclusion. Students reading the hard book gleaned more information than those reading the easy book, .143 to 1.625, respectively, which was more than

that recorded for students with low mathematical preparation who were exposed to the difficult book and reported in Table 13.

Table 13

Test of Differences Between Pretest and Posttest Scores for Students Who Completed Up to Two College Math Courses

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	33	1.303	4.468	2.051	63	-.390
Hard	32	1.500	3.936			
Difference		.197				
		Quantitative				
Easy	33	1.818	3.341	1.881	63	2.890
Hard	32	.469	3.741			
Difference		1.349				
		Graphical				
Easy	33	.697	2.280	1.573	63	.990
Hard	32	.125	2.673			
Difference		.384				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Analysis Based on ACT Scores

Analysis of ACT score differences was based upon a comparison of those who scored twenty or below to those who scored more than twenty. Again, the results were varied. Table 15 presents the t-values for those who scored up to twenty on the ACT.

Table 14

Test of Differences Between Pretest and Posttest Scores for Students Who Completed Three or More College Math Courses

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	7	1.429	3.619	1.583	13	-.850
Hard	8	2.125	1.554			
Difference		.696				
		Quantitative				
Easy	7	2.714	4.328	1.639	13	1.140
Hard	8	1.750	1.357			
Difference		.964				
		Graphical				
Easy	7	.143	1.476	1.387	13	-2.386
Hard	8	1.625	1.411			
Difference		1.482				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

The narrative section revealed no significant difference in the cognitive improvement between the easy book and hard book. However, both the quantitative and graphical sections revealed statistically significant mean improvement scores. In the quantitative section, the calculated t-value was 2.500 with α=.05 level of confidence, 24 degrees of freedom, and a critical t-value of 2.064.

The graphical section's results parallel those of the quantitative area. The calculated t-value of 2.279 is statistically significant with 24 degrees of freedom, α=.05 confidence level and a critical t-value of 2.064. Thus, it appears from the results in Table 15 that students who scored twenty or below on the ACT perform uniformly better on the tests when reading the easy book rather than the hard book.

Table 15

Test of Differences Between Pretest and Posttest Scores for Students Who Scored Up to Twenty on the ACT

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	15	1.733	4.638	1.887	24	.490
Hard	11	1.364	2.055			
Difference		.369				
		Quantitative				
Easy	15	1.800	3.886	1.907	24	2.500
Hard	11	-.091	3.291			
Difference		1.891				
		Graphical				
Easy	15	1.000	1.858	1.303	24	2.279
Hard	11	-.091	.891			
Difference		1.091				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Table 16 provides the data for those students who scored over twenty on the ACT. As suggested by the small information improvement scores, all these t-tests proved statistically insignificant. For the narrative, quantitative, and graphical sections, the calculated t-values of -1.460, .640, and .860, respectively, were all less than the critical t-value of 2.028. Thus, no conclusive relationship between ACT scores above twenty and textbook readability can be drawn from the data.

Table 16

Test of Differences Between Pretest and Posttest Scores for Students Who Scored Above Twenty on the ACT

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	17	.882	4.860	1.951	36	-1.460
Hard	21	1.810	2.962			
Difference		.928				
		Quantitative				
Easy	17	1.706	3.971	1.797	36	.640
Hard	21	1.332	2.633			
Difference		.373				
		Graphical				
Easy	17	.905	3.791	1.747	36	.860
Hard	21	.412	2.132			
Difference		.389				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Table 17

Test of Differences Between Pretest and Posttest Scores for Students with a Graduating Class of up to 300

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	22	1.500	2.250	1.867	50	-.505
Hard	30	1.767	3.122			
Difference		.267				
		Quantitative				
Easy	22	2.227	2.660	1.712	50	3.250
Hard	30	.667	3.126			
Difference		1.560				
		Graphical				
Easy	22	.364	2.338	1.624	50	-.151
Hard	30	.433	2.945			
Difference		.069				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Analysis Based on Size of High School Graduating Class

The demographic variable involving the size of high school graduating class provides for a comparison of students from a class of three hundred or less with those from a class of over three hundred. Table 17 reveals t-test results for those students in a graduating class of up to three hundred. The narrative and graphical sections provide no statistically significant information. At α=.05

level of confidence, 50 degrees of freedom, and a critical t-value of 2.009, the calculated t-values of -.505 and -.151 from the narrative and graphical sections, respectively, are statistically insignificant.

The quantitative section, on the other hand, shows a calculated t-value of 3.250, a critical t-value of 2.009, 50 degrees of freedom and α=.05 confidence level. Hence for the quantitative section a significant relationship between size of high school and performance on the readability test is indicated, in this case favoring the easy book.

Table 18 shows the t-test results for those students who were graduated with a class of over three hundred. With a critical t-value of 2.052, α=.05 level of confidence, and 27 degrees of freedom, none of the t-tests proved to be statistically significant. The narrative, quantitative, and graphical sections had calculated t-values of -.115, 1.110, and -.301, all of which are less than 2.052. Therefore, no inferences concerning graduates from large high schools and test performance can be made.

Analysis Based on Study of Economics in High School

Data resulting from t-tests for those students who studied economics in high school are presented in Table 19. Again, the narrative and graphical sections are seen not to be statistically significant when the calculated t-values of -.430 and .466 are compared to the critical t-value of 2.000.

Table 18

Test of Differences Between Pretest and Posttest Scores for Students with a Graduating Class of Over 300

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	19	1.105	1.221	2.065	27	-.115
Hard	10	1.200	1.440			
Difference		.095				
		Quantitative				
Easy	19	1.842	4.585	2.172	27	1.110
Hard	10	.900	4.989			
Difference		.942				
		Graphical				
Easy	19	.842	1.806	1.319	27	-.301
Hard	10	1.000	1.777			
Difference		.158				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

But the quantitative section's results are significant at α=.05 level with a calculated t-value of 2.480, 60 degrees of freedom, and a critical t-value of 2.000. Once again, more information was gleaned from the easier book by its readers.

Table 20 presents the calculations for those students who did not have economics in high school. None of the data appeared to be statistically significant. With a critical t-value of 2.109, the narrative, quantitative, and graphical

sections fell short with calculated t-values of -1.660, 1.390, and -.205, respectively. But, some evidence emerges from the analysis favoring those who study economics in high school as reflected by the results in Tables 19 and 20. There was a statistically significant mean score improvement for this group in the quantitative section of the easy book.

Table 19

Test of Differences Between Pretest and Posttest Scores for Students Studying Economics in High School

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	27	1.185	4.234	1.934	60	-.430
Hard	35	1.400	3.365			
Difference		.215				
		Quantitative				
Easy	27	1.889	2.795	1.804	60	2.480
Hard	35	.743	3.608			
Difference		1.146				
		Graphical				
Easy	27	.778	2.025	1.480	60	.466
Hard	35	.600	2.365			
Difference		.178				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Table 20

Test of Differences Between Pretest and Posttest Scores for Students Not Studying Economics in High School

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	14	1.571	4.109	1.877	17	-1.660
Hard	5	3.200	1.700			
Difference		1.629				
		Quantitative				
Easy	14	2.143	4.901	2.127	17	1.390
Hard	5	.600	3.300			
Difference		1.543				
		Graphical				
Easy	14	.214	2.182	1.695	17	-.205
Hard	5	.400	5.798			
Difference		.186				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Analysis Based on High School Graduation Year

Tables 21 and 22 contain the results of t-tests computed for another demographic grouping of students, those who graduated in 1993 or 1994 and those who were graduated before that date. The narrative and graphical sections for the 1993, or 1994 group in Table 21 show no statistically significant differences in information gain. The calculated t-values of -.980 and 1.471 from the narrative and graphical sections are both less than the critical t-value of 2.026.

Table 21

Test of Differences Between Pretest and Posttest Scores for Students Graduating in 1993 or 1994

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	22	.909	5.515	2.156	37	-.980
Hard	17	1.588	3.507			
Difference		.679				
		Quantitative				
Easy	22	1.364	3.766	1.715	37	2.250
Hard	17	.118	1.860			
Difference		1.246				
		Graphical				
Easy	22	.727	2.304	1.680	37	1.471
Hard	17	-.059	3.309			
Difference		.786				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

However, the quantitative section reveals a statistically significant difference between the easy and hard book group's information gain. With 37 degrees of freedom, α=.05 significance level, a calculated t-value of 2.250, and a critical t-value of 2.026, a definite statistical difference between the two populations exists. And once again, the easy book students scored the highest information gain.

The data computed for students graduating from high school before 1993 is presented in Table 22. The results parallel the conclusions reached for Table 21. The narrative and graphical sections showed calculated t-values of .260 and -1.480 with 40 degrees of freedom. At the α=.05 significance level and with a critical t-value of 2.021, the differences were not statistically significant.

