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JOURNAL OF ECONOMICS AND ECONOMIC EDUCATION RESEARCH

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LETTER FROM THE EDITOR

We are extremely pleased to present this issue of the *Journal of Economics and Economic Education Research*, an official publication of the Allied Academies' Academy of Economics and Economic Education Research, dedicated to the study, research and dissemination of information pertinent to the improvement of methodologies and effective teaching in the discipline of economics with a special emphasis on the process of economic education. The editorial board is composed primarily of directors of councils and centers for economic education affiliated with the National Council on Economic Education. This journal attempts to bridge the gap between the theoretical discipline of economics and the applied excellence relative to the teaching arts.

The Editorial Board considers two types of manuscripts for publication. First is empirical research related to the discipline of economics. The other is research oriented toward effective teaching methods and technologies in economics designed for grades kindergarten through twelve. These manuscripts are blind reviewed by the Editorial Board members with only the top programs in each category selected for publication, with an acceptance rate of less than 25%.

We are inviting papers for future editions of the *Journal for Economics and Economic Education Research* and encourage you to submit your manuscripts according to the guidelines found on the Allied Academies webpage at www.alliedacademies.org.

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ECONOMICS EDUCATION ARTICLES

MEASURING TEACHER EFFICACY FOR USE IN ECONOMIC EDUCATION

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ABSTRACT

This paper introduces an instrument to assess a newly recognized and important dimension of teacher effectiveness in economic education-personal economics teaching self-efficacy. The psychological theory-based construct measures the extent to which a teacher believes he or she has the capacity to affect student performance. The prime determinant of self-efficacy is content mastery. The national emphasis on K-12 economic education with standards adopted by many states mandate teacher training interventions, often by economic education councils and centers. The instrument can serve as a training assessment device and may serve as an explanatory variable in economic learning model research.

The instrument's construct validity has been established for use in science education and other fields. The authors translated prior developed and tested personal teaching efficacy items from a larger pool. Texas public school teacher data were used to conduct factor analysis showing that the instrument loaded on only one factor-- labeled personal economics teaching self-efficacy. Correlation analysis suggests that the instrument is sensitive to content mastery levels and does indeed measure a teacher's own sense of their economics teaching proficiency. The authors call for additional research to test the instrument's robustness across teacher groups, its training assessment sensitivity and its place in formal economic learning models.

INTRODUCTION

This paper describes the development and prospective applications of an instrument measuring a relatively new aspect of teacher capability-personal teacher self-efficacy. This psychological construct is defined as the extent to which the teacher believes he or she has the capacity to affect student performance. Prior theoretical and empirical work has extended researcher understanding of the construct to a relatively mature level. The instrument presented here is designed for

use both as a professional educator training assessment device and for possible use as a variable in economic education learning models that seek to explain the teaching-learning process. Understanding, then enhancing, the teaching-learning process in economic education poses challenges similar to those in disciplines like mathematics, chemistry and foreign languages that require abstract thinking and reflective learning. Experimental or quasi-experimental assessment of reasons for performance variance holds the interest of many economic education researchers. Characteristics of persons on both sides of the classroom, the means and modes of the teaching process and the influence of environmental factors combine to produce performance results that remain difficult to fully quantify. Should this new dimension prove valuable in replicated studies, perhaps by way of providing significant explanatory power in economic learning models, teacher-training interventions could gain a new meter to measure their impact.

The background section frames the institutional environment in economic education. A short overview of the national economic education infrastructure coupled with economic teaching requirements imposed on Texas teachers show why developing an instrument to measure personal teaching self-efficacy could be beneficial to the discipline. Discussion on self-efficacy theory reviews the current state of thought, known self-efficacy determinants and the factors that limit change in self-efficacy.

The section on instrument construction notes the original source of the items from prior teacher self-efficacy research in science education and the compilation of selected items into the instrument assessed for this paper. The instrument's test-bed venue was the 2002 state conference in San Antonio, Texas, for the Texas Council on Economic Education. Some 228 Texas teachers voluntarily and anonymously completed the instrument for evaluation. Factor analysis revealed only one factor loading of significance that the authors labeled personal economic teacher self-efficacy. Correlation analyses of the efficacy instrument scores to selected variables, such as level of economic preparation, further support the validity of the instrument as presently designed. The authors call for further research using the instrument to test its cross-sample stability, training intervention sensitivity and explanatory power in economic education learning models.

BACKGROUND

Beginning in the 1960s, then contemporary economic educators recognized that traditional teaching approaches in undergraduate economics too often failed to

achieve the desired knowledge comprehension or subject matter interest. A national thrust to redress those deficiencies spawned economic education research, teacher training and materials development at all educational levels throughout the U.S.

In the late 1970s, a roughly contemporaneous research thrust by psychological theorists Rotter and Bandura (Rotter, 1996; Bandura, 1977) began to explore a new aspect of a teacher's own perceived influence on students--whether control of teaching reinforcement lies within them or in the environment. Theorists labeled this new psychological construct self-efficacy. The idea was that teachers with high self-efficacy believed they could strongly influence student achievement and motivation, while those with low self-efficacy perceived the environment to have the greater influence.

Research applications using carefully constructed assessment instruments to test the line of thinking in science education and selected other teaching fields have produced meaningful results over the past twenty years (Riggs and Enochs, 1990). Both the theory and practical testing of the teacher self-efficacy concept have matured to a point where its application to economic education deserves attention. At the least, similar instruments might be beneficially used as a tool to assess K-12 teacher training interventions. At the most, a valid and reliable self-efficacy instrument scale might find its place as a meaningful explanatory variable in economic education learning models.

Teacher Education in Economics

The umbrella economic education institution is the National Council on Economic Education (NCEE). Founded in 1949, the NCEE as a nonprofit partnership of leaders in education, business and labor devotes its efforts to training teachers who then help K-12 school children learn about basic economic concepts. Each of the 50 states has a council on economic education that works through more than 260 university-based centers to deliver economics training services and materials to 120,000 public and private school teachers who then teach basic economics to over 7 million students. The NCEE continues to produce and distribute many excellent economic education materials through its nation-wide network.

Texas is one of several states to legislate educational achievement standards in the K-12 curriculum, including the infusion of economics. The Texas Essential Knowledge and Skills (TEKS) statutory requirements contain explicit economics content by grade level. From a recent survey by the Texas Council on Economic

Education, by sample estimation, half the 266,000 Texas teachers have none to minimal training in the subject of economics. They must prepare 4 million students each year to earn minimum scores on state-level tests used for school-level assessment and teacher evaluation. As a high school graduation requirement, all Texas students must take and pass a one-semester economics course. Beginning 2003, a revised middle school grades test, the Texas Assessment of Knowledge and Skills, (TAKS) will contain social studies items, including economics.

Even if teacher training in economics were broad-based, of consistently high quality and the teachers fully receptive, it is unrealistic to expect any teacher exposed to a few hours of economic concepts then handed a book of grade-appropriate lesson plans to immediately feel competent with the content in front of their students. Sufficient anecdotal information and research-based experiments show that economic workshop training can produce results. However, the extension of those efforts to effectively disseminate economic ideas through teacher training is far from complete.

From studies at the high school level, "The evidence indicates that when attempts are made to infuse economics into other subjects, not much economics gets learned." (Walstad, 2001). Citing evidence from other studies, Walstad further states that increased knowledge of economics was associated with improved teaching of economics. He suggests that additional training, perhaps as many as 6 formal university courses by teachers, would best achieve the student's economic education needs. In other words, mastery of the subject is instrumental to successful economics teaching in the high school (Walstad, 2001).

Formal learning assessment model specification across controlled studies on teacher training varies widely but the common theme is that the models try to capture an intervention's effect on a group of students or teachers, then allocates the effect to a set of variables germane to the methodology and selected demographic measures. A common research design is the pre-post assessment approach-often using an instrument available from the NCEE like the Test of Economic Knowledge, the Test of Economic Literacy and the Test of Understanding in College Economics-to measure the impact of a teaching or leaning intervention either in an experimental or quasi-experimental setting. Research variables of interest might include measures of experience, aptitude, prior economics training, attitude, and student learning styles. Into the mix of variables, researchers often introduce some form of teaching innovation such as computer-based instruction. This article introduces practitioners and researchers to a new variable, personal teacher self-efficacy, as a response measure to teacher training interventions. The next

section provides an overview of psychological efficacy theory on which the construct is based and the approach taken to design this particular instrument for economic education.

Teacher Self-efficacy Theory

Theorists who have studied personal teacher self-efficacy, a type of efficacy falling under social cognitive theory, define it as "the extent to which the teacher believes he or she has the capacity to affect student performance" (Tschannen, 1998). Over the past thirty years, efficacy theory has evolved sufficiently for researchers to recognize its major determinants, conceptual divisions and limits.

Education theorists distinguish between general teaching efficacy-the ability to control or influence external factors, and personal teaching efficacy-the ability to overcome obstacles to student learning, the focus of the instrument developed for this article. One set of researchers (Giskey and Passaro, 1994) pairs two useful dimensions, personal teaching efficacy versus general teaching efficacy with internal versus external locus of control. A key aspect of this psychological construct is that self-efficacy is one of the few concepts that can discern competence-the ability to execute effective actions, from the idea of contingency-the actions will achieve desired outcomes. Efficacy is a self-perception of competence, not a measure of the level of competence.

Most efficacy theorists appear to accept the following four efficacy determinant parameters: a) mastery experiences, b) physiological and emotional states, c) vicarious experiences and d) social persuasion. Quite importantly, theorists broadly agree that mastery experiences are the most powerful source of efficacy. In teaching applications, the perception on the part of the teacher that a performance has been successful also raises efficacy beliefs. Finally, theorists' opinions generally agree that personal teaching efficacy relates to ones own feelings of competence.

Business psychology theorists Gist and Mitchell discuss the bounds to self-efficacy enhancement-the change in self-efficacy-to be limited by the following factors: a) the initial level of self-efficacy and collectively the b) variability, locus and controllability of the determinants of self-efficacy (Gist and Mitchell, 1992). So theoretical development and empirical testing to date support that personal self-efficacy has an operational definition with four identified determinants, of which content mastery is paramount, and recognizes bounds limiting change in the efficacy level.

INSTRUMENT CONSTRUCTION AND TESTING

A team of education researchers constructed a science teaching efficacy instrument for pre-service elementary teachers, showing promise in forming a base of items transferable to economics (Riggs and Enochs, 1990). Their 25-item instrument, with 13 items aimed at personal science teaching efficacy was reviewed by the authors. Twelve of the 13 statements were borrowed and carefully re-worded to relate to "economics education" distinct from "science education."

Our new instrument's 12 personal teaching efficacy statements, six positively worded and six negatively worded statements, incorporated the same standard five point Likert scale from 1 (strongly agree) to 5(strongly disagree) as the Riggs and Enochs survey instrument. In addition, the survey contains items asking for the respondent's years in education, and how they rated themselves in economics preparation, in economics teaching proficiency and in general teaching proficiency. Respondent feedback was then transferred into a data file for factor and correlation analyses. This 17-item instrument appears in the appendix.

At its 2002 annual conference in San Antonio, Texas, the Texas Council on Economic Education (TCEE), asked that the attending K-12 teachers voluntarily and anonymously complete the teaching efficacy survey prior to leaving a plenary session. Of the 312 teachers, representing 182 different Texas schools, attending the conference, 228 completed the survey. The six negatively worded statement responses were re-scaled by subtracting their scale value from the number 6 to generate a scale with a common logical orientation. The lower the score, the more positive the sense of self-efficacy, the higher the score, the more negative or lower, the sense of self-efficacy. The theoretical minimum score would be 12, very high self-efficacy and the theoretical maximum score would be 60, very low self-efficacy.

STATISTICAL RESULTS AND INTERPRETATION

Factor Analysis

Like the Riggs and Enoch approach (Riggs and Enochs, 1990), we incorporated factor analysis to assess the 12-items addressing efficacy aspects. Factor analysis is a commonly employed set of statistical processes to find internal links among large numbers of variables by statistically seeking their common relationships. The principal components method, the one applied here, provides a unique solution by looking at the total variance among the variables, here the 12

survey items. Factor analysis determines an eigenvalue, the portion of all factor's variance accounted for by each factor. As a rule of thumb, factors of interest usually possess eigenvalues greater than 1. All factors, by statistical design, are orthogonal and are uncorrelated with the other factors.