Table 22

Test of Differences Between Pretest and Posttest Scores for Students Graduating Before 1993

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	19	1.789	2.287	1.735	40	.260
Hard	23	1.652	3.601			
Difference		.137				
		Quantitative				
Easy	19	2.684	2.228	1.839	40	2.650
Hard	23	1.174	4.332			
Difference		1.510				
		Graphical				
Easy	19	.421	1.924	1.376	40	-1.480
Hard	23	1.043	1.772			
Difference		.622				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

Once again, the quantitative section yielded a statistically significant difference in the cognitive achievement. The calculated t-value was 2.650 and the critical t-value was 2.021 which was significant at α=.05 level. As before, the easy book group reaped the highest information gain. But with this exception, year of high school graduation appeared overall not to influence student outcome on the readability examination.

Analysis Based on Type of High School Attended

Analysis of whether the student was graduated from a public or private high school yielded the same information garnered in earlier analyses. Table 23 presents the t-test results for those students who attended a public high school and Table 24 gives data for those who attended a private high school.

The narrative and graphical sections produced insignificant differences in information improvement for public or private high school students, as reference to Tables 23 and 24 indicates. For the public school students, comparing a critical t-value of 1.994 to -.550 for the narrative calculated t-value and -.507 for the graphical calculated t-value reveals that there is no statistically significant difference.

The private high school students' information gain was also not statistically significant. The critical t-value was 2.447 compared to a calculated t-value of -.840 for the narrative section and .820 for the graphical section.

Table 23

Test of Differences Between Pretest and Posttest Scores for Students Who Attended Public High School

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	38	1.368	4.293	2.003	71	-.550
Hard	35	1.629	3.711			
Difference		.261				
		Quantitative				
Easy	38	1.974	3.324	1.894	71	2.650
Hard	35	.800	3.871			
Difference		1.174				
		Graphical				
Easy	38	.595	1.858	1.481	71	-.507
Hard	35	.771	2.592			
Difference		.176				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

However, the quantitative section revealed a statistically significant difference in the mean improvement score for public high school graduates. The calculated t-value was 2.650, with α=.05 confidence level, 71 degrees of freedom, and a critical t-value of 1.994. Once again, the easy book students scored the greatest information gain.

Table 24

Test of Differences Between Pretest and Posttest Scores for Students Who Attended Private High School

Book Group	N	Mean	Var.	PSD	df	t
		Narrative				
Easy	3	.667	2.333	1.520	6	-.840
Hard	5	1.600	2.300			
Difference		.933				
		Quantitative				
Easy	3	2.000	7.000	1.673	6	1.470
Hard	5	.200	.700			
Difference		1.800				
		Graphical				
Easy	3	.333	8.333	1.892	6	.820
Hard	5	-.800	1.200			
Difference		1.133				

All standard deviations are reported from pooled data.
PSD = pooled standard deviation df = degrees of freedom

The quantitative section for the private high school graduates revealed no statistically significant difference between the mean scores of the easy book group and the hard book group. This is indicated when a calculated t-value of 1.470 is compared to 2.447, the critical t-value. In this instance, the variable like most of the other demographic variables yields little definitive information concerning the relationship between students' background and their performance on

readability examinations. The exception generally has involved the textbooks' quantitative topics. .

Chapter Summary

After the initial testing of the primary data, t-tests were run on the demographic data. The procedure involved comparing students using the easy text to those using the hard text categorized by class standing, sex, major, and the number of college math courses completed. In addition, the ACT score, size of high school graduating class, whether economics was studied in high school, and whether the students attended a public or private high school were compared. In the quantitative section of the easy textbook, readability appeared to play a role in information gain. But the main thrust of the demographic analysis suggests acceptance of the null hypothesis that no significant difference in cognitive gain is registered between the more readable and less readable book. Hence, it may be concluded that among students with varying demographic backgrounds, readability indexes are not reliable indicators of potential cognitive gain.

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Summary

The purpose of this study was to determine if readability formulas are appropriate tools for selecting a readable textbook for principles of economics classes. To make this determination, the study sought to discover whether readability and information gain are related in an economics text.

This study was conducted in five macroeconomics classes at Middle Tennessee State University, Murfreesboro, Tennessee, during the 1995 Spring semester. Two contemporary textbooks were chosen for this study, one with a high readability level and one with a low readability level. Passages on the exchange rate, cost analysis, and monopoly profit maximization were chosen from the two textbooks. The first passage presented the material in narrative form, the second in a quantitative manner, and the third graphically. In each class, one student was given the three passages from the readable book, and another was given the three passages from the difficult book in alternate fashion. Prior to reading each passage, each student was given a pretest over the selection's content. After the passage was read, an identical

posttest was given. Comparisons were then made of the test mean score improvement between the two books to determine in which book informaion gain was greater. The sample mean score improvement for each section or passage was computed by subtracting the pretest score from the posttest score obtained by each student.

The primary null hypothesis for this study was that in the narrative section no significant difference would be found in information gain when the mean score improvement of students using the easy book was compared to the same score of those using the hard book. Two secondary hypotheses were offered which maintained that there would be no significant differences between pre- and posttest mean score information gain in the quantitative section nor in the graphical section. To test for statistical significance, the standard t-distribution for small samples was utilized.

Conclusion

When passages from the two books were thus compared and the t-test was applied, no significant differences were discovered for the narrative and graphical sections. Based upon these results, therefore, it cannot be stated that readability index values are indicators of potential cognitive achievement for textbook material presented in narrative and graphical form. However, test results in the quantitative section did prove to be statistically significant. Hence the alternative hypothesis that readability index values are suggestive of potential information gain can be accepted.

A simple regression model was also developed to explore the interaction between student demographic characteristics, readability, and cognitive gain. Of the six variables included in the model, only sex and class standing proved to be statistically significant. The textbook readability index value was not a statistically significant explanatory variable.

Implications

While analyzing this study, it became apparent that improvements in research methodology could be made and that there were further areas of research into the teaching of economics which could be pursued. The following are submitted:

1. Additional research might be warranted concerning how to select the narrative topic for a pre- and posttest evaluation. Choosing a topic with a more appropriate readability level and one consistent with the published index value would provide a better basis for determining whether information gain can be suggested by the index level ascribed to the textbook.

2. Future research might be improved if a longer period were allowed for the reading and studying of each passage. Such a change would encourage students to learn information for application to problems or questions, not simply to engage in rote memorization. The result should be a more definitive registering of information gain.

3. Changing the format of the pre- and posttest to allow student access to the graphic and quantitative displays while they are actually answering the questions may

prove to be beneficial in testing for cognitive gain. With this revised format, the exam questions could be more in depth, searching for information gain rather than inviting a response based upon rote memorization or on random factors.

4. Further research into the quantitative sections of economics textbooks might prove helpful. Since mathematics is becoming so central to the study of the principles of economics, it might be useful to investigate which form of mathematical presentation (verbal or quantitative) is most easily understood and applied by students.

5. Additional research with a larger sample of students might be warranted. A larger sample could improve the credibility of any findings because the demographic diversity of students who comprise the typical class in economics necessitates comparisons between groups of unequal size. Statistical conclusions are correspondingly limited.

APPENDICES

Appendix A

I N S T R U C T I O N S

1. There are nine sections in the following test. Five to seven minutes will be allowed for completion of each section.

2. At the end of each section, please wait for further instructions. Do not go back to earlier parts of the exam.

3. After completing the entire test, turn the test over on your desk.

4. When asked, please pass your test to the front of the class.

** These test results will not be considered in your final grade in ECON 241 Principles of Macroeconomics.

Please provide the following information.

1. Class standing: FR ___ SO ___ JR ___ SR ___ GS ___

2. Male ___ Female ___

3. Major: _____

4. Size of high school graduating class:
   ___ 30 or under
   ___ 30 - 100
   ___ 100 - 300
   ___ over 300

5. Took economics in high school: Yes ___ No ___

6. Year graduated from high school _____

7. Number of college math courses already completed: _____

8. Overall or composite ACT or SAT score: _____

9. Type of high school attended: Public ___ Private ___

10. Have you completed a college level course in Principles of Economics before this course? Yes ___ No ___

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. A gold standard is an example of a:

   a. fixed exchange rate system.
   b. nondiscretionary "pegged" currency.
   c. flexible exchange rate system.
   d. a floating exchange rate system.

2. Which of the following is not a force that can cause changes in the supply and demand for a country's currency?

   a. income changes.
   b. price changes.
   c. consumption changes.
   d. interest rate changes.

3. A nation on the gold standard agrees to:

   a. allow free movement of gold across national boarders.
   b. tie the domestic money supply to the stock of gold.
   c. fix the price of currency relative to gold.
   d. all of the above.

4. If the U.S. has more price inflation than other countries:

   a. U.S. demand for foreign currency rises.
   b. U.S. demand for foreign currency falls.
   c. foreign demand for U.S. dollars rises.
   d. U.S. price inflation only influences foreign currency supply, not demand.

5. If the dollar's value is expected to drop, there will be a _____ in the demand for dollars and _____ in the supply, which causes a drop in the value of the dollar.

   a. increase; decrease.
   b. decrease; no change.
   c. no change; increase.
   d. decrease; increase.

6. A balance of payments deficit results in a gold _____ and a _____ in the country's money supply.

   a. inflow; increase.
   b. outflow; decrease.
   c. inflow; decrease.
   d. outflow; increase.

7. The gold standard prevailed as an international monetary system from the late 1800s to the:

   a. 1920s.
   b. 1930s.
   c. 1940s.
   d. 1950s.

8. A rise in the U.S. interest rates relative to interest rates in other countries:

   a. reduces the foreign demand for U.S. financial assets.
   b. increases the foreign demand for U.S. financial assets.
   c. has no influence on foreign demand for U.S. financial assets.
   d. will influence foreign demand for U.S. financial assets only if the domestic money supply is unchanged.

STOP!!

Wait for further Instructions

When governments do not enter into foreign exchange markets at all, but leave the determination of exchange rates totally up to currency traders, the country is said to have a **flexible exchange rate.** The price of its currency is allowed to rise and fall as market forces dictate. When governments sometimes buy or sell currencies to influence the exchange rate, while at other times they let private market forces operate, the country is said to have a **partially flexible exchange rate.** A partially flexible exchange rate is sometimes called a *dirty float* because it isn't purely market determined or government determined.

If the government chooses a particular exchange rate and offers to buy and sell currencies at that price, it is imposing a **fixed exchange rate.** For example, suppose the U.S. government says it will buy francs at 20¢ and sell dollars at 5 francs. In that case we say that the country has a fixed exchange rate of 5 francs to the dollar.

Forces That Cause Shifts in the Supply of and Demand for Currencies The major forces that can cause shifts include changes in a country's income, changes in a country's prices, changes in interest rates, and changes in expectations. Let's consider each in turn.

Changes in a Country's Income The demand for imports depends on the income in a country. When a country's income falls, demand for imports falls. Hence demand for foreign currency to buy those imports falls, which means that the supply of the country's currency to buy the foreign currency falls. That's why in our presentation of the Keynesian model we said that imports depend on income.

Changes in a Country's Prices The United States's demand for imports and foreign countries' demand for U.S. exports depend on prices of U.S. goods compared to prices of foreign competing goods. If the United States has more inflation than other countries, foreign goods will become cheaper, U.S. demand for foreign currencies will tend to increase, and foreign demand for dollars will tend to decrease. This rise in U.S. inflation will shift the dollar supply outward and the dollar demand inward.

Changes in Interest Rates People like to invest their savings in assets that will yield the highest return. A rise in U.S. interest rates relative to those abroad will increase demand for U.S. assets as long as that rise is a rise in the real interest rate—that is, as long as the rise isn't accompanied by a rise in inflation. As a result of a rise in the U.S. interest rate, demand for dollars will increase, while simultaneously the supply of dollars will decrease as fewer Americans sell their dollars to buy foreign assets. A fall in the U.S. interest rate or a rise in foreign interest rates will have the opposite effect.

Changes in Expectations If the value of a currency falls, the holders of that currency and of assets denominated in that currency lose; if the value of a currency rises, the holders of that currency and of assets denominated in that currency gain. So everyone tries to hold currencies whose value will rise and get rid of currencies whose value will fall. Thus, expectations of whether a currency will rise or fall can cause large shifts in the supply and demand. Expectations can even be self-fulfilling. For example, the expectation of a rise in the dollar's value will increase the demand for dollars and decrease the supply, which will cause a rise in the value of the dollar. The dollar rises because it is expected to rise.

The Gold Standard: A Fixed Exchange Rate System Governments played a major role in determining exchange rates until the 1930s. Beginning with the Paris Conference of 1867 and lasting until 1933 (except for the period around World War I), most of the world economies had a system of relatively fixed exchange rates under what was called a **gold standard.** Under a gold standard, the amount of money a country issued had to be directly tied to gold, either because gold coin served as the currency in a country (as it did in the United States before 1914) or because countries were required by law to have a certain percentage of gold backing their currencies. Gold served as currency or backed all currencies. Each country participating in a gold standard agreed to fix the price of its currency relative to gold. That meant a country would agree to pay a specified amount of gold upon demand to anyone who wanted to exchange that country's currency for gold. To do so, each country had to maintain a stockpile of gold. When a country fixed the price of its currency relative to gold, it fixed its currency's price in relation to other currencies, as a result of the process of arbitrage.

Under the gold standard, a country made up a difference between the quantity supplied and the quantity demanded of its currency by buying or selling gold to hold the price of its currency fixed in terms of gold. How much a country would need to buy and sell depended upon its balance of payments deficit or surplus. If the country ran a surplus in the balance of payments, it was required to sell its currency—that is, buy gold—to stop the value of its currency from rising. If a country ran a deficit in the balance of payments, it was required to buy its currency—that is, sell gold—to stop the value of its currency from falling.

Since gold served as reserves to a country's currency, a balance of payments *deficit* (and hence a downward pressure on the exchange rate) would result in a flow of gold out of the country and hence a decrease in the country's money supply. That decrease in the money supply would contract the economy, decreasing imports, lowering the country's price level, and increasing the interest rate, all of which would work toward eliminating the balance of payments deficit.

Similarly a country with a balance of payments *surplus* would experience an inflow of gold. That flow would increase the country's money supply, increasing income (and hence imports), the price level (making imports cheaper and exports more expensive), and lowering the interest rate (increasing capital outflows). These would work toward eliminating the balance of payments surplus.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. A gold standard is an example of a:

   a. fixed exchange rate system.
   b. nondiscretionary "pegged" currency.
   c. flexible exchange rate system.
   d. a floating exchange rate system.

2. Which of the following is not a force that can cause changes in the supply and demand for a country's currency?

   a. income changes.
   b. price changes.
   c. consumption changes.
   d. interest rate changes.

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   a. allow free movement of gold across national boarders.
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   d. all of the above.

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   b. U.S. demand for foreign currency falls.
   c. foreign demand for U.S. dollars rises.
   d. U.S. price inflation only influences foreign currency supply, not demand.

5. If the dollar's value is expected to drop, there will be a _____ in the demand for dollars and _____ in the supply, which causes a drop in the value of the dollar.

   a. increase; decrease.
   b. decrease; no change.
   c. no change; increase.
   d. decrease; increase.

6. A balance of payments deficit results in a gold _____ and a _____ in the country's money supply.

   a. inflow; increase.
   b. outflow; decrease.
   c. inflow; decrease.
   d. outflow; increase.

7. The gold standard prevailed as an international monetary system from the late 1800s to the:

   a. 1920s.
   b. 1930s.
   c. 1940s.
   d. 1950s.

8. A rise in the U.S. interest rates relative to interest rates in other countries:

   a. reduces the foreign demand for U.S. financial assets.
   b. increases the foreign demand for U.S. financial assets.
   c. has no influence on foreign demand for U.S. financial assets.
   d. will influence foreign demand for U.S. financial assets only if the domestic money supply is unchanged.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. Total variable costs (VC) are those production costs which:

   a. do not change as output (Q) changes.
   b. do change as output (Q) changes.
   c. are fixed until maximum output (Q) is reached and then they change.
   d. would exist even though the firm produced no output.

2. If total fixed cost (FC) is $100 and total variable cost (VC) is $240 and output (Q) is 4 units, then average total cost (ATC) is:

   a. $60.
   b. $25.
   c. $85.
   d. $340.

3. Marginal cost (MC) equals:

   a. change in total cost (TC) / change in quantity (Q).
   b. change in quantity (Q) / change in total cost (TC).
   c. total cost (TC) / quantity (Q).
   d. quantity (Q) / total cost (TC).

4. Quantity (Q) changes from 5 to 6 units, total fixed cost (FC) is $100, and total variable cost (VC) changes from $370 to $450. What is the marginal cost (MC) of the sixth unit?

   a. $75.
   b. $80.
   c. $90.
   d. $100.

5. Assume that total fixed cost (FC) is $100. Output (Q) rises from 4 to 5 units and as a result total cost (TC) rises from $300 to $400. What is the average fixed cost (AFC) of the fifth unit?

   a. $80.
   b. $100.
   c. $20.
   d. Not enough information is given for an answer.

6. If marginal cost (MC) is greater than average total cost (ATC), then average total cost (ATC) is:

   a. rising.
   b. falling.
   c. MC is always less than ATC.
   d. MC and ATC are not related.

7. If marginal cost (MC) is less than average variable cost (AVC), then average variable cost (AVC) is:

   a. rising.
   b. falling.
   c. Marginal cost (MC) is always above average variable cost (AVC).
   d. Marginal cost (MC) and average variable cost (AVC) are not related.

8. Average total cost (ATC) is which of the following?

   a. AVC - AFC.
   b. AFC - AVC.
   c. AVC + AFC.
   d. AVC / AFC.

STOP!!