The factor analysis table of most interest in this research is presented below as Table 1. Factor 1 possesses the only eigenvalue greater than one and explains just over 50 percent of the total variance of the 12 factors. This single factor has a communality of 50 percent that is shared with the remaining factors. We could label this factor "personal economic teaching self-efficacy."

Table 1 Factor Analysis Results

Factor	1	2	3	4	5	6
Eigenvalue	6.0966	0.8344	0.7722	0.7284	0.6673	0.5535
Cumulative Variance	0.5081	0.5776	0.6419	0.7026	0.7582	0.8044
Factor	7	8	9	10	11	12
Eigenvalue	0.5213	0.4387	0.3951	0.3644	0.3349	0.2928
Cumulative Variance	0.8478	0.8844	0.9173	0.9477	0.9756	1.0000

Correlation Analysis

The efficacy instrument score, still with the negatively worded items' Likert scale reversed, was correlated with three items in the survey, as shown in Table 2. The efficacy instrument's actual score range was 12, highest possible personal teacher efficacy, to 57, one item value away from the lowest possible personal teacher efficacy. The sample showed an average efficacy score of 30.72 and standard deviation of 9.22.

The efficacy score correlated highly (.82) with reported "economics teaching proficiency." A result one would desire and expect, if the instrument truly captured the economic teaching efficacy dimension. The correlation with "general teaching proficiency" was a very low .06, which further confirms that the instrument is picking up that dimension of personal teaching self-efficacy dealing with the teaching of economics. The correlation of .66 with "economics preparation" appears consistent with the logic that mastery is a significant determinant of self-efficacy and the teachers self-report that half the respondents felt their economics preparation to be adequate or less. On item 27, the average response was 3.26, indicating that

just over half rated their "economics preparation" as "adequate, good or strong" with the remainder rating their subject matter preparation "none, minimal or adequate."

The correlation results provide preliminary evidence that the efficacy instrument designed for K-12 Texas teachers who must teach some economics is consistent with the psychological theory on self-efficacy. In particular, reported higher levels of economics teaching proficiency leads to higher efficacy (lower efficacy instrument scale values), modestly correlated economics preparation to efficacy score supports the link between mastery and efficacy and the low correlation between general teaching proficiency and the instrument scale implies that only the economic teaching dimension is reflected in the responses.

Table 2 Efficacy Score Correlations

Efficacy Score with:	Item 27 -Economics preparation	Item 28 -Economics teaching proficiency	Item 29 -General teaching proficiency
Correlation	.66	.82	.06

Descriptive results by item are shown in Table 3. Nearly half the respondents were high school economics teachers and eleven percent high school non-economics teachers. Another eleven percent came from middle schools and twenty-eight percent represented elementary grades.

Table 3 Non-efficacy Item Descriptive Results

Item Number	Average	Standard Deviation	Minimum	Maximum
25-Years taught	13.49	9.23	1	40
27-Economics preparation	3.26	1.16	1	5
28-Economics teaching proficiency	2.91	1.17	1	5
29-General teaching proficiency	1.54	0.73	1	5
	Elementary	Middle School	High School -Non-econ	High School -Econ
26-Grade Taught	65 (28.5%)	25 (11.0%)	26 (11.4%)	112 (49.1%)

FUTURE RESEARCH

The personal economic teaching efficacy instrument is offered to those performing training and conducting research in economic education. Application of this research idea in economic education is new. Work in at least three areas must be conducted with findings generally supporting those revealed here, to have confidence that the instrument is valid and useful in the field.

First, the instrument's sensitivity across groups should be tested. A one-time test using Texas teachers that provides positive indications of its validity is a necessary but not sufficient condition. Next, the instrument must be tested for training intervention sensitivity in an experimental or quasi-experimental design. Settings as rudimentary as a teacher training workshop focused on some aspect of economic content with a pre-post assessment structure could provide suggestive results, if self-efficacy rose with the level of economic training. Finally, in more controlled experimental environments, the instrument's statistical robustness as an explanatory variable among others in economic learning models must be explored. Bona fide results could provide professionals the necessary confidence that the instrument measures this new content mastery-sensitive dimension of teacher influence.

SUMMARY AND CONCLUSIONS

The authors introduce and describe an instrument to measure a relatively new construct, personal teacher self-efficacy for use in economic education. Self-efficacy is defined as the extent to which the teacher believes he or she has the capacity to affect student performance. Borrowing items from a prior developed instrument for use in science education, a new 12-item efficacy instrument worded for economic education was formed with six positively worded and six negatively worded efficacy-based rating statements using a 5-point Likert scale, plus five informational items. At a statewide conference in 2002, 228 K-12 Texas teachers, who were statutorily mandated to teach aspects of economics in their classes, anonymously and voluntarily completed the instrument.

Factor analysis on the efficacy score, after reversing the scale on the negatively worded items, revealed a single factor labeled "personal economic teaching self-efficacy" that absorbed 50 percent of the total 12-item variance. Correlation analysis revealed a .82 correlation with self-rated "economics teaching proficiency" and a .66 correlation with self-reported "economics preparation." The

correlation with "general teaching proficiency" was a low .06. The correlation results suggest that this newly designed efficacy instrument does reflect personal economics teaching efficacy, but not general teaching efficacy, and that it is sensitive to the level of content mastery.

The authors suggest that the instrument be tested further in three arenas. First, the instrument's sensitivity across groups, then the instrument's training intervention sensitivity in an experimental or quasi-experimental design and, finally, in controlled experimental environments to test the robustness of the instrument as a new explanatory variable in economic learning models.

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APPENDIX

Personal Economics Teaching Efficacy Instrument

Instructions: Indicate your response to each item according to the scale below.
Do not give your name.

Scale: SA = strongly agree; A = agree; U = neutral or undecided;
D = disagree; SD = strongly disagree

1. I am continually finding better ways to teach economics.
2. Even when I try very hard, I don't teach economics as well as I do most subjects.
3. I know the steps necessary to teach economic concepts effectively.
4. I generally teach economics ineffectively.
5. I understand economics well enough to be effective teaching the subject at my assigned grade level.
6. I find it difficult to explain to students how economics works.
7. I am typically able to answer students' economics questions.
8. I wonder if I have the necessary training to teach economics.
9. Given a choice, I would not invite the principal to evaluate my economics teaching.
10. When a student has difficulty understanding an economic concept, I am usually at a loss about how to help the student better understand.
11. When teaching economics, I usually welcome student questions.

12. I don't know what to do to turn students on to economics.
13. The number of years I have taught is: years.
14. I now teach: 1) elementary 2) middle 3) senior high, NOT economics 4) senior high economics.
15. I rate my formal economics preparation as: 1) none 2) minimal 3) adequate 4) good 5) strong.
16. I rate my economics teaching proficiency as: 1) weak 2) fair 3) adequate 4) good 5) strong.
17. I rate my general teaching proficiency as: 1) weak 2) fair 3) adequate 4) good 5) strong.

THE BUSINESS OF TEACHING STATISTICS AS AN EXPERIMENTAL SCIENCE: OR AN EXPERIMENT IN THE SCIENCE OF TEACHING BUSINESS STATISTICS

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ABSTRACT

The results of a two semester experiment teaching business statistics as a computer lab based course, rather than a lecture based (or lecture based with lab component) course, shows that students show significant improvement in data interpretation and analysis at the cost of a slight degradation of probability technique performance. The evidence is from over 200 students (representing 3 lab sections and 1 control group section) on 5 exam questions and the course capstone project. Indirect assessments further suggest that students recognize the value of the lab approach both from the immediate rewards of deeper conceptual understanding to the longer lasting effects from future use of the techniques.

INTRODUCTION

As instructors, we should be concerned with the results of our teaching (meaning student learning) rather than any perceived glory or status involved in the method of our teaching. I mention this as I believe that the headlong rush to incorporate technology into the classroom has not been as carefully considered as it should be. One approach to any change in teaching method is to conduct a scientific experiment, using a control group and careful analysis, on the students in such a course.

This paper describes a year long experiment teaching statistics as a (computer) lab science instead of as a traditional lecture based course. Over the course of my year as a Distinguished Teaching Fellow with UW System, I developed a project analyzing the learning goals and teaching methods of the Statistics course at the University of Wisconsin - Oshkosh (Econ 210). I conducted

three sections of the course with a computer lab instead of a lecture only course. The lab occupied roughly a quarter of the class contact hours.

My findings are that students in the lab based course gained a facility with computer oriented statistical analysis and lost the trepidation to approach computer work and numerically oriented problems so often found even in students who successfully completed other statistics programs. Furthermore, the students from the lab based course did not show any degradation of skill with standard statistical techniques and methods. The lab students took away with them a very important job skill. They were able to recognize their new facility with computer oriented statistical analysis with very positive comments on class evaluations as well as with continuing feedback to the course instructor over succeeding semesters.

THE EXPERIMENT AND EVALUATION METHODOLOGIES

During 2000 three sections of our normal statistics course was converted from a lecture based course to a lab based course. There were a total of 13 sections of the course offered during that time. In the Spring of 2000, only one section was converted to a lab course and students were not apprized of the change until the course begun. Sufficient other sections were available for students who wished to transfer out if they felt strongly they did not want to participate in the experiment; two students did not complete the course in the Spring of 2000. Fall 2000 saw two lab sections offered, again without notations in registration material though student word of mouth may have biased student selection of these sections; there were no drops that term.

The statistics course offered in the Economics department serves both the Economics Department majors and minors but also all majors from the College of Business. Other departments in the College of Letters and Sciences offer their own statistics courses, such as Sociology, Psychology and Mathematics. Therefore, our student base is generally rather homogenous as to major and career aspiration. All students were undergrads and the non lab section has 35% females while the lab section has 34% females. This closely follows general enrollment in the Economics Department and in the College of Business here.

The course sections under consideration here, 3 lab based sections and 1 non lab (lecture) section were all taught using the same basic text, with the same professor, at roughly the same times of day, with the same lecture notes in an attempt to keep the control group as consistent with the experimental groups as possible. All of these sections were offered three days per week, 60 minutes per

day, for 14 weeks (standard course schedule at our university). Both sections has weekly homework with very similar problems on each homework assignment. The lab sections were offered in the regular chalkboard/overhead equipped lecture room twice a week with one 60 minute session moved to the university computer lab. The exceptions were on exam weeks, so there were 11 labs in a 14 week semester (two midterms and one final in the course).

Lab assignments were briefly discussed at the beginning of each lab period, with a lab worksheet handed out as well as an instruction sheet each week. The course text book also gave computer instruction and examples, though little reference was made to that source. Each assignment required data manipulation in order to obtain the required results, but further, the labs required the analysis of our empirical evidence. Students, then, were drawn into interpretation of the results as much as required to manipulate data using computer software (Minitab for Windows, Version 12). The performance on the labs themselves demonstrates facility with the computer aspect of the experiment. The professor was available during the entire lab period to answer questions and keep students on track. Perhaps because of this, students did uniformly well on these labs averaging 14 or better on each of the 15 point assignments.

Evidence about the effectiveness of that experiment was gathered in the form of the performance and opinions of those students who had taken one of these sections and compared to students who had taken regular lecture based sections of the same course from me in the succeeding semester. Specifically, I compared individual exam question results from both lab based and non lab based statistics sections to determine if the lab seems to have any direct effect on the abilities of students to handle quantitative problems. Further, I placed questions on the end of semester student opinion surveys regarding the lab experience. I also observed focus groups made up of both types (lab and non lab) of students. These groups were conducted primarily by Dr. Bryan Lily of the College of Business at our University (so that I would not bias the students' opinions), who did a parallel study of the overall effectiveness of the statistics/math component taught to undergraduate business majors.

EVALUATION AND RESULTS

Evaluation of this experiment takes two general forms. The first is the direct evidence of student learning in lab courses compared to the control group in a traditional non lab course. The primarily usefulness of using computers is to ease

the computation burden on the student so there is more time for interpretation and analysis of statistical evidence. The second form of evaluation comes from the students themselves in the form of student opinion surveys regarding the perceived usefulness of using a computer based lab component in this course.

DIRECT LEARNING ASSESSMENT

For many years I have assigned the same final homework project in my business statistics courses. That project requires students to find (or create) a data set, run a regression from that data. Furthermore, students are required to analyze that regression in terms of its appropriateness and its results (see Appendix for a copy of that homework assignment for Spring 2001). All of my classes have the identical assignment, but only the three experimental sections had the benefit of a computer lab directly incorporated in to the course. The other sections had 3 (out of a total of 9) course assignments that required the use of a computer. Those other sections had no in lab direction, though I was available during office hours to answer questions regarding the computer program.