Wait for further Instructions

Output	Fixed costs (FC)	Variable costs (VC)	Total costs (TC) (FC + VC)	Change in total costs	Fixed costs (AFC) FC/Output	Variable costs (AVC) VC/Output	Total costs (ATC) AFC + AVC
4	50	50	100		12.50	12.50	25.00
				10			
5	50	60	110		10.00	12.00	22.00
				6			
10	50	100	150		5.00	10.00	15.00
				6			
11	50	106	156		4.54	9.64	14.18
				7			
17	50	150	200		2.94	8.82	11.76
				7			
18	50	157	207		2.78	8.72	11.50
				25			
21	50	182	232		2.38	8.67	11.05
				18			
23	50	200	250		2.17	8.70	10.87
				10			
24	50	210	260		2.08	8.75	10.83
				40			
28	50	250	300		1.79	8.93	10.72
				15			
29	50	265	315		1.72	9.14	10.86
				85			
32	50	350	400		1.56	10.94	12.50

Fixed costs are costs that are spent and cannot be changed in the period of time under consideration. There are no fixed costs in the long run since all inputs are variable and hence their costs are variable. In the short run, however, a number of costs will be fixed. For example, say you make earrings. You buy a machine for working with silver, but suddenly there's no demand for silver earrings. Assuming that machine can't be modified and used for other purposes, the money you spent on it is a fixed cost.

Besides buying the machine, the silversmith must also hire workers. These workers are the earring maker's **variable costs.** Variable costs are costs that change as output changes. The earring maker's variable costs are shown in column 3. Notice that as output increases, variable costs increase. For example, when she produces 11 pairs of earrings, variable costs are $106; when she produces 17, variable costs rise to $150.

All costs are either fixed or variable in the standard model so the sum of her fixed and variable costs equals her **total cost,**

$$TC = FC + VC.$$

The earring maker's total costs are presented in column 4. Each entry in column 4 is the sum of the entries in columns 2 and 3 in the same row. For example, to produce 17 pairs of earrings, fixed costs are $50 and variable costs are $150 so total cost is $200.

average total cost (often called *average cost*) equals total cost divided by the quantity produced. Thus,

$$ATC = TC/Q.$$

Average fixed cost equals fixed cost divided by quantity produced:

$$AFC = FC/Q.$$

Average variable cost equals variable cost divided by quantity produced:

$$AVC = VC/Q.$$

Average fixed cost and average variable cost are shown in columns 6 and 7. The most important average cost concept, average total cost, is shown in column 8. Average total cost can also be thought of as the sum of average fixed cost and average variable cost:

$$ATC = AFC + AVC.$$

All these costs are important to our earring maker, but they are not the most important cost she considers in her decision as to how many pairs of earrings to produce. That distinction goes to marginal cost, which appears in column 5.[3] Marginal cost is the increased (decreased) total cost of increasing (or decreasing) the level of output by one unit. Let's find marginal cost by considering what happens if our earring maker increases production by one unit—from 10 to 11. Looking again at Exhibit 3, we see that the total cost rises from $150 to $156. In this case the marginal cost of producing the eleventh unit is $6.

The Relationship between the Marginal Cost and Average Cost Curves Now that we've considered the shapes of each cost curve, let's consider some of the important relationships among them—specifically the relationships between the marginal cost curve on the one hand and the average variable cost and average total cost curves on the other.

The positioning of the marginal cost curve is not happenstance. The position of marginal cost relative to average total cost tells us whether average total cost is rising or falling.

If MC > ATC, then ATC is rising.
If MC = ATC, then ATC is at its low point.
If MC < ATC, then ATC is falling.

Marginal and average reflect a general relationship that also holds for marginal cost and average variable cost.

If MC > AVC, then AVC is rising.
If MC = AVC, then AVC is at its low point.
If MC < AVC, then AVC is falling.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. Total variable costs (VC) are those production costs which:

   a. do not change as output (Q) changes.
   b. do change as output (Q) changes.
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5. Assume that total fixed cost (FC) is $100. Output (Q) rises from 4 to 5 units and as a result total cost (TC) rises from $300 to $400. What is the average fixed cost (AFC) of the fifth unit?

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   a. rising.
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   d. Marginal cost (MC) and average variable cost (AVC) are not related.

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   a. AVC - AFC.
   b. AFC - AVC.
   c. AVC + AFC.
   d. AVC / AFC.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. For the monopoly firm

   a. the demand (D) curve lies above the MR curve.
   b. the demand (D) curve lies below the MR curve.
   c. the demand (D) curve is the same as the MR curve.
   d. none of the above.

2. For a monopolist who is maximizing profits:

   a. price (P) will exceed MC.
   b. MR will exceed MC.
   c. MR=MC=P.
   d. MR will exceed Price (P).

3. The monopolist's profit-maximizing level of output is determined by the equality of:

   a. price (P) and marginal cost (MC).
   b. price (P) and marginal revenue (MR).
   c. marginal revenue (MR) and average total cost (ATC).
   d. marginal revenue (MR) and marginal cost (MC).

4. In the monopoly firm, as output expands the Average Total Cost Curve (ATC):

   a. first falls, then rises or is U-shaped.
   b. falls continuously.
   c. rises continuously.
   d. first rises, then falls.

5. If the marginal revenue (MR) of the monopolist's sixth unit is 3 and its marginal cost (MC) is 10, the firm should:

   a. maintain the same level of production.
   b. decrease its level of production.
   c. increase its level of production.
   d. try to increase the marginal revenue (MR).

6. If price (P) is above average total costs (ATC), the monopolist would:

   a. break even.
   b. incur a loss.
   c. incur a profit.
   d. shut down.

7. The total profit of the monopolist:

   a. is QM x P + ATC
   b. is QM x P - ATC
   c. is QM x P
   d. is P - ATC

8. All of the statements except one is true concerning the monopoly graph. Which is not true?

   a. To determine the price charged on the vertical axis one must refer to the Demand Curve (D).
   b. A profit "rectangle" can be identified on the graph.
   c. Per unit profit is P - ATC.
   d. The profit "rectangle" represents per unit profit.

STOP!!

Wait for further Instructions

PROFITS AND MONOPOLY

So far we've talked about the output and pricing decisions of a monopolist. We haven't said anything about whether the monopolist makes a profit.[1] As was the case with the perfect competitor, that can be determined only by comparing average total cost to price. So before we can determine profit, we need to add another curve: the average total cost curve. As we saw with a perfect competitor, it's important to follow the correct sequence when finding profit.

- First, determine the output the monopolist will produce by the intersection of the marginal cost and marginal revenue curves.
- Second, determine the price the monopolist will charge for that output.
- Third, determine average cost at that level of output.
- Fourth, determine the monopolist's profit (loss) by comparing AR (= P) to average total cost.

If price exceeds average cost at the output it chooses, the monopolist will make a profit. If price equals average cost, the monopolist will make no profit (but it will make a normal return). If price is less than average cost, the monopolist will incur a loss: Total cost exceeds total revenue.

An Example of a Monopolist Making a Profit

I consider the case of a profit in Exhibit 4(a), (b), and (c), going through the steps slowly. The monopolist's demand curve, marginal cost, and average total cost curve are presented in Exhibit 4(a). Our first step is to determine output, which we do by drawing the marginal revenue curve and finding the output level at which marginal cost equals marginal revenue. From that point draw a vertical line to the horizontal (quantity) axis. That intersection tells us the monopolist's output, Q_M in Exhibit 4(b). The second step is to find what price the monopolist will charge at that output. We do so by extending the vertical line to the demand curve (point *A*) and then extending a horizontal line over to the price axis. Doing so gives price, P_M. Our third step is to determine the average cost at that price. We do so by seeing where our vertical line at the chosen output intersects the average total cost curve (point *B*). That tells us the monopolist's average cost at its chosen output.

To determine profit, we extend lines from where the quantity line intersects the demand curve (point *A*) and the average total cost curve (point *B*) to the price axis in Exhibit 4(c). The resulting shaded rectangle represents the monopolist's profit.

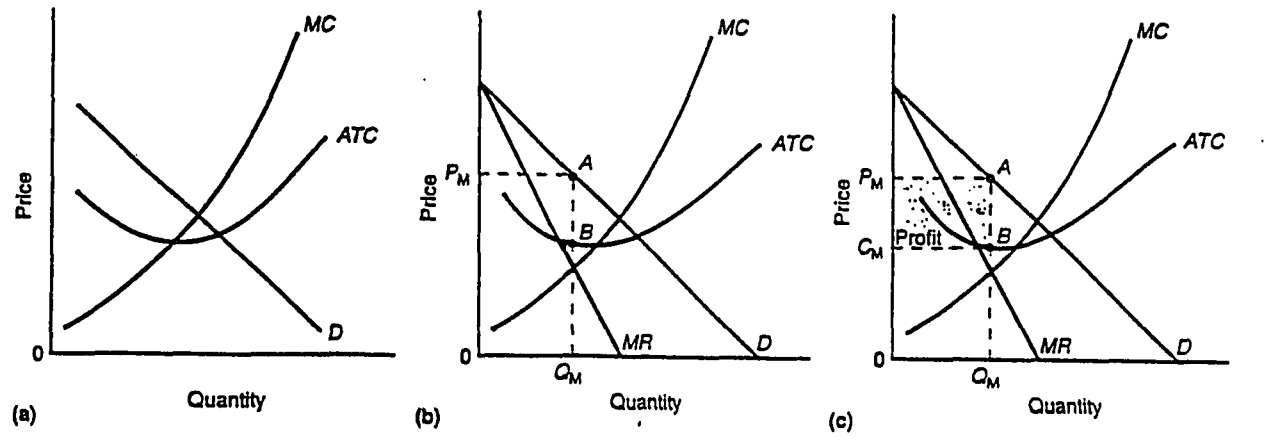

EXHIBIT 4 (a, b, and c) Monopolist Makes a Profit

After one has determined a monopolist's price and output decision, one can determine the profit by extending lines from points *A* and *B* to the price axis. The resulting rectangle represents the monopolist's profit.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. For the monopoly firm

   a. the demand (D) curve lies above the MR curve.
   b. the demand (D) curve lies below the MR curve.
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   c. Per unit profit is P - ATC.
   d. The profit "rectangle" represents per unit profit.

Appendix B

I N S T R U C T I O N S

1. There are nine sections in the following test. Five to seven minutes will be allowed for completion of each section.

2. At the end of each section, please wait for further instructions. Do not go back to earlier parts of the exam.

3. After completing the entire test, turn the test over on your desk.

4. When asked, please pass your test to the front of the class.

** These test results will not be considered in your final grade in ECON 241 Principles of Macroeconomics.

Please provide the following information.

1. Class standing: FR ___ SO ___ JR ___ SR ___ GS ___

2. Male ___ Female ___

3. Major: _____

4. Size of high school graduating class:
   ___ 30 or under
   ___ 30 - 100
   ___ 100 - 300
   ___ over 300

5. Took economics in high school: Yes ___ No ___

6. Year graduated from high school _____

7. Number of college math courses already completed: _____

8. Overall or composite ACT or SAT score: _____

9. Type of high school attended: Public ___ Private ___

10. Have you completed a college level course in Principles of Economics before this course? Yes ___ No ___

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. A gold standard is an example of a:

   a. fixed exchange rate system.
   b. nondiscretionary "pegged" currency.
   c. flexible exchange rate system.
   d. a floating exchange rate system.

2. Which of the following is not a force that can cause changes in the supply and demand for a country's currency?

   a. income changes.
   b. price changes.
   c. consumption changes.
   d. interest rate changes.

3. A nation on the gold standard agrees to:

   a. allow free movement of gold across national boarders.
   b. tie the domestic money supply to the stock of gold.
   c. fix the price of currency relative to gold.
   d. all of the above.

4. If the U.S. has more price inflation than other countries:

   a. U.S. demand for foreign currency rises.
   b. U.S. demand for foreign currency falls.
   c. foreign demand for U.S. dollars rises.
   d. U.S. price inflation only influences foreign currency supply, not demand.

5. If the dollar's value is expected to drop, there will be a _____ in the demand for dollars and _____ in the supply, which causes a drop in the value of the dollar.

   a. increase; decrease.
   b. decrease; no change.
   c. no change; increase.
   d. decrease; increase.

6. A balance of payments deficit results in a gold _____ and a _____ in the country's money supply.

   a. inflow; increase.
   b. outflow; decrease.
   c. inflow; decrease.
   d. outflow; increase.

7. The gold standard prevailed as an international monetary system from the late 1800s to the:

   a. 1920s.
   b. 1930s.
   c. 1940s.
   d. 1950s.

8. A rise in the U.S. interest rates relative to interest rates in other countries:

   a. reduces the foreign demand for U.S. financial assets.
   b. increases the foreign demand for U.S. financial assets.
   c. has no influence on foreign demand for U.S. financial assets.
   d. will influence foreign demand for U.S. financial assets only if the domestic money supply is unchanged.

STOP!!

Wait for further Instructions

EXCHANGE RATE SYSTEMS AND BALANCE OF PAYMENTS ADJUSTMENTS

Both the size and persistence of a nation's balance of payments deficits and surpluses and the kind of adjustments it must make to correct these imbalances depend on the system of exchange rates being used. There are two polar options: (1) a system of flexible or floating exchange rates where the rates at which national currencies exchange for one another are determined by demand and supply, and (2) a system of rigidly fixed exchange rates by which governmental intervention in foreign exchange markets or some other mechanism offsets the changes in exchange rates which fluctuations in demand and supply would otherwise cause.

What forces will cause the demand and supply curves for pounds to change, thereby causing the dollar to appreciate or depreciate?

Relative Income Changes If the growth of a nation's national income is more rapid than other countries', its currency is likely to depreciate. A country's imports vary directly with its level of income. As incomes rise in the United States, American consumers buy more domestically produced goods *and* also more foreign goods. If the United States' economy is expanding rapidly and the British economy is stagnant, American imports of British goods—and therefore U.S. demand for pounds—will increase. The dollar price of pounds will rise, meaning the dollar has depreciated.

Relative Price Changes If the domestic price level rises rapidly in the United States and remains constant in Britain, American consumers will seek out relatively low-priced British goods, increasing the demand for pounds. Conversely, the British will purchase fewer American goods, reducing the supply of pounds. This combination of an increase in the demand for, and a reduction in the supply of, pounds will cause the dollar to depreciate.

In fact, differences in relative price levels among nations—which reflect changes in price levels over time—help explain persistent differences in exchange rates. In 1992 an American dollar could buy .56 British pounds, 124 Japanese yen, or 5340 Turkish lira. One reason for these differences is that the prices of British goods and services in pounds were far lower than the prices of Japanese goods and services in yen and the prices of Turkish goods and services in lira. For example, the same market basket of products costing $500 in the United States might cost 250 pounds in England, 67,500 yen in Japan, and 2,500,000 lira in Turkey. *Generally, the higher the prices of a nation's goods and services in terms of its own currency, the greater the amount of that currency which can be obtained with an American dollar.*

Relative Real Interest Rates Suppose the United States restricts the growth of its money supply (tight money policy), as it did in the late 1970s and early 1980s, to control inflation. As a result, *real* interest rates—nominal interest rates adjusted for the rate of inflation—were high in the United States compared to most other nations. Consequently, British individuals and firms found the United States an attractive place to make financial investments. This increase in the demand for American financial assets meant an increase in the supply of British pounds and the dollar therefore appreciated in value.

Speculation Suppose it is widely anticipated that the American economy will *(a)* grow faster than the British economy, *(b)* experience more rapid inflation than the British economy, and *(c)* have lower future real interest rates than Britain. All these expectations would lead one to believe that in the future the dollar will depreciate and, conversely, the pound will appreciate. Holders of dollars will thus attempt to convert them into pounds, increasing the demand for pounds. This conversion causes the dollar to depreciate and the pound to appreciate. A self-fulfilling prophecy arises: The dollar depreciates and the pound appreciates because speculators act on the supposition that these changes in currency values will in fact happen.

INTERNATIONAL EXCHANGE RATE SYSTEMS

The Gold Standard: Fixed Exchange Rates

Over the 1879–1934 period—except for the World War I years—an international monetary system known as the gold standard prevailed. The gold standard provided for fixed exchange rates. A look at its operation and ultimate downfall is instructive as to the functioning and some of the advantages and problems associated with fixed-rate systems. Currently a number of economists advocate fixed exchange rates and a few even call for a return to the international gold standard.

Conditions A nation is on the gold standard when it fulfills three conditions:

1 It must define its monetary unit in terms of a certain quantity of gold.
2 It must maintain a fixed relationship between its stock of gold and its domestic money supply.
3 It must allow gold to be freely exported and imported.

If each nation defines its monetary unit in terms of gold, the various national currencies will have a fixed relationship to one another. For example, suppose the United States defines a dollar as being worth 25 grains of gold and Britain defines its pound sterling as being worth 50 grains of gold. This means that a British pound is worth $\frac{50}{25}$ dollars or, simply, £1 equals $2.

Recall that the gold standard requires participants to maintain a fixed relationship between their domestic money supplies and their quantities of gold. Therefore, the flow of gold from the United States to Britain would bring about a contraction of the money supply in America and an expansion of the money supply in Britain. Other things being equal, this will reduce aggregate demand and, therefore, lower real domestic output, employment, and the price level in the United States. Also, the reduced money supply will boost American interest rates.

The opposite occurs in Britain. The inflow of gold increases the money supply, causing aggregate demand, national income, employment, and the price level to all increase. The increased money supply will also lower interest rates in Britain.

Demise The worldwide Great Depression of the 1930s signaled the end of the gold standard. As domestic outputs and employment plummeted worldwide, the restoration of prosperity became the primary goal of afflicted nations. Protectionist measures such as the United States' Smoot-Hawley Tariff were enacted as nations sought to increase net exports and stimulate their domestic economies. And each nation was fearful that its economic recovery would be aborted by a balance of payments deficit which would lead to an outflow of gold and consequent contractionary effects. Indeed, nations attempted to devalue their currencies in term of gold to make their exports more attractive and imports less attractive. These devaluations undermined a basic condition of the gold standard and the system broke down.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

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   a. fixed exchange rate system.
   b. nondiscretionary "pegged" currency.
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   d. a floating exchange rate system.