The results from the homework are summarized in Table 1, where the scores are summarized as the number of points OFF from the total available, and shown under "Points Lost." It is quite clear that the computer lab sections outperformed the lecture section in my sample. This is a key result because of the importance of regression analysis to the practitioner of statistics in the business world.

Table 1: Points Lost on Homework Project

	Lab Course Sections	Non-Lab Sections	Significant Difference? (T-Statistic)
Points Lost Average	0.42	2.11	YES - lab students did better
(std)	(1.19)	(3.37)	(4.12)**
Number Graded Responses	86	38	
**Significant at 95%			

Another form of direct learning assessment comes from exam scores on particular questions. Beginning with the second exam, where statistics (as opposed to probability) is directly tested, certain questions were placed on exams for both the lab sections and non-lab sections of the statistics course. The following two questions were on the second midterm in the Fall of 2000 and in the Spring of 2001.

I was very careful to keep and use a very thorough answer key in order to keep the partial credit grading as consistent as possible, the scores are the number of points OFF from the total available, and shown under "Points Lost." The conclusions, drawn by the students in each problem, are shown under "Conclusion." Significance tests were performed at the 95% (5% significance) level.

The first question uses a one sample t test technique. Students were free to perform use the p-value for testing the proposition or a cutoff t-test or a confidence interval test. They were required to report the p-value, however.

> A national publication reported that a college student living away from home spends, on average, no more than $15 per month on laundry. You believe this figure is too low and want to disprove this claim. To conduct the test, you randomly select 30 college students and ask them to keep track of the amount of money they spend during a given month for laundry. The sample produces an average expenditure on laundry of $17.12, with a standard deviation of $4.52. At 95% confidence, do students really spend only $15 per month? Show all work and state your conclusion with a FULL sentence. Also, report a p-value. 17 pts.

The results from this exam question are as follows:

Table 2: Points Lost on Exam Question

	Lab Course Sections	Non-Lab Sections	Significant Difference? (T-Statistic)
Points Lost Average	1.89	1.48	NO
(std)	(2.45)	(2.15)	(.89)
Conclusion (correct=1)			
Average	.93	.90	NO
(std)	(.258)	(.304)	(.51)
Number of Graded Responses	57	40	

This question has two important parts: 1. The mechanics of the statistics (evaluated by the overall score for the problem) and 2. The correctness of the conclusion *based on the mechanics as performed* (evaluated by 1=correct and 0=incorrect). Note that an evaluation of "1" could be given to the incorrect answer

of "No, these groups do not have statistically different proportions at the 95% confidence level" ***IF*** the incorrect numerical work in the problem supports that answer of 'no difference.'

There is no statistical difference between either the technical manipulation involved in the problem or in the conclusion reliability on this problem. Though, there is a very slight raw score difference showing better technical skills in the non lab section and better conclusion reliability in the lab section.

The second identical question used a two sample proportion technique. Again students were free to choose method, but had to report a p-value and state a clear conclusion. That problem follows:

A study of female entrepreneurs was conducted to determine their definition of success. The women were offered optional choices such as happiness/self fulfillment, sales/profit, and achievement/challenge. The women were divided into groups according to the gross sales of their businesses. It seems that a higher proportion of female entrepreneurs in the $100,000 to $500,000 category than in the less than $100,000 category seemed to rate sales/profit as a definition of success. Does the raw data (given below) support this conclusion at a 95% confidence level? Show all work and state your conclusion with a FULL sentence. Also, report a p-value. 17 pts.

	Less than $100,000	Between $100.000 and $500,000
n	100	95
sp	.24	.41

The results from this exam question were as follows:

Table 3: Points Lost on Exam Questions

	Lab Course Sections	Non-Lab Sections	Significant Difference? (T-Statistic)
Points Lost Average	2.82	2.08	NO
(std)	(3.83)	(2.52)	(1.16)
Conclusion (correct=1)			
Average	.649	.75	NO
(std)	(.481)	(.439)	(1.07)
Number of Graded Responses	57	40	

Results are reported as for the previous questions. Again there is not statistical difference between either the total score (points lost) or the accuracy of the conclusion at the 5% significance level.

Three identical questions were placed on the final exams for all students. The first is a problem that combines a t test with a probability calculation:

> Data accumulated by the National Climatic Data Center shows that the average wind speed in miles per hour for Chicago, Ill. is 10.3. Suppose wind speed measurements are normally distributed for a given geographic location. Let the standard deviation of wind speed in Chicago be 4 mph.
>
> 1. What is the probability that the wind speed on a randomly selected day is 11.3 or greater? 5 pts.
> 2. Chicago has the nickname of the "windy city", lets see if that is true. Suppose that on 25 randomly selected days we measure the wind speed in St. Louis Mo. and find an average wind speed of 9.7 with a standard deviation of 3.6. Can we really say, at 99% confidence, that Chicago is the "windy city" (at least compared to St. Louis)? 5 pts.

The results from this exam question are as follows:

Table 4: Points Lost on Exam Question

	Lab Course Sections	Non-Lab Sections	Significant Difference? (T-Statistic)
Points Lost Average	4.60	3.33	NO
(std)	(3.27)	(3.10)	(1.94)
Conclusion (correct=1)			
Average	.439	.525	NO
(std)	(.501)	(.506)	(.83)
Number of Graded Responses	57	40	

The lab students lost more points on the mechanics of the question (though still not significant at 5%, two tailed test) as well as had slightly lower accuracy on the conclusion. As the computer portion of the course was used primarily for data manipulation (statistics) and less for probability calculation (even for distributions),

it is, perhaps, not so surprising that a problem that includes manipulation of a probability distribution poses more difficulty for the lab students.

The second statistical problem on both finals required a two sample proportion technique (again):

> A company's market share is very sensitive to both its level of advertising and the levels of its competitors' advertising. A firm known to have a 56% market share in the past wants to test whether or not this value is still valid in view of recent advertising campaigns of its competitors and its own increased level of advertising. A random sample of 500 consumers reveals that 298 of them use the company's product. Is there evidence to conclude that the company's market share is no longer 56%? Has it increased or decreased? Make your conclusions explicit. 9 points (total)
> a. Test at 95%
> b. What is your ultimate conclusion? Explain.

The results from this exam question are as follows:

Table 5: Points Lost on Exam Question

	Lab Course Sections	Non-Lab Sections	Significant Difference? (T-Statistic)
Points Lost Average	3.44	3.05	NO
(std)	(3.39)	(2.89)	(.61)
Conclusion (correct=1)			
Average	.509	.475	NO
(std)	(.504)	(.506)	(.32)
Number of Graded Responses	57	40	

Once more, the lab students did slightly worse at computation but slightly better at the accuracy of conclusion. Still, however, these results were not statistically significant.

The last identical problem on both sets of exams was a pure probability problem. I wanted to see if the lab students were truly missing out on probability. This question was just a basic counting problem using combinations.

A publishing company publishes five different how-to books, and it has a special offer of three books for $10. A woman has decided to buy three books and give them to her husband one at a time to entice him into making three desired how repairs. In how many ways can three books be selected and ordered from the list of five books? 5 pts.

The results from this exam question are as follow:

Table 6: Points Lost on Exam Question

	Lab Course Sections	Non-Lab Sections	Significant Difference? (T-Statistic)
Points Lost Average	2.32	1.5	YES-lab students did worse
(std)	(1.99)	(1.96)	(2.00)**
Number of Graded Responses	57	40	
** Significant at 95%			

As no analysis was required by this problem, the only data acquired was on the accuracy of the computation. The students from the lab course did do significantly worse at the 5% level at probability computation.

The preceding results show, at the 5% significance level, no difference between the statistical problem solving skills acquired by students that took the course with a lab setting or without the lab component. There is a small, but significant, difference between the probability skills acquired by these students. The non-lab students performed better on that type of skill. This is no surprise given that the computer is really of very little value for solving these types of problems. I do not consider this an insurmountable difficulty for the lab based environment, however, as I would venture to guess that very few employers place higher importance on probability skills rather than statistical ones.

STUDENT OPINIONS ABOUT THEIR LEARNING EXPERIENCES IN STATISTICS

Student evaluation surveys from the three lab based statistics sections had extra assessment questions added to the regular course evaluation instrument regarding the value of the lab experience. Students were also encouraged to express

sentiments in a more free form fashion in the 'open comment' section of the instrument. As these responses are only given to the professor after course grades are assigned and all written comments are typed to preserve student anonymity.

This first set of comments and results are from the second semester of the experiment, after some modifications to the labs were made. In Fall 2000, those questions (numbered 35-39, on the survey instrument) were:

35.	Did the lab component of this course aid in your understanding of the course material?
36.	Did the lab component of this course encourage you to try using course material for other courses in the future?
37.	Lab is a valuable addition to courses of this type.
38.	I learned something in the lab component of this course.
39.	The lab component of this course should be eliminated.

The table below summarizes the responses from Fall 2000 (number of responses, with percentage responding in parenthesis):

Table 7: Student Survey Responses
(percentage responding in parentheses)

Questions	mn 2	mn 3	mn 4	mn 5	mn 6	mn 7	mn 8
	1 Strongly Disagree	2 disagree	3 in between	4 agree	5 strongly agree	# responding	Mean
lab aided understanding	0	8	3	15	20	46	4.02
	(0)	(17.4)	(6.5)	(32.6)	(43.5)		
lab encouraged future use	1	2	17	20	6	46	3.61
	(2.2)	(4.3)	(36)	(43.5)	(13)		
lab is valuable	2	2	4	17	20	46	4.04
	(4.3)	(4.3)	(8.7)	(37)	(43.5)		
learned some thing in lab	2	2	4	21	16	46	3.95
	(4.3)	(4.3)	(8.7)	(45.6)	(35)		
lab should be eliminated	27	11	2	2	2	44	1.65
	(61.4)	(25)	(4.5)	(4.5)	(4.5)		

Generally, it appears from this data that fewer than 10% of the students think lab should be eliminated. An overwhelming majority think that lab is valuable and encouraged future use of computers.

The comments from student evaluations relevant to the lab set up were:
I liked the lab, helped make the course more realistic and useable
I think the lab helped put the lectures into perspective.
The lab was very helpful and challenged me. It added a different technique for learning the material. It showed us how to put the material we learned to work.
I enjoyed the lab. It was a lot better than (other prof's) computer assignments.
This is the second time I took the course and I feel it was much more beneficial with the lab, it was a nice change of pace on Friday and it allowed me to lean the material quicker & better.
Lab helps not only with this class but helps to familiarize with the computer and programs in general.

These comments are particularly gratifying because there were no negative comments concerning the lab component of the course in the Fall 2000 evaluations. It even appears that students were actually getting what we want them to get: reinforcement of techniques and familiarity with common statistical software.

The first semester of the experiment was not quite so positive, but still overwhelmingly positive. The survey instrument for Spring 2000 had the following additional questions (numbered 35-39):

35.	I have learned something in the lab portion of this course.
36.	Lab is a valuable addition to courses of this type.
37.	The labs in this course need a major overhaul.
38.	The labs in this course need a minor tune-up.
39.	The labs in this course need to be eliminated.

The following table summarizes the responses for Spring 2000:

Table 8: Student Survey Responses
(percentage responding in parentheses)

Questions	mn 2	mn 3	mn 4	mn 5	mn 6	mn 7	mn 8
	1	2	3	4	5	#	Mean
	strongly disagree	disagree	in between	agree	strongly agree	responding	
Learned something in lab	1	0	4	16	6	27	3.96
	(3.7)	(0)	(14.8)	(59.3)	(22.2)		
labs were valuable	2	0	5	12	8	27	3.89
	(7.4)	(0)	(18.5)	(44.4)	(29.6)		
labs need major overhaul	2	16	6	1	6	27	2.44
	(7.4)	(59.3)	(22.2)	(3.7)	(7.4)		
labs need minor tune-up	0	1	9	14	3	27	2.44
	(0)	(3.7)	(33.3)	(51.9)	(11.1)		
lab should be eliminated	13	10	1	0	0	24	1.5
	(54.2)	(41.7)	(4.2)	(0)	(0)		

While there were no students that expressed the opinion that labs should be eliminated, there were three students that indicated that labs needed substantial revision. Still, the general results from the student opinion surveys indicate that students liked the lab component of the course.