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   a. $75.
   b. $80.
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5. Assume that total fixed cost (FC) is $100. Output (Q) rises from 4 to 5 units and as a result total cost (TC) rises from $300 to $400. What is the average fixed cost (AFC) of the fifth unit?

   a. $80.
   b. $100.
   c. $20.
   d. Not enough information is given for an answer.

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   b. AFC - AVC.
   c. AVC + AFC.
   d. AVC / AFC.

STOP!!

Wait for further Instructions

Total-cost data				Average-cost data			
(1) Total product (Q)	(2) Total fixed cost (TFC)	(3) Total variable cost (TVC)	(4) Total cost (TC) TC = TFC + TVC	(5) Average fixed cost (AFC) $AFC = \frac{TFC}{Q}$	(6) Average variable cost (AVC) $AVC = \frac{TVC}{Q}$	(7) Average total cost (ATC) $ATC = \frac{TC}{Q}$	(8) Marginal cost (MC) $MC = \frac{\text{change in TC}}{\text{change in Q}}$
0	$100	$ 0	$ 100				$ 90
1	100	90	190	$100.00	$90.00	$190.00	80
2	100	170	270	50.00	85.00	135.00	70
3	100	240	340	33.33	80.00	113.33	60
4	100	300	400	25.00	75.00	100.00	70
5	100	370	470	20.00	74.00	94.00	80
6	100	450	550	16.67	75.00	91.67	90
7	100	540	640	14.29	77.14	91.43	110
8	100	650	750	12.50	81.25	93.75	130
9	100	780	880	11.11	86.67	97.78	150
10	100	930	1030	10.00	93.00	103.00	

Fixed Costs **Fixed costs** *are those costs which in total do not vary with changes in output.* Fixed costs are associated with the very existence of a firm's plant and therefore must be paid even if its output is zero. Such costs as interest on a firm's bonded indebtedness, rental payments, a portion of depreciation on equipment and buildings, insurance premiums, and the salaries of top management and key personnel are generally fixed costs. In column 2 of Table 22-2 we assume that the firm's total fixed costs are $100.

Variable Costs **Variable costs** *are those costs which change with the level of output.* They include payments for materials, fuel, power, transportation services, most labor, and similar variable resources. In column 3 of Table 22-2 we find that the total of variable costs changes directly with output. But note that *the increases in variable costs associated with each one-unit increase in output are not constant.* As production begins, variable costs will for a time increase by a *decreasing* amount; this is true through the fourth unit of output. Beyond the fourth unit, however, variable costs rise by *increasing* amounts for each successive unit of output.

Total Cost **Total cost** is the *sum of fixed and variable costs at each level of output.* It is shown in column 4 of Table 22-2. At zero units of output, total cost is equal to the firm's fixed costs. Then for each unit of production—1 through 10—total cost varies by the same amounts as does variable cost.

1 AFC **Average fixed cost** (AFC) is found by dividing total fixed cost (TFC) by the corresponding output *(Q)*. That is,

$$AFC = \frac{TFC}{Q}$$

While total fixed costs are, by definition, independent of output, AFC will decline so long as output increases. As output increases, a given total fixed cost of $100 is being spread over a larger and larger output. When output is just 1 unit, total fixed costs and AFC are equal at $100. But at 2 units of output, total fixed costs of $100 become $50 worth of fixed costs per unit; then $33.33, as $100 is spread over 3 units; and $25, when spread over 4 units. This is commonly refered to as "spreading the overhead."

2 AVC **Average variable cost** (AVC) is calculated by dividing total variable cost (TVC) by the corresponding output *(Q)*:

$$AVC = \frac{TVC}{Q}$$

AVC declines initially, reaches a minimum, and then increases again. Graphically, this is a U-shaped or saucer-shaped AVC curve, as shown in Figure 22-4.

Because total variable cost reflects the law of diminishing returns, so must the AVC figures, which are derived from total variable cost. Due to increasing returns, it takes fewer and fewer additional variable resources to produce each of the first 4 units of output. As a result, variable cost per unit will decline. AVC hits a minimum with the fifth unit of output, and beyond this point AVC rises as diminishing returns require more and more variable resources to produce each additional unit of output.

3 ATC **Average total cost** (ATC) is found by dividing total cost (TC) by total output *(Q)* or by adding AFC and AVC for each of the ten levels of output:

$$ATC = \frac{TC}{Q} = AFC + AVC$$

Marginal Cost

One final and very crucial cost concept remains—marginal cost. **Marginal cost** (MC) *is the extra, or additional, cost of producing one more unit of output.* MC can be determined for each additional unit of output by noting the *change* in total cost which that unit's production entails.

$$MC = \frac{\text{change in TC}}{\text{change in } Q}$$

Our data are structured so that the "change in Q" is always "1," so we have defined MC as the cost of *one* more unit of output.

Relation of MC to AVC and ATC The marginal cost curve intersects both the AVC and ATC curves at their minimum points.

So it is with costs. When the amount added to total cost (marginal cost) is less than the average of total cost, ATC will fall. Conversely, when marginal cost exceeds ATC, ATC will rise. This means in Figure 22-5 that so long as MC lies below ATC, the latter will fall, and where MC is above ATC, ATC will rise. Therefore, at the point of intersection where MC equals ATC, ATC has just ceased to fall but has not yet begun to rise. This, by definition, is the minimum point on the ATC curve. *The marginal-cost curve intersects the average-total-cost curve at the latter's minimum point.*

Because MC can be defined as the addition either to total cost *or* to total variable cost resulting from one more unit of output, this same rationale explains why the MC curve also crosses the AVC curve at the latter's minimum point. No such relationship exists for the MC curve and the average-fixed-cost curve, because the two are not related; marginal cost includes only those costs which change with output, and fixed costs by definition are independent of output.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. Total variable costs (VC) are those production costs which:

   a. do not change as output (Q) changes.
   b. do change as output (Q) changes.
   c. are fixed until maximum output (Q) is reached and then they change.
   d. would exist even though the firm produced no output.

2. If total fixed cost (FC) is $100 and total variable cost (VC) is $240 and output (Q) is 4 units, then average total cost (ATC) is:

   a. $60.
   b. $25.
   c. $85.
   d. $340.

3. Marginal cost (MC) equals:

   a. change in total cost (TC) / change in quantity (Q).
   b. change in quantity (Q) / change in total cost (TC).
   c. total cost (TC) / quantity (Q).
   d. quantity (Q) / total cost (TC).

4. Quantity (Q) changes from 5 to 6 units, total fixed cost (FC) is $100, and total variable cost (VC) changes from $370 to $450. What is the marginal cost (MC) of the sixth unit?

   a. $75.
   b. $80.
   c. $90.
   d. $100.

5. Assume that total fixed cost (FC) is $100. Output (Q) rises from 4 to 5 units and as a result total cost (TC) rises from $300 to $400. What is the average fixed cost (AFC) of the fifth unit?

   a. $80.
   b. $100.
   c. $20.
   d. Not enough information is given for an answer.

6. If marginal cost (MC) is greater than average total cost (ATC), then average total cost (ATC) is:

   a. rising.
   b. falling.
   c. MC is always less than ATC.
   d. MC and ATC are not related.

7. If marginal cost (MC) is less than average variable cost (AVC), then average variable cost (AVC) is:

   a. rising.
   b. falling.
   c. Marginal cost (MC) is always above average variable cost (AVC).
   d. Marginal cost (MC) and average variable cost (AVC) are not related.

8. Average total cost (ATC) is which of the following?

   a. AVC - AFC.
   b. AFC - AVC.
   c. AVC + AFC.
   d. AVC / AFC.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. For the monopoly firm

   a. the demand (D) curve lies above the MR curve.
   b. the demand (D) curve lies below the MR curve.
   c. the demand (D) curve is the same as the MR curve.
   d. none of the above.

2. For a monopolist who is maximizing profits:

   a. price (P) will exceed MC.
   b. MR will exceed MC.
   c. MR=MC=P.
   d. MR will exceed Price (P).

3. The monopolist's profit-maximizing level of output is determined by the equality of:

   a. price (P) and marginal cost (MC).
   b. price (P) and marginal revenue (MR).
   c. marginal revenue (MR) and average total cost (ATC).
   d. marginal revenue (MR) and marginal cost (MC).

4. In the monopoly firm, as output expands the Average Total Cost Curve (ATC):

   a. first falls, then rises or is U-shaped.
   b. falls continuously.
   c. rises continuously.
   d. first rises, then falls.

5. If the marginal revenue (MR) of the monopolist's sixth unit is 3 and its marginal cost (MC) is 10, the firm should:

   a. maintain the same level of production.
   b. decrease its level of production.
   c. increase its level of production.
   d. try to increase the marginal revenue (MR).

6. If price (P) is above average total costs (ATC), the monopolist would:

   a. break even.
   b. incur a loss.
   c. incur a profit.
   d. shut down.

7. The total profit of the monopolist:

   a. is QM x P + ATC
   b. is QM x P - ATC
   c. is QM x P
   d. is P - ATC

8. All of the statements except one is true concerning the monopoly graph. Which is not true?

   a. To determine the price charged on the vertical axis one must refer to the Demand Curve (D).
   b. A profit "rectangle" can be identified on the graph.
   c. Per unit profit is P - ATC.
   d. The profit "rectangle" represents per unit profit.

STOP!!

Wait for further Instructions

This analysis is presented graphically in Figure 24-3 (Key Graph), where the demand, marginal-revenue, average-total-cost, and marginal-cost data of Table 24-1 have been drawn. Comparing marginal revenue and marginal cost confirms that the profit-maximizing output is 5 units or, more generally, Q_m. The unique price at which Q_m can be sold is found by extending a perpendicular line up from the profit-maximizing point on the output axis and then at right angles from the point at which it hits the demand curve to the vertical axis. The indicated price is P_m. To charge a price higher than P_m, the monopolist must move up the demand curve, meaning that sales will fall short of the profit-maximizing level Q_m. Specifically, the firm will fail to produce units of output whose marginal revenue exceeds their marginal cost. If the monopolist charges less than P_m, it would involve a sales volume in excess of the profit-maximizing output.

Columns 2 and 5 of Table 24-1 indicate that, at 5 units of output, product price of $122 exceeds average total cost of $94. Economic profits are therefore $28 per unit; total economic profits are then $140 (= 5 × $28). In Figure 24-3, per unit profit is indicated by the distance AP_m, and total economic profits—the gray area—are found by multiplying this unit profit by the profit-maximizing output Q_m.

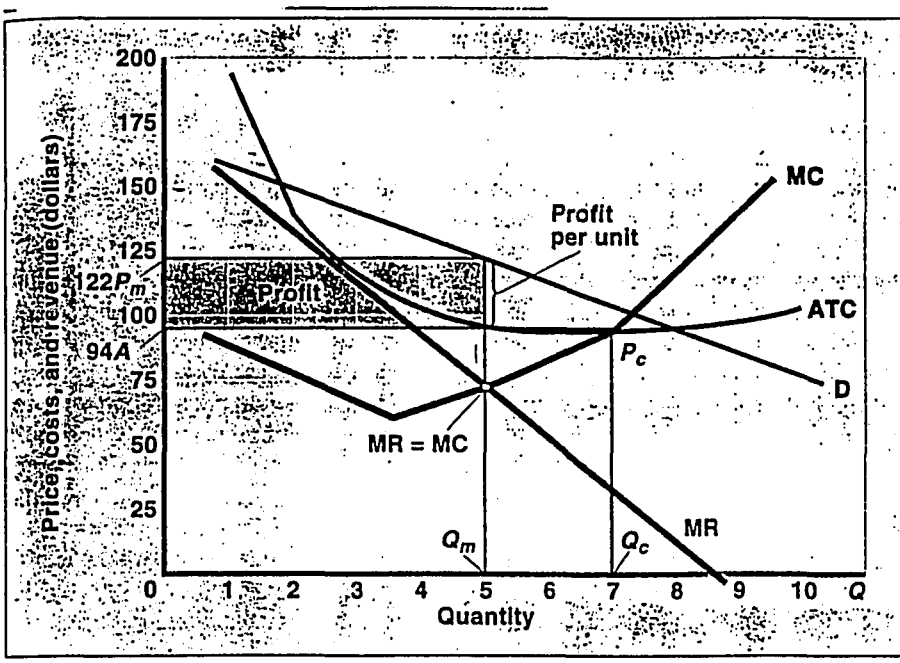

FIGURE 24-3
The profit-maximizing postion of a pure monopolist

The pure monopolist maximizes profits by producing the MR = MC output. In this instance profit is AP_m per unit, and total profits are measure by the gray rectangle.

STOP!!

Wait for further Instructions

Multiple Choice

Circle the letter of the correct response.

1. For the monopoly firm

   a. the demand (D) curve lies above the MR curve.
   b. the demand (D) curve lies below the MR curve.
   c. the demand (D) curve is the same as the MR curve.
   d. none of the above.

2. For a monopolist who is maximizing profits:

   a. price (P) will exceed MC.
   b. MR will exceed MC.
   c. MR=MC=P.
   d. MR will exceed Price (P).

3. The monopolist's profit-maximizing level of output is determined by the equality of:

   a. price (P) and marginal cost (MC).
   b. price (P) and marginal revenue (MR).
   c. marginal revenue (MR) and average total cost (ATC).
   d. marginal revenue (MR) and marginal cost (MC).

4. In the monopoly firm, as output expands the Average Total Cost Curve (ATC):

   a. first falls, then rises or is U-shaped.
   b. falls continuously.
   c. rises continuously.
   d. first rises, then falls.

5. If the marginal revenue (MR) of the monopolist's sixth unit is 3 and its marginal cost (MC) is 10, the firm should:

   a. maintain the same level of production.
   b. decrease its level of production.
   c. increase its level of production.
   d. try to increase the marginal revenue (MR).

6. If price (P) is above average total costs (ATC), the monopolist would:

   a. break even.
   b. incur a loss.
   c. incur a profit.
   d. shut down.

7. The total profit of the monopolist:

   a. is QM x P + ATC
   b. is QM x P - ATC
   c. is QM x P
   d. is P - ATC

8. All of the statements except one is true concerning the monopoly graph. Which is not true?

   a. To determine the price charged on the vertical axis one must refer to the Demand Curve (D).
   b. A profit "rectangle" can be identified on the graph.
   c. Per unit profit is P - ATC.
   d. The profit "rectangle" represents per unit profit.

Appendix C

When governments do not enter into foreign exchange markets at all, but leave the determination of exchange rates totally up to currency traders, the country is said to have a **flexible exchange rate.** The price of its currency is allowed to rise and fall as market forces dictate. When governments sometimes buy or sell currencies to influence the exchange rate, while at other times they let private market forces operate, the country is said to have a **partially flexible exchange rate.** A partially flexible exchange rate is sometimes called a *dirty float* because it isn't purely market determined or government determined.

If the government chooses a particular exchange rate and offers to buy and sell currencies at that price, it is imposing a **fixed exchange rate.** For example, suppose the U.S. government says it will buy francs at 20¢ and sell dollars at 5 francs. In that case we say that the country has a fixed exchange rate of 5 francs to the dollar.

Forces That Cause Shifts in the Supply of and Demand for Currencies The major forces that can cause shifts include changes in a country's income, changes in a country's prices, changes in interest rates, and changes in expectations. Let's consider each in turn.

Changes in a Country's Income The demand for imports depends on the income in a country. When a country's income falls, demand for imports falls. Hence demand for foreign currency to buy those imports falls, which means that the supply of the country's currency to buy the foreign currency falls. That's why in our presentation of the Keynesian model we said that imports depend on income.

Changes in a Country's Prices The United States's demand for imports and foreign countries' demand for U.S. exports depend on prices of U.S. goods compared to prices of foreign competing goods. If the United States has more inflation than other countries, foreign goods will become cheaper, U.S. demand for foreign currencies will tend to increase, and foreign demand for dollars will tend to decrease. This rise in U.S. inflation will shift the dollar supply outward and the dollar demand inward.

Changes in Interest Rates People like to invest their savings in assets that will yield the highest return. A rise in U.S. interest rates relative to those abroad will increase demand for U.S. assets as long as that rise is a rise in the real interest rate—that is, as long as the rise isn't accompanied by a rise in inflation. As a result of a rise in the U.S. interest rate, demand for dollars will increase, while simultaneously the supply of dollars will decrease as fewer Americans sell their dollars to buy foreign assets. A fall in the U.S. interest rate or a rise in foreign interest rates will have the opposite effect.

Changes in Expectations If the value of a currency falls, the holders of that currency and of assets denominated in that currency lose; if the value of a currency rises, the holders of that currency and of assets denominated in that currency gain. So everyone tries to hold currencies whose value will rise and get rid of currencies whose value will fall. Thus, expectations of whether a currency will rise or fall can cause large shifts in the supply and demand. Expectations can even be self-fulfilling. For example, the expectation of a rise in the dollar's value will increase the demand for dollars and decrease the supply, which will cause a rise in the value of the dollar. The dollar rises because it is expected to rise.

The Gold Standard: A Fixed Exchange Rate System Governments played a major role in determining exchange rates until the 1930s. Beginning with the Paris Conference of 1867 and lasting until 1933 (except for the period around World War I), most of the world economies had a system of relatively fixed exchange rates under what was called a **gold standard.** Under a gold standard, the amount of money a country issued had to be directly tied to gold, either because gold coin served as the currency in a country (as it did in the United States before 1914) or because countries were required by law to have a certain percentage of gold backing their currencies. Gold served as currency or backed all currencies. Each country participating in a gold standard agreed to fix the price of its currency relative to gold. That meant a country would agree to pay a specified amount of gold upon demand to anyone who wanted to exchange that country's currency for gold. To do so, each country had to maintain a stockpile of gold. When a country fixed the price of its currency relative to gold, it fixed its currency's price in relation to other currencies, as a result of the process of arbitrage.