Student comments from the "free comment" section relevant to the lab experience from Spring 2000 were:

I do like the labs for the reason that they are easy points to bring your grade up.
About the labs: I think initial stuff should be take home assignments. We use minitab without know (sic) what we're doing a lot in lab.
Having taken this stats course before (different instructor) I feel that the labs are a highly effective way of learning in a practical manor. (The early labs need a bit more work - maybe hand out directions for the lab the period before lab)
Make the labs relate to what is learned in class. Talk for the first 5 minutes of the lab to explain the connection.

These suggestions, in particular taking more attention to explain how to use the software program were implemented in the succeeding semester.

The general gist of these opinions shows student opinion to be strongly in favor of the lab (see particularly the results from the 'lab is valuable' and 'I learned something in lab' questions). It is fairly clear that students really appreciated the lab, though some apparently liked it primarily for "easy points!!"

A second method of gathering opinions about a lab based component to the statistics course was obtained by the use of focus groups. Congruent with this study of the lab based statistics course is an ongoing project to evaluate the overall mathematics/statistics component of the Business major core. Two groups with a total of 17 students were drawn randomly from a business marketing class (for which math/stats is a requirement) on 11/16/00. Two professors (Drs. Burnett and Lily) presided over the sessions. A list of questions were agreed upon beforehand and were asked of both sessions. Those questions and the responses from the group are reported below. Each section has students that had a substantial experience with computers in the statistics course, although some of the students who identified themselves this way took a traditional lecture based course that required frequent computer homeworks (done outside of the class setting) with Professor K. McGee.

Computer readiness:	Do you feel prepared to use computer statistics programs on your own projects? If so, how did you get introduced to this type of computer usage?
Lab Students:	Yes. Most of these students had little exposure to any type of statistical or empirical program before statistics.
Non-Lab Students:	Generally, no. Most of these students had no exposure to any empirical programs at all before statistics and only those with Professor McGee felt they had enough homework using computers that they felt they could use them on their own..
In -class computer usage:	Do you feel that you need more in-class work with computers? In essence, what are your feelings toward computer labs in the math/stats sections?
Lab Students:	Generally the students really liked lab.
Non-Lab Students:	Most non lab students thought a lab would be a good idea, though students who had taken professor McGee were exposed to computer programs as homework assignments.

Knowledge versus memorizing:	To what degree do you understand the concepts as opposed to memorizing mechanically how to solve very specific problems? In other words, do you feel that you would be able to use the course concepts and apply them to new problems that you have not seen before?
Lab Students:	One comment that they just learned 'what' to do, instead of why.
Non-Lab Students:	Very few thought they had any handle on the 'whys' though most of both groups of students could recognize an empirical problem that required statistics.
Retention:	What do you retain from these classes and what do you not retain?
Lab Students:	Mostly the statistics, not the probability.
Non-Lab Students:	Most claimed to retain very little.
What material from these classes do you see being used in later classes? What material and what classes?	
Both types of students agreed they saw this material in Marketing to some extent and in Econometrics (for those that had taken it). Many of these students were fairly new to the major and so had not taken a lot of upper division courses, however.	
Do the math and stats courses seem connected or disconnected from each other?	
Lab Students:	Disconnected.
Non-Lab Students:	Disconnected.
Critical thinking:	Does your experience in stats/math aid your ability to think critically?
Lab Students:	Yes.
Non-Lab Students:	Some thought so, others thought it was just another 'time waster' of a class.
Using data:	Do you feel you have been taught how data can be used and how it is often abused?
Lab Students:	Yes.
Non-Lab Students:	Those that had taken either Burnett (in a non lab setting) or McGee thought they did.

The focus groups had much discussion that seemed to support the idea of a lab in the statistics course and for a general reformulation of the requirement in general. There were several specific comments that suggested a more cogent course grouping and tighter content control would be welcomed. Several students thought

the disparity between topics taught and emphasized among different sections of the course was too large.

CONCLUSIONS

In general, my results show that students do significantly better on computerized regression analysis that requires the use of data interpretation. They demonstrate no substantial skill degradation with statistical (as opposed to probability) techniques with the lab set up. Further, they seem to appreciate the lab experience, and are more likely to believe they will use the material in the future. That leads to my recommendation that statistics sections move to a lab format. Moreover, I would suggest that emphasis be placed on analysis and interpretation of results rather than on computation as the computer makes number crunching by hand increasingly obsolete for practitioners.

APPENDIX

Homework # 9	
This homework cannot be dropped	
This is the homework you've been waiting for. As discussed previously in class, you get to be a bit creative (with the subject matter, not the methodology!!).	
The assignment is to design a regression, run it, test it and give me your conclusions.	
You may collect the data yourself, either through a survey you take personally or through the library (gov. documents section is a good place to go for economics data), or you may use the Statistical Abstract of the United States that is on reserve in the economics dept. office.	
I expect you to turn in :	
1.	An explanation of why you chose the regression (why do you think that your x's predict what y?).
2.	Explain how you collected your data and where it came from. Was it a survey (include a copy of the questions you asked)? How was the survey conducted (who was asked)? Was the data from a government document(which one)? Was the data from the internet (what URL, what source)?
3.	What did you expect (before you ran the regression) in terms of signs of the slopes (for slopes>0, for instance - should higher levels of the independent variable be associated with higher or lower levels of the dependent variable).

Homework # 9	
4.	A computer printout of the data (I want df$25 and I would prefer df$40), I would much prefer a multiple regression (more than 1 type of x).
5.	Output from your regression.
6.	Tests of the slopes. Which were significant? Did it match what you expected?
7.	Conclusions - was the regression any "good", if so why, if not why not (look at both the goodness of fit and the signs/ significance of the slopes). Did you prove what you wanted to prove? If there were problems with the regression, what steps should be taken to overcome them?
This should be a couple of pages of computer output, and maybe a page of writing (maybe two if you write really big, I'm not looking for a tome here). Either write neatly, print, or type (if your writing is illegible).	
This should actually be sort of fun. I'm looking for some facility with the skills we have been learning, nothing more. Your grade will be based on how you display your grasp of the class material, not whether your regression "worked".	

ENDNOTES

[1] The text was Basic Statistics for Business and Economics (3rd edition), Doublas A. Lind, Robert Mason and William Marchal, Irwin/McGraw Hill, 2000. The author taught each of the sections mid-day with existing lecture notes adjusted for time constraints as noted.

[2] A full set of lab materials are available from the author.

REFERENCES

Lind, D.A., R. Mason & W. Marchal. (2000). *Basic Statistics for Business and Economics* (3rd Ed.), New York: Irwin/McGraw Hill.

ECONOMICS ARTICLES

PRICE ADJUSTMENT AND THE MARKET PROCESS: DEALING WITH DISEQUILIBRIUM

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ABSTRACT

This paper discusses competitive price adjustment in the context of a model which retains the Marshallian supply and demand framework while emphasizing the function of entrepreneurship. It considers how entrepreneurial gains are made in both surplus and shortage markets and by competitors on both sides of the market as price is driven to the market-clearing level. Put differently and more simply, it considers how participants on both sides of the market are able to gain through their ability to deal with disequilibrium. The reasoning is intuitive, the presentation verbal and diagrammatic, not mathematical. But the analysis is more formal and, it is hoped, more instructive than the sort of discussion one typically finds in undergraduate economics textbooks.

> *If competitive markets are to be explained in terms of Marshallian supply and demand diagrams, surely we are entitled to a theoretical process--a story which might account for the economists' confidence in the special relevance of the intersection point in that supply and demand diagram.*
>
> Israel M. Kirzner (1997, 66)

> *Determining precisely what people do who are not in equilibrium is not one of the notable achievements of economics.*
>
> Theodore W. Schultz (1975, 829)

INTRODUCTION

Introductory-level economics textbooks tell an equilibrium "story" of sorts, but not in formal terms. Michael Parkin's *Economics* offers one of the better discussions. A shortage, Parkin explains, forces the price up:

> Suppose the price of a tape is $2. Consumers plan to buy 6 million tapes a week, and producers plan to sell 3 million tapes a week.... Some producers, noticing lines of unsatisfied consumers, move their prices up. Some producers increase their output. As producers push their prices up, the price rises toward its equilibrium.
>
> Michael Parkin (1998, 79)

A surplus, on the other hand, forces the price down:

> Suppose the price of a tape is $4. Producers plan to sell 5 million tapes a week, and consumers plan to buy 3 million tapes a week.... Some producers, unable to sell the quantities of tapes they planned to sell, cut their prices. In addition, some producers scale back production. As producers cut prices, the price falls toward its equilibrium.
>
> Michael Parkin (1998, 79)

While this sort of discussion is intuitively appealing, at least on the surface, on deeper examination it begs fundamental questions regarding the competitive model. If market participants are assumed to take prices as given, and determine how much to buy and sell accordingly, then whose decision is it to change prices? Do some have information not available to others? If information does not flow freely, does this market "imperfection" impede the progress toward equilibrium?

These are hardly new questions[1], yet they remain largely unexplored in most undergraduate textbooks -- even in more advanced price theory texts. Indeed, intermediate microeconomics texts often develop the concept of market equilibrium almost entirely mathematically, in effect treating markets as being at all times in the purely static state described by solutions to simultaneous equation systems solved for "p" and "q". Neither approach, the informal nor the mathematical, does justice

to the process of equilibrium -- particularly in the context of entrepreneurial behavior and the gains to those who bring markets to equilibrium.

Theodore Schultz (1975) has argued that while some theorists have commented incisively on the absence of the entrepreneur in general equilibrium theory, few seem to have fully explored the idea that significant benefits come to those who are able successfully to bring markets into (or at least closer to) equilibrium. Speaking of one such theorist in particular (Israel Kirzner, the prominent Austrian theorist quoted above) Schultz contends that

> He sees clearly the omission of the entrepreneur in received equilibrium theory, but he persists in holding fast to the zero profit concept in that theory and, as a consequence, fails to see the economic rewards that accrue to those who bring about equilibrium.
>
> Theodore Schultz (1975, 833)

This paper discusses competitive price adjustment in the context of a model which retains the Marshallian supply and demand framework while emphasizing the function of entrepreneurship. We consider how entrepreneurial gains are made in both surplus and shortage markets and by competitors on both sides of the market. The reasoning is intuitive, the presentation verbal and diagrammatic, not mathematical. But the analysis is more formal and, it is hoped, more instructive than the sort of discussion one typically finds in undergraduate economics textbooks. In short, we hope to provide what Kirzner himself calls for above: a story that elucidates the process of equilibrium in the context of Marshallian supply and demand diagrams.[2] We feel that such an analysis would fill a void in the current literature of economic education.

A SIMPLE MODEL OF PRICE ADJUSTMENT

Equilibrium represents a simultaneous solution of the optimization problems of both demanders and suppliers, a perfect and complete coordination of their plans. When the market is out of equilibrium, not all participants are successfully executing their plans. If the market is in surplus not all sellers are able to sell as much as they planned (though all demanders can purchase their planned quantities), and if the market is in shortage not all demanders are able to purchase as much as planned (though all suppliers are successful at selling their planned quantities). Put differently, suppliers are off their supply curves in surplus markets and demanders

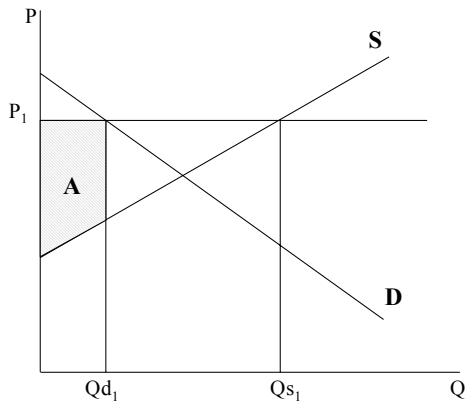
are off their demand curves when the market is in shortage. Disappointed expectations presumably lead to the formulation of new plans which will in turn push the market closer to equilibrium; this is one of the qualities of entrepreneurial activity, or actions which follow from alertness to opportunities to gain or to avoid loss. But is the competitive model able to explain how such adjustments occur?

The market demand curve indicates what demanders will do collectively when all suppliers raise their prices. The demand curve faced by an individual seller raising price independently is much more elastic than market demand. In the extreme case of perfect competition the demand is perfectly elastic, and any seller who raises price independently loses all sales. How, then, is price to rise in a shortage? Simultaneously by all suppliers? How could they know when and how much to raise price? Similarly, the market supply curve indicates what suppliers will do collectively in response to a higher or lower price. The supply curve faced by one demander acting independently would be much more elastic than market supply. In the extreme case of perfect competition it would be horizontal, and the demander who reduced the offer price in a surplus market would be unable to purchase the good at all. Here again, one wonders how the market is supposed to adjust.

The model presented here describes the process by which prices move toward equilibrium in competitive markets. The analysis assumes unchanging market data (tastes and preferences, resource endowments, technology, etc.) which are not fully known by market participants. Entrepreneurs are "discovering" information that already exists in dispersed form in the market, but not revealed in its totality to any single market participant. [3] The competitive market process induces individual demanders and suppliers to reveal their own demand and supply curves, and consequently the respective market curves. This does not happen instantaneously. One can imagine a demander incrementally searching for a price which is acceptable to a supplier and sufficient to acquire the quantity desired, but without offering the maximum demand price. Likewise, suppliers might incrementally search for a price which is acceptable to demanders and sufficient to assure planned sales, but not offer the minimum supply price. Neither demanders nor suppliers will have a very accurate picture of the market as a whole, but competition amongst them will reveal at least a part of the picture to each.

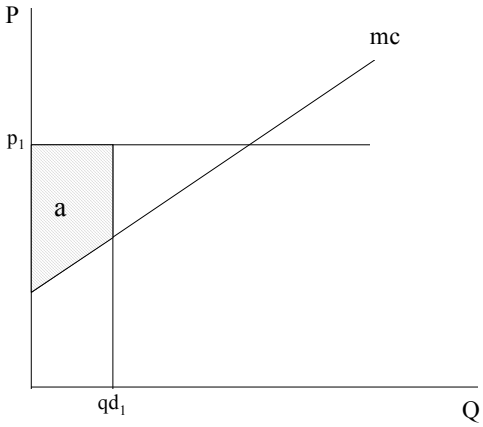
Figure 1 depicts a market in which a surplus exists at price *P1*. Market demand is only Qd_1, while suppliers are willing to supply Qs_1 at that price. Collectively, suppliers realize producer surplus equal to area *A*.

Figure 1



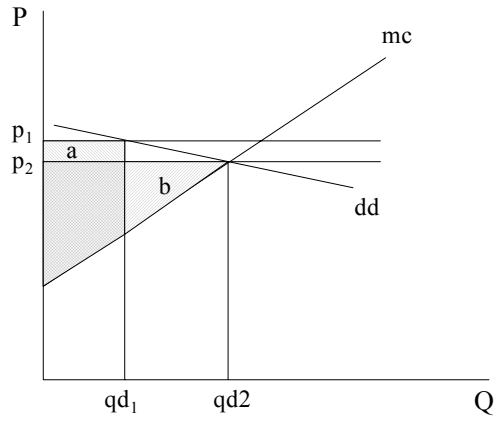
Individual suppliers in this market find themselves off their supply curves, as represented in Figure 2. The supplier is selling only qd_1 at price p_1, and realizing producer surplus equal to the shaded area *a*.

Figure 2



The supplier is willing to accept a lower price if this results in additional producer surplus. The demand curve faced by a single supplier acting independently--*dd* in Figure 3--is much more elastic than the market demand curve. Thus an entrepreneurial seller who first recognizes the condition of the market will be able to sell a much larger quantity by lowering the price a bit.

Figure 3

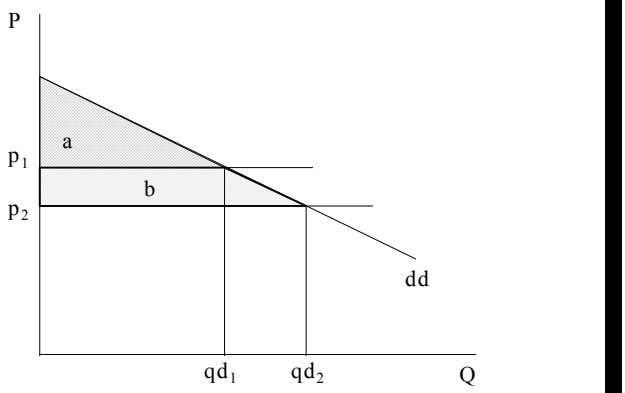


We may assume that the supplier represented in Figure 3 is able to sell as much as desired at the lower price, i.e., is no longer off the supply curve. Does this action produce a net gain in producer surplus? For a slight decrease in price, the answer is "yes." Figure 3 depicts the generalized choice situation facing the supplier. A decrease in price moves the supplier from qd_1 to qd_2. The supplier loses producer surplus equal to area a, but gains producer surplus equal to area *b*. If *b* is greater than *a*, the supplier realizes a net gain in producer surplus, and therefore is willing to offer the good for sale at the lower price.

Other suppliers remain off their marginal cost curves temporarily. It is important to note, however, that by acting--in this case by lowering price--the entrepreneurial supplier reveals information about the market. By successfully lowering price, shown in Figure 4 as movement from point *a* to point *b*, the entrepreneur communicates to others that the market is in surplus. As other sellers follow the entrepreneurial lead and lower their prices, the supplier who initiated the price change will be driven off the marginal cost curve once again (point *c* in Figure 4), as customers discover equally low (or lower) prices elsewhere. In other words,

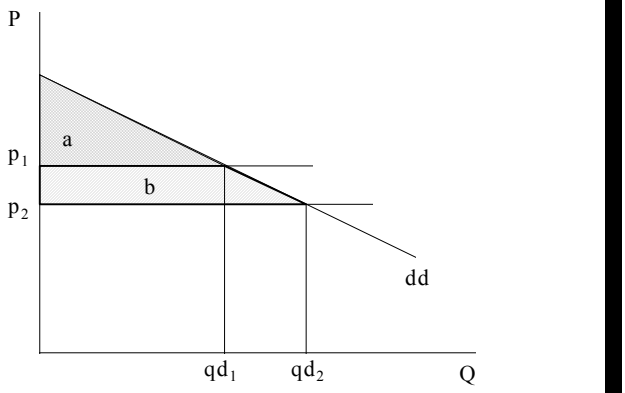
the supplier faces demand dd_2. From here, the supplier may move again to gain producer surplus by further price cutting (thus increasing quantity demanded along dd_2). Continual competitive price cutting drives the price further toward equilibrium, at which point the supplier faces demand dd_e.

Figure 4



As price falls demanders will want to purchase a larger quantity; in fact, an entrepreneur on the demand side of the market who perceives the market to be in surplus may initiate a competitive price change in order to realize additional consumer surplus. Figure 5 depicts the demander's generalized choice situation.

Figure 5

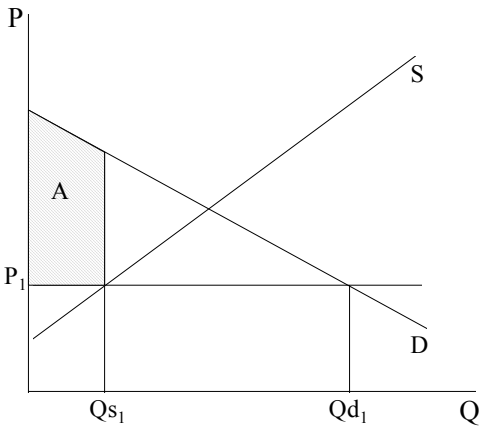


Each demander is able to purchase the amount desired, i.e., all are on their demand curves at price p_1. Consumer surplus is equal to the shaded area *a*. However, each demander can act to increase consumer surplus by recognizing that the prevailing price (the price used to make utility calculations) is not an equilibrium price. Since the market is in surplus, buyers can move to a superior position, at a lower price, where consumer surplus is unambiguously greater with the addition of area *b*. Note that the movement of additional demanders to the superior position does not prevent the first demander from continuing in that position.

Once price has been lowered to the market clearing level, each supplier should be able to sell the quantity indicated by profit-maximizing calculations using that (equilibrium) price. There will be no disappointed expectations on the supply side of the market. The same may be said of the demand side of the market although in this case demanders have been able successfully to execute their utility-maximizing plans at all prices at and above equilibrium. Once equilibrium or a coordinated state has been "discovered," all participants' expectations will be fulfilled, and all plans successfully executed. Of course this state might never be accomplished in fact, given the dynamic nature of the market. But this is what a competitive market tends toward.

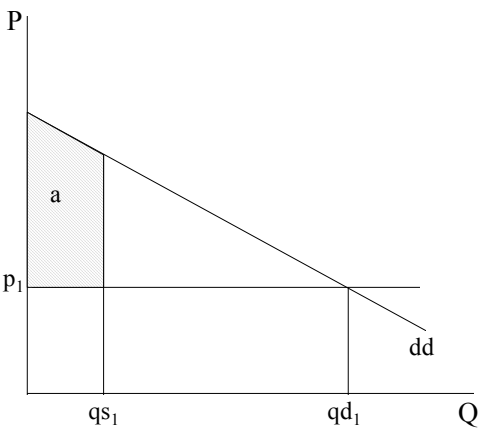
Figure 6 illustrates a market in shortage at price P_1. The market demand is Qd_1, while suppliers are willing to supply only Qs_1 that price. Collectively demanders are realizing consumer surplus equal to area *A*.

Figure 6



In Figure 7, each individual demander is purchasing only qs_1 at price p_1 and each is realizing consumer surplus equal to the shaded area *a*. Buyers are willing to offer a higher price if this results in additional consumer surplus.

Figure 7



The supply curve faced by a single buyer acting independently (*ss* in Figure 8) is much more elastic than the market supply curve. Thus an entrepreneurial buyer who recognizes the condition of the market will be able to obtain a much larger quantity by offering a higher price. The buyer represented in Figure 8 is assumed to be able to buy as much as desired at the higher price. Does this action produce a net gain in consumer surplus? Figure 8 depicts the demander's generalized choice situation.

A price increase moves the demander from qs_1 to qs_2. The demander loses consumer surplus equal to area *a*, but gains consumer surplus equal to *b*. If *b* is greater than *a*, the demander realizes a net gain in consumer surplus, and therefore is willing to offer the higher price for the good.

Other demanders remain off their demand curves temporarily. But once they follow the entrepreneurial lead, the demander who initiated the price increase will be driven off the demand curve once again (Point *C* in Figure 9), as suppliers find other buyers offering the same (or higher) prices. That is, the buyer now faces supply ss_2. From here, one may move again to gain consumer surplus by further price increases (thus increasing quantity supplied along ss_2). Continuous

competitive price increases drive the market towards equilibrium, at which point the buyer faces supply ss_e.

Figure 8

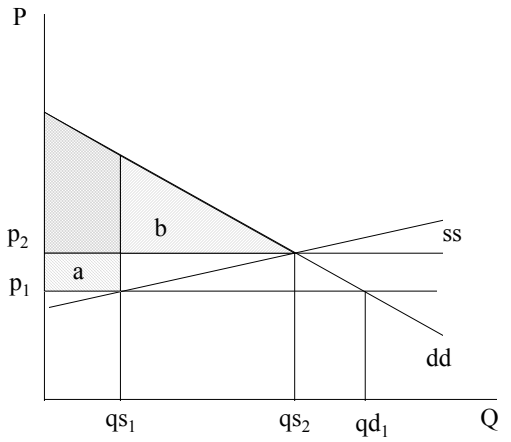
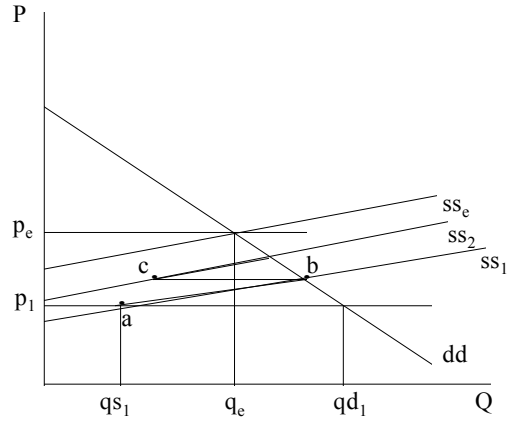
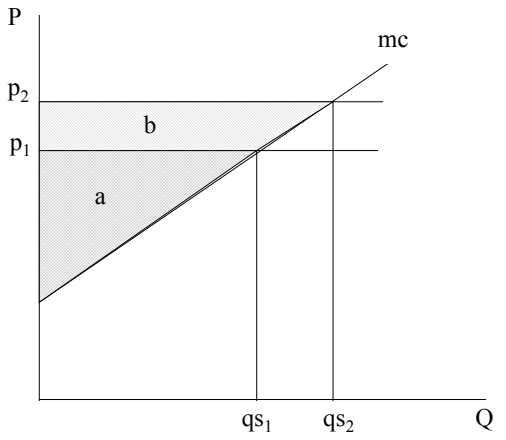


Figure 9



As price rises, suppliers will want to supply a larger quantity. Indeed, an entrepreneur on the supply side of the market who perceives that the market is in shortage may initiate a price increase in order to realize additional producer surplus. Figure 10 depicts the supplier's generalized choice situation.