Under the gold standard, a country made up a difference between the quantity supplied and the quantity demanded of its currency by buying or selling gold to hold the price of its currency fixed in terms of gold. How much a country would need to buy and sell depended upon its balance of payments deficit or surplus. If the country ran a surplus in the balance of payments, it was required to sell its currency—that is, buy gold—to stop the value of its currency from rising. If a country ran a deficit in the balance of payments, it was required to buy its currency—that is, sell gold—to stop the value of its currency from falling.

Since gold served as reserves to a country's currency, a balance of payments *deficit* (and hence a downward pressure on the exchange rate) would result in a flow of gold out of the country and hence a decrease in the country's money supply. That decrease in the money supply would contract the economy, decreasing imports, lowering the country's price level, and increasing the interest rate, all of which would work toward eliminating the balance of payments deficit.

Similarly a country with a balance of payments *surplus* would experience an inflow of gold. That flow would increase the country's money supply, increasing income (and hence imports), the price level (making imports cheaper and exports more expensive), and lowering the interest rate (increasing capital outflows). These would work toward eliminating the balance of payments surplus.

FOG INDEX COMPUTATIONS FOR TEST B: NARRATIVE SECTION

Part 1

Average Sentence Length: 102 words / 2 sentences = 51

Percentage of Hard Words: 12 long words / 102 words = 11.76%

FOG INDEX: (51 + 11.76) x .4 = 25.1 grade level

Part 2

Average Sentence Length: 118 words / 6 sentences = 19.67

Percentage of Hard Words: 16 long words / 118 words = 13.6%

FOG INDEX: (19.67 + 13.6) x .4 = 13.3 grade level

Part 3

Average Sentence Length: 128 words / 5 sentences = 25.6

Percentage of Hard Words: 17 long words / 128 words = 13.3%

FOG INDEX: (25.6 + 13.3) x .4 = 15.56 grade level

Part 4

Average Sentence Length: 113 words / 6 sentences = 18.83

Percentage of Hard Words: 13 long words / 113 words = 11.5%

FOG INDEX: (18.83 + 11.5) x .4 = 12.13 grade level

AVERAGE FOG INDEX

(25.1 + 13.3 + 15.56 + 12.13) / 4 = 16.52 or 17 grade level

EXCHANGE RATE SYSTEMS AND BALANCE OF PAYMENTS ADJUSTMENTS

Both the size and persistence of a nation's balance of payments deficits and surpluses and the kind of adjustments it must make to correct these imbalances depend on the system of exchange rates being used. There are two polar options: (1) a system of flexible or floating exchange rates where the rates at which national currencies exchange for one another are determined by demand and supply, and (2) a system of rigidly fixed exchange rates by which governmental intervention in foreign exchange markets or some other mechanism offsets the changes in exchange rates which fluctuations in demand and supply would otherwise cause.

What forces will cause the demand and supply curves for pounds to change, thereby causing the dollar to appreciate or depreciate?

Relative Income Changes If the growth of a nation's national income is more rapid than other countries', its currency is likely to depreciate. A country's imports vary directly with its level of income. As incomes rise in the United States, American consumers buy more domestically produced goods *and* also more foreign goods. If the United States' economy is expanding rapidly and the British economy is stagnant, American imports of British goods—and therefore U.S. demand for pounds—will increase. The dollar price of pounds will rise, meaning the dollar has depreciated.

Relative Price Changes If the domestic price level rises rapidly in the United States and remains constant in Britain, American consumers will seek out relatively low-priced British goods, increasing the demand for pounds. Conversely, the British will purchase fewer American goods, reducing the supply of pounds. This combination of an increase in the demand for, and a reduction in the supply of, pounds will cause the dollar to depreciate.

In fact, differences in relative price levels among nations—which reflect changes in price levels over time—help explain persistent differences in exchange rates. In 1992 an American dollar could buy .56 British pounds, 124 Japanese yen, or 5340 Turkish lira. One reason for these differences is that the prices of British goods and services in pounds were far lower than the prices of Japanese goods and services in yen and the prices of Turkish goods and services in lira. For example, the same market basket of products costing $500 in the United States might cost 250 pounds in England, 67,500 yen in Japan, and 2,500,000 lira in Turkey. *Generally, the higher the prices of a nation's goods and services in terms of its own currency, the greater the amount of that currency which can be obtained with an American dollar.*

Relative Real Interest Rates Suppose the United States restricts the growth of its money supply (tight money policy), as it did in the late 1970s and early 1980s, to control inflation. As a result, *real* interest rates—nominal interest rates adjusted for the rate of inflation—were high in the United States compared to most other nations. Consequently, British individuals and firms found the United States an attractive place to make financial investments. This increase in the demand for American financial assets meant an increase in the supply of British pounds and the dollar therefore appreciated in value.

Speculation Suppose it is widely anticipated that the American economy will *(a)* grow faster than the British economy, *(b)* experience more rapid inflation than the British economy, and *(c)* have lower future real interest rates than Britain. All these expectations would lead one to believe that in the future the dollar will depreciate and, conversely, the pound will appreciate. Holders of dollars will thus attempt to convert them into pounds, increasing the demand for pounds. This conversion causes the dollar to depreciate and the pound to appreciate. A self-fulfilling prophecy arises: The dollar depreciates and the pound appreciates because speculators act on the supposition that these changes in currency values will in fact happen.

INTERNATIONAL EXCHANGE RATE SYSTEMS

The Gold Standard: Fixed Exchange Rates

Over the 1879–1934 period—except for the World War I years—an international monetary system known as the gold standard prevailed. The gold standard provided for fixed exchange rates. A look at its operation and ultimate downfall is instructive as to the functioning and some of the advantages and problems associated with fixed-rate systems. Currently a number of economists advocate fixed exchange rates and a few even call for a return to the international gold standard.

Conditions A nation is on the gold standard when it fulfills three conditions:

1 It must define its monetary unit in terms of a certain quantity of gold.
2 It must maintain a fixed relationship between its stock of gold and its domestic money supply.
3 It must allow gold to be freely exported and imported.

If each nation defines its monetary unit in terms of gold, the various national currencies will have a fixed relationship to one another. For example, suppose the United States defines a dollar as being worth 25 grains of gold and Britain defines its pound sterling as being worth 50 grains of gold. This means that a British pound is worth 50/25 dollars or, simply, £1 equals $2.

Recall that the gold standard requires participants to maintain a fixed relationship between their domestic money supplies and their quantities of gold. Therefore, the flow of gold from the United States to Britain would bring about a contraction of the money supply in America and an expansion of the money supply in Britain. Other things being equal, this will reduce aggregate demand and, therefore, lower real domestic output, employment, and the price level in the United States. Also, the reduced money supply will boost American interest rates.

The opposite occurs in Britain. The inflow of gold increases the money supply, causing aggregate demand, national income, employment, and the price level to all increase. The increased money supply will also lower interest rates in Britain.

Demise The worldwide Great Depression of the 1930s signaled the end of the gold standard. As domestic outputs and employment plummeted worldwide, the restoration of prosperity became the primary goal of afflicted nations. Protectionist measures such as the United States' Smoot-Hawley Tariff were enacted as nations sought to increase net exports and stimulate their domestic economies. And each nation was fearful that its economic recovery would be aborted by a balance of payments deficit which would lead to an outflow of gold and consequent contractionary effects. Indeed, nations attempted to devalue their currencies in term of gold to make their exports more attractive and imports less attractive. These devaluations undermined a basic condition of the gold standard and the system broke down.

FOG INDEX COMPUTATIONS FOR TEST A: NARRATIVE SECTION

Part 1

Average Sentence Length: 101 words / 4 sentences = 25.25

Percentage of Hard Words: 17 long words / 101 words = 16.8%

FOG INDEX: (25.25 + 16.8) x .4 = 16.82 grade level

Part 2

Average Sentence Length: 120 words / 5 sentences = 24

Percentage of Hard Words 6 long words / 120 words = 5%

FOG INDEX: (24 + 5) x .4 = 11.6 grade level

Part 3

Average Sentence Length: 110 words / 4 sentences = 27.5

Percentage of Hard Words: 5 long words / 110 words = 4.5%

FOG INDEX: (27.5 + 4.5) x .4 = 12.8 grade level

Part 4

Average Sentence Length: 119 words / 4 sentences = 19.75

Percentage of Hard Words: 10 long words / 119 words = 8.4%

FOG INDEX: (19.75 + 8.4) x .4 = 15.26 grade level

AVERAGE FOG INDEX

(16.82 + 11.6 + 12.8 + 15.26) / 4 = 14.12 grade level

Appendix D

MEMO

TO: Rebecca Deel
Dr. B. W. Balch
Department of Economics & Finance

FROM: Thomas L. Tang
MTSU Institutional Review Board

RE: The Reliability of Economic Textbooks Readability Indexes as a Measure of Cognitive Gain: A Comparative Analysis

DATE: April 11, 1995

Since your research involves the comparison among instructional techniques in established or commonly accepted educational settings, it is exempt from the informed consent requirements of 45 CFR part 46 and is approved by the MTSU Institutional Review Board. The approval is granted for one year only and must be reviewed by this Committee on an annual basis, if the project continues beyond the next 12 months; likewise any change of the protocol requires re-submission of your project for Committee approval.

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