Figure 10



Each supplier is able to sell the amount desired, i.e., all are on their MC curves at price p_1. Producer surplus is equal to the shaded area *a*. However, each supplier can act to increase producer surplus by recognizing that the prevailing price (the price used to make profit maximization calculations) is not an equilibrium price. Since the market is in shortage, suppliers can move to a superior position, at a higher price, where producer surplus is unambiguously greater with the addition of area *b*.

When the price reaches equilibrium there will be no disappointed expectations on the demand side of the market. The same may be said of the supply side of the market although in this case suppliers have been able to execute successfully their plans at all prices.

To summarize, the essence of disequilibrium is disappointed expectations and plans not successfully executed. In the surplus market, suppliers' expectations are unfulfilled; in the case of a shortage, demanders' expectations are unfulfilled. But entrepreneurship may be exercised on either side of the market in either disequilibrium condition. Even though all demanders' expectations are fulfilled and

plans successfully executed in a surplus market, an entrepreneur on the demand side of the market can still make gains by offering a lower price. Similarly, all suppliers' expectations are fulfilled and plans successfully executed in a shortage market, but a supply-side entrepreneur can still make gains by raising price.

In order to realize entrepreneurial gains, either in producer surplus or consumer surplus, it is of course necessary to act. But acting entails revealing what one knows about the condition of the market. Certainly the supply-side entrepreneur would be happy to go on selling the good at a price just below the surplus price at which the other sellers are "stuck" for the moment. The entrepreneurial supplier might even attempt to conceal the fact of offering a lower price in the hope that no one else will perceive, at least for a time, what the condition of the market really is. Thus the entrepreneurial act is *inherently* competitive. Market participants act knowing their gains depend upon moving more swiftly or more correctly than other entrepreneurs. Being the first to act is crucial to realizing gains in producer surplus.

Whether demanders or suppliers initiate price changes, individuals acting entrepreneurially eventually do reveal new information, their own perceptions of the condition of the market, whether they want this to happen or not. Other participants may choose to respond to this information or ignore it. If it is correct information and other participants respond in kind, the market price moves incrementally toward the equilibrium level. The scenario is closed when no further gains in producer or consumer surplus can be earned. Then all expectations are fulfilled and all plans successfully executed. The market is in equilibrium.

CONCLUDING REMARKS

Admittedly, this analysis leaves important methodological questions unanswered, particularly from a subjectivist perspective. Subjectivism implies that choices made by even the most rational actors can never be fully predicted, because no two minds are the same. The bits and pieces of information available to different persons-- and more importantly their subjective understandings of them-- differ. While each person's plans are presumably coherent in the context of the individual's own action, and may even lead to an "individual" equilibrium, a "collective" equilibrium is not necessarily implied. Expounding on this point of view, Karen Vaughn rightly emphasizes the inseparability of time and knowledge:

> The passage of time (and presumably action in time), means that people will learn more about both their ends and means, and more about the plans that other people are undertaking. This will imply that initial plans will be revised, often many times in the light of new knowledge. Revision of plans, then, is the norm rather than the exception in human action. In such a world, it would be extremely unlikely that all plans would ever be "coordinated."
>
> (Vaughn, 1994,154)

Can market equilibrium be expected to obtain if participants' plans are continually changing to fit today's subjective reality? Surely it would be wrong to deny the subjective element in human understanding and action. But it would be a mistake also to view human understanding as a fantasy-flight, unconstrained by anything more objective than the mind's capacity for hallucination. The model developed above rests on the tacit premise that individuals' subjective understandings *converge*, in part through entrepreneurial discovery, on objective market realities. This convergence implies progress toward mutually consistent perceptions and expectations among the various market participants and the possibility, at least, of *movement towards* market equilibrium.

Theoretical difficulties aside, it remains empirically true that markets in reality show a reliable *tendency* to move toward equilibrium-a tendency which F.A. Hayek thought to be ultimately an empirical proposition. [4] Perhaps more to the point, however, is Hayek's incisive distinction between "prediction" and "orientation:"

> The service of a theory which does not tell us what particular events to expect at a definite moment, but only what kinds of events we are to expect within a certain range, or on complexities of a certain type, would perhaps be better described by the term orientation than by speaking of prediction. Although such a theory does not tell us precisely what to expect, it will still make the world around us a more familiar world...because we can at least exclude certain eventualities. It makes it a more orderly world in which the events make sense because we can at least say in general terms how they hang together and are able to form a coherent picture of them...[t]hough we are not in a position to specify precisely what to expect....
>
> (Hayek, 1967, 18).

Borrowing Hayek's terminology, we may say in conclusion that the simple theory of price adjustment offered above is "oriented" toward equilibrium, and that it "excludes certain eventualities" (e.g., price increases in the face of a market surplus) within the context of certain constraining assumptions (that market data such as tastes and preferences, resource endowments, technology, etc., are stable over the period of analysis), but "does not tell us what particular events to expect at a definite moment".

We need not endorse the idea of a final, static equilibrium as more than what Vaughn has referred to as a "metaphor" of neoclassical economics (Vaughn, 1994,166). It remains a useful metaphor nonetheless, and our purpose here will have been served here if we have fleshed out the *process* that moves the market towards equilibrium, in terms at once more formal than the typical undergraduate-level discussion, yet more meaningful than the more advanced mathematical derivation in which the very concept of an equilibrating process is abandoned.

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ENDNOTES

[1] Kenneth Arrow (1959) observed that "Each individual participant in the market is supposed to take prices as given and determine his choices as to purchases and sales accordingly; there is no one left over whose job it is to make a decision on price." (P. 43)

[2] As such, our analysis does not go into game theoretic approaches, or other approaches that take one outside the traditional Marshallian supply and demand framework. Neither does it deny their validity or usefulness, of course.

[3] Kirzner (1997) draws critical distinctions among three types of learning: the deliberate generation of information, entrepreneurial discovery, and accidental or purely serendipitous acquisition of knowledge. As we shall see, it is entrepreneurial discovery that is crucial to the process of equilibrium developed here (p. 72).

[4] Hayek (1972) characterizes the question as that of "the empirical probability that people will learn (that is, that their subjective data will come to correspond with each other and with the objective facts)" (pp. 49-50).

THE LONG RUN RELATIONSHIP BETWEEN GOVERNMENT EXPENDITURES AND ECONOMIC GROWTH: CASE OF JORDAN

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Osamah Al-Khazali, American University of Sharjah

ABSTRACT

Using data from the Jordanian economy, the paper conducts a causality test of the Wagner's Law which states that there is a relationship between the growth in government expenditures and the economic growth. The findings of the study show that the growth in the economy Granger causes the growth in the government sector. Thus, the Wagner's Law applies to the case of Jordan. Using co-integration technique and the VAR model, the study suggests that there is a uni-directional relationship between the economic growth and the growth in the government expenditures.

INTRODUCTION

The size of the government expenditures in Jordan has increased since 1969. With respect to the government services, its contribution to the GDP in the years 1969, 1980, and 1990 was 27.2 percent, 28.5 percent, and 30.9 percent, respectively (Penn Tables). The purpose of this paper is to examine the relationship between the government size and the economic development in the case of Jordan. This goal will be achieved using the methodology suggested by Wagner (1893), and Islam and Nazemzadeh (2001). This analysis will be in the framework of "Wagner's Law" that suggested that there is correlation between the relative size of government sector and the economic development in the country. That is, there is a tendency for the government sector to grow as the national income grows. So this paper will test empirically whether or not a causal relationship exists between the size of the government sector and the growth of the economy.

Review of the literature shows mixed support of "Wagner's Law" which suggests that there is a relationship between the relative size of the government and the economic growth. Conte and Darrat (1988) conducted an empirical study on the OECD countries for the period 1960-1984 to test whether there is Granger causality relationship between the growth in the public sector and economic growth in these countries. Their findings showed that the growth in the government sector had mixed impact on the rate of economic growth, and that in most of the OECD countries had no clear effect on the growth rate in their real income. Other study on the Canadian economy for the period 1947-1986, Afxentious and Serletis (1991) have empirically tested the Granger-Sims causality relationship between government expenditure and gross domestic product. Their findings indicated that neither Wagner's hypothesis, which runs from GDP to government spending, nor the reverse causality, which runs from the government spending to GDP, is statistically supported. In addition, Yousefi and Abizadeh (1992) tested Wagner's Law using data over the period 1950-1985 for each of the randomly selected 30 states of the U.S. economy. The empirical findings of their study indicated that Wagner's Law is valid for 70 percent of the cases considered in the study, i.e., in 21 out of the 30 states selected randomly. In another study, Abizadeh and Yousefi (1998) have empirically tested the Wagner's Law on the South Korean economy and they concluded that government expenditures have not contributed to economic growth in the case of South Korea. An empirical study on the U.S. economy by Islam and Nazemzadeh (2001) shows that a long run relationship exists between the relative size of the government and the economic development. It also shows that there is a uni-directional causal relationship between the relative size of the government and the economic development and that relationship goes from economic development to the relative size of the government.

The paper will be organized as follows. Section 2 presents the data used in the study. Methodology will be discussed in section 3, while the empirical results will be discussed in section 4. Finally, summary and conclusion will be presented in section 5.

DATA

Data used in the study were extracted from various sources. These include the Central Bank of Jordan, Jordan Department of Statistics, and the international financial statistics. The study covers the case of Jordan over the period of 1969-1999. This study uses the relative size of government expenditures (GSIZE)

and the real GDP (RGDP) to examine the causal relation between them. Note that LGSIZE and LRGDP are used as proxy for "ln GSIZE" and "ln RGDP", respectively.

METHODOLOGY

Vector Autoregression (VAR) for Short-run Equilibrium

Causal relationships are evaluated by a VAR framework, which treats all variables within the system as being endogenous. Essentially, this approach estimates a system of structural equations in an unrestricted reduced form. The system's responses to random shocks are traced by the decompositions of variance or error term and innovation accounting. At the same time, the dynamic interactions among the variables of the system are examined by analyzing the impulse response function. Such a nonstructural (or as some argue, semi-structural) model is particularly suited for investigating the causal chains within a system of equations. The model sheds light into the exogenity of a variable and reveals the dynamic response of one variable to random shocks in innovations of another variable in the system.

The VAR representation in the form:

$$x_t = A + \mathrm{B}(L)u_t = A + \sum_{s=0}^{\infty} B(s)u_{t-s} \tag{1}$$

where x_t is a linear combination of current and past one-step-ahead forecast errors or "innovations," A is a 2x1 vector of constants, *B(L)* an identity matrix with a lag operator and u_t a vector of unorthogonalized innovations that shows the unexpected changes in stock price or LGSIZE. Thus *B(s)* represents the dynamic response of each endogenous variable x_t to a shock after *s* periods, u_{t-s}.

Since this study is interested in the moving average (MA) representation with orthogonalized innovations, we chooses a matrix *G* such that $\mathrm{G}^{-1}\Sigma\mathrm{G}^{-1'} = I$. This gives a vector of orthogonalized innovations $v_t = G^{-1}u_t$ satisfying $E[v_t v_t'] = I$. The Choleski decomposition allows us to obtain a lower triangular *G* as a solution to $GG' = S$. Thus one has the following MA representation with orthogonalized innovations:

$$x_t = A + \sum_{s=0}^{\infty} B(s)Gv_{t-s} = A + \sum_{s=0}^{\infty} C(s)v_{t-s} \tag{2}$$

where v_t is a vector of orthogonalized innovations. Using equation (6), impulse responses are derived and confidence bands generated by Monte Carlo Integration. The coefficients of *c(s)* represent responses to shock in particular variables, such as LRGDP and LGSIZE. The variance of each element in *x* can be allocated to sources in elements of *v* because *v* is serially and contemporaneously uncorrelated.

VAR models are essentially for testing a short-run relation between LRGDP and LGSIZE. For the long run relationship between the two variables, we apply co-integration test.

Unit Roots and Co-integration Tests for Long-run Equilibrium

The two variables x_t and y_t are said to be cointegrated if (1) the two are nonstationary and integrated of the same order (that is, the same order of differencing is required to produce stationarity); (2) there exists a long-run equilibrium relationship; and (3) the error term is stationary. The application of the co-integration technique thus presupposes the nonstationarity of variables under consideration. Therefore, this study first tests for unit root in spot and forward premium rates for all countries under study before it tests for co-integration.

The unit root tests, developed by Fuller (1976), Dickey and Fuller (1979; 1981), Said and Dickey (1984), and later refined by Phillips and Perron(1988), examine whether a time series is stationary by taking into account the heteroscedasticity in the time-series data. If the unit root hypothesis is rejected, it means that a time series is stationary. If the unit root hypothesis is not rejected, the series is non-stationary. Testing for the presence of one unit root can be made by the following model (Fuller, 1976; Dickey & Fuller, 1979; 1981):

$$Y_t = \beta_2 y_{t-1} + e_t \qquad t = 1, 2, \ldots, T \qquad (3)$$

$$Y_t = \beta_0 + \beta_2 y_{t-1} + e_t \qquad t = 1, 2, \ldots, T \qquad (4)$$

$$Y_t = \beta_0 + \beta_1 t + \beta_2 y_{t-1} + e_t \qquad t = 1, 2, \ldots, T \qquad (5)$$

where Y_t is the variable being tested for unit roots, β_1 or β_2 are the regression coefficients, and e_t is the random error term which is normally distributed with a mean of zero and variance σ^2. The *t*-test statistic for the null hypothesis

$$H_0: \beta = 1 \text{ is } (\beta\text{-}1)/s(\beta)$$

where $s(\beta)$ is the standard error of the regression coefficient β. The Z_t statistics is modification of the Dickey-Fuller *t*-statistics suggested by Phillips & Perron, 1988 which allows for autocorrelation and conditional heteroscedasticity in the error term of the Dickey-Fuller regression. The $Z_{\tilde{\rho}}$ statistics, also suggested by Phillips & Perron (1988), is a similar modification of the test statistics $N(\beta-1)$, where N is the number of observations. Fuller (1976) tabulates the critical values of the sample distribution of the regression using the Monte Carlo experiments. Then, the critical values are compared with the calculated values to test the null hypothesis. If the null hypothesis fails to be rejected, this conclusion implies the presence of a unit root in the time series, rendering it nonstationary (random walk). If the null hypothesis of a unit root in government spending and real GDP is not rejected, this result implies that the consecutive changes in government spending and real GDP over the period are random. On the other hand, to examine the long-run relationship between government spending and real GDP the co-integration test will be applied.

The co-integration technique, pioneered by Granger (1983) and Engle and Granger(1987), offers an alternative in time-domain time series analysis. The co-integration analysis is a convenient tool to examine the presence of an equilibrium relationship between two sequences of random variables consistent with short-run dynamics. In this approach, the existence of a long-run relationship between two nonstationary processes is tested by examining the stability of deviations from the relationship. This process uses coefficients estimated by fitting static regressions.

It is frequently of interest to test whether the set of variables is cointegrated. This test may be desired because of the economic implications as to whether or not a system being tested is in equilibrium in the long-run. Testing for co-integration combines the problems of unit root tests and tests with parameters unidentified under the null hypothesis.

In a bivariate case, if two variables are integrated in the same order, they may be cointegrated, i.e., there may exist a long-run equilibrium relationship between them. This relationship is true if, and only if, there exists a stationary vector zt which is a linear combination of the two series x_t and y_t.

A variable z is said to be integrated of order $d[z\sim I(d)]$ if it has a stationary, invertable, non-deterministic autoregressive moving average (ARMA) representation after differencing d times. Two variables x and y, where both are $I(1)$ processes can be considered. Following Granger (1986), if there exists some constant a, such that

$$Z_t = x_t - ay_t$$

if $I(0)$, then x and y are said to be cointegrated of order zero, where a is the co-integration parameter.

Number of tests have been proposed in the literature to determine if x and y are cointegrated (a useful summary is given in Granger, 1986). The present study concentrates on two tests: the augmented Dickey-Fuller (ADF) and Phillips and Perron test of residuals from the cointegrating regression. The cointegrating regression for the present model has the following form:

$$x_t=\alpha+\beta y_t+\epsilon_t \tag{6}$$

Stock, 1984 has demonstrated that when x_t and y_t are cointegrated, *OLS* estimates of β are consistent and highly efficient.

Given *OLS* estimates of the residual series ϵ_t, tests of co-integration proceed by setting the null hypothesis that x_t and y_t are not cointegrated.

$$H_0: x_t , y_t \text{ not cointegrated}$$

The test of H_0 is enforced by constructing DF and ADF statistics. These tests are computed by first running the following regression (Granger & Engle, 1987 stated that the procedure can also be used to determine the order of integration of a raw data series, although the critical values differ):

$$\Delta\varepsilon_t = \alpha+\beta_0\varepsilon_{t-1}+\sum_{j=1}^{\rho}\beta_j\Delta\varepsilon_{t-1}+g_t \tag{7}$$

The test statistics are computed as the ratio of β_0 to its estimated standard error. The order of ρ is set to ensure that the estimated residual series, g_t, are white noise. If $\rho = 0$, the estimated t ratio is known as the DF statistics; for $\rho > 0$, the t ratio is known as the ADF statistics.

EMPIRICAL RESULTS

VAR Model Results: Granger Causality Test Results

Table 1 reports the causality test results between LGSIZE and real LRGDP. When the LGSIZE is the dependent variable, given LRGDP, all of the lags of

LGSIZE are important in explaining the movement of LGSIZE. On the other hand, given LGSIZE , the zero coefficients of all lags in LRGDP can be rejected, which implies that past values of LRGDP shock do matter in the movement of the LGSIZE in the presence of past lags of the LGSIZE. When the LRGDP is the dependent variable, given LGSIZE, all of the lags of LRGDP are important in explaining the movement of LRGDP. On the other hand, given LRGDP, the zero coefficients of all lags in LGSIZE cannot be rejected. This result implies that past values of the LGSIZE shock does not matter in the movement of LRGDP in the presence of past lags of LRGDP.

Table 1
F-statistics for tests in which all lags of designated variables have zero coefficients

Equation	Variable	
	$LGSIZE_{t-4}$	$LGDP_{t-4}$
LGSIZE	6.54[a]	3.34[b]
LGDP	1.54	7.54[a]

[a, b] indicate F statistics is significant at 1% and 5%, respectively.

The Granger test shows that the null hypothesis "LRGDP" does not Ganger cause LGSIZE is rejected. However, the reverse null hypothesis "LGSIZE" does not Granger cause "LRGDP" could not be rejected. Thus, the test shows clear uni-directional Granger causality flowing from the LRGDP variable to the LGZISE variable. This result is quite consistent with Wagner's Law in that economic progress as measured per capita real income Granger causes growth of the public sector as measured by the relative share of the public sector in the economy, but not the other way.

One can note that this kind of statistical causal relationship is misleading since *OLS* results are fairly robust in the VAR. To capture the refined causal relationships among variables, variance decomposition's (innovations) results will be introduced in the next section.

Variance Decomposition (Innovation) Results

In Table 2, LRGDP and LGSIZE seem Granger-causally prior in the sense that most of the 24-month forecast error variances are accounted for by the

innovations in the two-variable system. Table 2 indicates that LGSIZE appears to be explained by LRGDP. On the other hand, LRGDP does not appear to be explained by LGSIZE. When the LGSIZE is the dependent variable in the VAR system, 24.04% of the 24-month of forecast error of LGSIZE is explained by the innovations of LRGDP. Furthermore, when LRGDP is the dependent variable in the VAR system, 95.95% of the 24-month of forecast error of LRGDP is explained by the innovations of LRGDP. This indicates that LRGDP cause movement and explain the changes in LGSIZE.

Table 2
Percentage of 24-Month Forecast Error Variance Explained by Innovations in Each Variable Based on Two-Variable Innovation Accounting Using LLGSIZE and LGDP

	By Innovations in Variables	
Explained	LGSIZE	LGDP
	(%)	(%)
LGSIZE	75.94	24.04
LGDP	5.05	95.95

Time Path Between LGSIZE And LRGDP

The impulse response function, or moving average representation, is suggested as an alternative descriptive device of the VAR system because autoregressive systems are very difficult to define succinctly; there are complex patterns of cross-equation feedbacks and estimated lagged coefficients that tend to oscillate. The impulse response function may yield a reasonable economic interpretation. The impulse response function is computed by artificially imposing a one standard deviation shock to one variable and by measuring the response of each variable in the system.[1]

The pattern of dynamic responses of each of the two variables (LGZISE and LRGDP) to innovations in a particular variable using the simulated responses of the estimated VAR system is estimated. To facilitate the interpretation, the time paths of impulse responses of the two variables to a shock in one variable are plotted.[2]

In addition to the uni-directional causality between LGSIZE and LRGDP, the study finds a consistent positive response of LGSIZE to shocks in LRGDP and a weak consistent positive response of LRGDP to shocks in LGSIZE. Hence, LGSIZE is not a good indicator in predicting fluctuations in LRGDP in the case of

Jordan. But it may take a number of years before the effect of LGSIZE shocks are fully reflected in LRGDP as evidenced by the variance decomposition analysis.

The time path of the response between LRGDP and the unpredicted movement in LGSIZE can be tested due to the long memory of information contained in LRGDP and LGSIZE. To estimate the time path between LRGDP and LGSIZE, we use the VAR models for the two variables.

The response of the LRGDP to the unexpected movements (innovations or shocks) in the LGSIZE and the bands of plus or minus two standard errors are shown in Figure 1.[3] To derive the time path, the VAR models are applied over a forecast period of 24 months (two years). Figure 1 shows that an unexpected movement in the LGSIZE causes small changes in the LRGDP over time. This is shown in the impulse response function. As we can see from the graphs in Figure 1, the initial short run response of there is a low positive response in LRGDP towards a positive shock in LGSIZE at one standard deviation. Also, in the short-run, there is a low positive response in LGSIZE towards a positive shock in LRGDP at one standard deviation

From Figure 1 we conclude that after a transitory period of a positive shock to LRGDP, the impulse function in the Jordanian economy would later become a large positive and permanent in the long run. This positive long run effect of LRGDP on LGSIZE, support the uni-directional causality between the two variables in the short-run as well as in the long-run.

Unit Root and Co-integration Results

Table 3 reports the unit root results using both the ADF and PP tests. The ADF and PP test reveals that the null hypothesis of unit root is accepted for GSIZE and RGDP variables because the calculated values are less than the corresponding McKinnon (1991) critical values for the levels of the variables. For the first difference of the variables, the calculated values exceed the critical values, thus rejecting the null of unit roots for the first differenced series.

Table 3 also indicates that the null hypothesis cannot be rejected; the levels of GSIZE and RGDP contain stochastic trends. Thus, it is entirely possible that the inference using the *t*-distribution, which indicates that the RGDP have significant forecasting ability for GSIZE, could be highly misleading. The findings that unit roots in GSIZE and RGDP cannot be rejected indicate that the usual methodology of regressing the level of GSIZE on the RGDP is not able to provide evidence that the RGDP has any ability to forecast future GSIZE. Thus, this paper looks at

another methodology, such as co-integration, to examine the relationship between RGDP and GSIZE.

Table 3.
Unit Root tests for LGSIZE and GDP

Variable	ADF	PP	Accept/Reject H_0
LGSIZE	-2.15	-1.60	Accept
RGDP	-0.57	-0.33	Accept

Given that the GSIZE and RGDP are all *I*(1) processes, one can then proceed to test for co-integration. The present study concentrates on two tests: ADF and PP tests of residuals from the co-integration regression. The ADF and PP tests on the residual from the long-run equation are presented in Table 4.[4] The results from both tests suggest that the residual series is stationary. This is because the null of unit root is rejected at the 1% Mckinnon critical value. Based on this result, it is concluded that the LGSIZE and LRGDP variables are co-integrated.

The conclusion from Table 3 is that the hypothesis of no co-integration between LGSIZE and LRGDP could be rejected in the case of Jordan on the basis of the Augmented Dickey-Fuller test results. These results mean LGSIZE and LRGDP have ability to predict each other.

SUMMARY AND CONCLUSION

This paper investigates the applicability of Wagner's Law in the Jordanian economy. Using co-integration technique and the VAR model, the study suggests that there is a uni-directional relationship between the economic growth and the growth in the government expenditures. Thus, the findings of this study support the hypothesis of the Wagner's Law which states that the growth in the economy causes the growth in the government expenditures.

The results of the VAR model shows that, in the short run, economic growth explains the movements in the government expenditures. Furthermore, the findings of the time path analysis conclude that after a transitory period of a positive shock to real GDP, the impulse function in the Jordanian economy would later become a large positive and permanent in the long run. This positive long run effect of real GDP on the government expenditures support the uni-directional causality between the two variables in the short-run as well as in the long run.

The unit root results indicate that the government expenditures and economic growth are non-stationary in their levels but stationary in the first difference. On the other hand, findings of the co-integration analysis show that government expenditures and economic growth are co-integrated. Thus, these results support the Wagner's hypothesis as a long-run equilibrium.

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ENDNOTES

[1] Given the VAR system, the typical random shocks are the positive residual of a one standard deviation unit in each equation. For example, the residual in the LRGDP is referred to as the LRGDP innovation in the sense that it cannot be predicted from past values of variables in the system.

[2] Due to space limitations, impulse responses of the two variables (LGSIZE and LRGDP) can be requested from the authors.

[3] Figure 1 is available from the Authors upon request.

[4] Table 4 is available from the Authors upon request.

THE MONETARY APPROACH TO BALANCE OF PAYMENTS: A REVIEW OF THE SEMINAL SHORT-RUN EMPIRICAL RESEARCH

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ABSTRACT

This paper provides a review of the seminal short-run empirical research on the monetary approach to the balance of payments with a comprehensive reference guide to the literature. The paper reviews the three major alternative theories of balance of payments adjustments. These theories are the elasticities and absorption approaches (associated with Keynesian theory), and the monetary approach. In the elasticities and absorption approaches the focus of attention is on the trade balance with unemployed resources. In the monetary approach, on the other hand, the focus of attention is on the balance of payments (or the money account) with full employment. The monetary approach emphasizes the role of the demand for and supply of money in the economy. The paper focuses on the monetary approach to balance of payments and reviews the seminal short-run empirical work on the monetary approach to balance of payments. Throughout, the paper provides a comprehensive set of references corresponding to each point discussed. Together, these references exhaust the existing short-run research on the monetary approach to balance of payments.

INTRODUCTION

This paper provides a review of the seminal short-run empirical research on the monetary approach to the balance of payments with a comprehensive reference guide to the literature. The paper reviews the three major alternative theories of balance of payments adjustments. These theories are the elasticities and absorption approaches (associated with Keynesian theory), and the monetary approach. In the elasticities and absorption approaches the focus of attention is on the trade balance with unemployed resources. The elasticities approach emphasizes the role of the relative prices (or exchange rate) in balance of payments adjustments by considering

imports and exports as being dependent on relative prices (through the exchange rate). The absorption approach emphasizes the role of income (or expenditure) in balance of payments adjustments by considering the change in expenditure relative to income resulting from a change in exports and/or imports. In the monetary approach, on the other hand, the focus of attention is on the balance of payments (or the money account) with full employment. The monetary approach emphasizes the role of the demand for and supply of money in the economy. The paper focuses on the monetary approach to balance of payments and reviews the seminal short-run empirical work on the monetary approach to balance of payments. Due to space limitation the seminal long-run empirical work on the monetary approach to balance of payments is reviewed in another paper. Throughout, the paper provides a comprehensive set of references corresponding to each point discussed. Together, these references exhaust the existing short-run research on the monetary approach to balance of payments.

This study is organized in the following way: First, it reviews three alternative theories of balance of payments adjustments. They are the elasticities and absorption approaches (associated with Keynesian theory), and the monetary approach. Then, the seminal short-run empirical work on the monetary approach is reviewed. It notes that the literature may be divided into two classes, long run (associated with Johnson) and short run (associated with Prais). Then, the review focuses on the seminal short-run literature. The theoretical model is described first, and then the estimated results are reported. At the end of the discussion, some comments on the short-run approach are made.

DIFFERENT APPROACHES TO THE BALANCE OF PAYMENT ANALYSIS

Three alternative theories of balance of payments adjustment are reviewed in this section. They are commonly known as the elasticities, absorption, and monetary approaches. Johnson (1958, 1972, 1973, 1976, 1977a, 1977b, 1977c) and Whitman (1975) have discussed these other approaches to balance of payments.

The elasticities approach applies the Marshallian analysis of elasticities of supply and demand for individual commodities to the analysis of exports and imports as a whole. It is spelled out by Joan Robinson (1950).

Robinson was mainly concerned with the conditions under which devaluation of a currency would lead to an improvement in the balance of trade. Suppose the trade balance equation is written as:

X = value of exports
IM = value of imports
BT = balance of trade
BT = X - IM (1)

In this context, it is generally assumed that exports depend on the price of exports, and imports depend on the price of imports. These relations are then translated into elasticities, by differentiating the above equation with respect to the exchange rate. In effect, the exchange rate clears balance of payments. A criterion for a change of the balance of trade in the desired direction can be established, assuming that export and import prices adjust to equate the demand for and supply of exports and imports.

The effect of a devaluation on the trade balance depends on four elasticities: the foreign elasticity of demand for exports, and the home elasticity of supply, the foreign elasticity of supply of imports, and the home elasticity of demand for imports (Robinson, 1950, 87). For the special case where it is assumed that the trade balance is initially zero and that the two supply schedules are infinitely elastic, the elasticities condition for the impact of a devaluation to be an improvement in the trade balance, is that the sum of the demand elasticities exceed unity. This has been termed the "Marshall-Lerner condition."

This special case and the assumptions behind it should be viewed against the background of the time they were developed, the great depression of the 1930s. The theory adopted Keynesian assumptions of wage and price rigidity and mass unemployment and used these to extend the Keynesian analysis to the international sphere. Robinson (1950) mentions that her "main endeavor is to elaborate the hints thrown out by Mr. Keynes in his Treaties on Money, Chapter 21." p. 83.

Under Keynesian assumptions of sticky wages and prices, devaluation changes the prices of domestic goods relative to foreign goods, i.e., a change in the terms of trade, in foreign and domestic markets, and causes alterations in production and consumption (Johnson, 1972). This in turn has an impact on the balance of trade.

It is important to note the following two characteristics of the special case of elasticities approach: (i) Any impact of the devaluation on the demand for domestic output is assumed to be met by variations in output and employment rather than relative prices, with the repercussions of variations in output on the balance of payments regarded as secondary. This is made possible by the assumption that supply elasticities are infinite. The assumption of output and employment being variable proved highly unsatisfactory in the immediate postwar period of full and

over-full employment. (ii) The connections between the balance of payments and the money supply, and between the money supply and the aggregate demand, are ignored. This is made possible by the assumed existence of unemployed resources, as well as by the Keynesian skepticism regarding the influence of money. Johnson (1972) emphasizes that the monetary approach differs crucially from the elasticities approach on both these grounds.

A notable shortcoming of the elasticities analysis is its neglect of capital flows. Even though the adherents of the elasticities approach were attempting to guide the policy-maker in improving the country's balance of payments, their focus, nevertheless, was on the balance of trade (net exports of goods and services). For the special case mentioned above, this is traceable to the emphasis in Keynesian analysis (see Whitman, 1975, 492) given to aggregate demand (of which net exports are a component).

Before we close this section, one important point has to be mentioned. In the literature, the elasticities approach is often mistakenly referred to as being a partial equilibrium analysis. This type of argument is based on the fact that in the special case elasticities of supplies of export and imports are assumed to be infinite, the effect of changes in the quantity of goods and services exported and imported are independent of, or are not sensitive to, the happenings elsewhere in the economy; e.g., the change in income which results from the change in exports does not have an effect on imports. The important point to note is that, whereas the special case of infinitely elastic supplies of exports is a partial equilibrium analysis, the general case is not. In general, the elasticities approach considers the usual demand and supplies for imports and exports where they are obtained on the basis of the production possibilities curve of domestic economies, like any usual general equilibrium analysis, everything depends on the happenings elsewhere in the economy, i.e., general equilibrium analysis. The absorption approach was first presented by Alexander (1952). He sought to look at the balance of trade from the point of view of national income accounting:

Y = domestic production of goods and services
E = domestic absorption of goods and services, or domestic total expenditure
BT = balance of trade

$$BT = Y - E \qquad (2)$$

The above identity is useful in pointing out that an improvement in the balance of trade calls for an increase in production relative to absorption.

When unemployed resources exist, the following mechanism is visualized: the effect of a devaluation is to increase exports and decrease imports. This in turn causes an increase in production (income) through the multiplier mechanism. If total expenditure rises by a smaller amount, there will be an improvement in the balance of trade (Alexander, 1952, 262-263). Thus, the balance is set to be identical with the real hoarding of the economy, which is the difference between total production and total absorption of goods and services, and therefore equal to the accumulation of securities and/or money balances. In the absorption approach, in effect, income or expenditure clears balance of payments. The monetary approach concentrates on the accumulation of money balances only. In the presence of unemployment, therefore, devaluation not only aids the balance of payments, but also helps the economy move towards full employment and is, therefore, doubly attractive (Alexander, 1952, 262-263).

Suppose, however, that the country is at full employment to begin with. It cannot hope to improve its trade balance by increasing real income. Here, it has to depend on its ability to reduce absorption. How can a devaluation achieve this? Alexander argued that the rise in the price level consequent upon the devaluation would tend to discourage consumption and investment expenditures out of a given level of income. One way this will happen is through the "real balance effect" - a reference to the public's curtailment of expenditure in order to rebuild their stock of real cash balances that was diminished by the increase in the price level. The real-balance effect plays an important role in the monetary approach as well.

However, under conditions of full employment, a devaluation cannot be expected to produce, by itself, the desired extent of change in the overall balance. The reduction in the public's expenditure in order to build their money balances will have to be supplemented by domestic deflationary policies, the so-called "expenditure-switching" and "expenditure-reducing" policies (Johnson, 1958). This, of course, is because the balance of trade cannot be improved through a rise in the output level.

The absorption approach can be said to work only in the presence of unemployed resources. The absorption approach is a significant improvement over the special case of the elasticities approach in one important sense, this is its view of the external balance via national income accounting. In this manner, the approach relates the balance to the happenings elsewhere in the economy rather than taking the partial equilibrium view of the special case of the elasticities approach in analyzing the external sector in isolation.

The "monetary approach" is so called because it considers disequilibrium in the balance of payments to be essentially, though not exclusively, a monetary phenomenon. To say that something is essentially a monetary phenomenon means that money plays a vital role, but does not imply that only money plays a role. The monetary approach takes explicit account of the influence of real variables such as levels of income and interest rates on the behavior of the balance of payments. Kreinin and Officer (1978), Magee (1976), and Whitman (1975) have reviewed the literature on the monetary approach to balance of payments. The term "monetary approach" was first used by Mundell (1968) to refer to the new theory (Mussa, 1976).

The elasticities and absorption approaches are concerned with the balance of trade while the monetary approach concerns itself with the deficit on monetary account. In principle, this balance consists of the items that affect the domestic monetary base.

In general, the approach assumes full employment and emphasizes the budget constraint imposed on the country's international spending. It views the current and capital accounts of the balance of payments as the "windows" to the outside world, through which an excess of domestic stock demand for money over domestic stock supply of money, or of excess domestic stock supply of money over domestic stock demand for money, are cleared (Frenkel & Johnson, 1976). Accordingly, surpluses in the trade account and the capital account, respectively, represent excess flow supplies of goods and of securities, and as excess domestic demand for money. Consequently, in analyzing the money account, or more familiarly, the rate of increase or decrease in the country's international reserves, the monetary approach focuses on the determinants of the excess stock demand for, or supply of, money. Dornbusch (1971, 1973a, 1973b) discusses the role of the real-balance effect.

This theory divides the country's monetary base into foreign assets and domestic assets of the monetary authorities. An increase in foreign assets of the central bank is achieved when the central bank purchases foreign exchange or gold. Under pegged exchange rates, the central bank buys foreign exchange in order to prevent the national currency from appreciating in the foreign exchange market. The central bank's purchase of foreign assets increases its domestic monetary liabilities by the same amount.

An increase in domestic assets of the central bank is achieved when the central bank purchases bonds from the fiscal branch of the government (the treasury), or from the public. The central bank's purchases of domestic assets (e.g.,

bonds) increases its domestic monetary liabilities, i.e., the monetary base, by the same amount. The excess supply of money has to be matched by an equivalent excess demand for goods and/or securities. This is because the budget constraint deems that the public's flow demand for goods, securities, and money - assuming that these three encompass all that the public demands - should add up to the public's total income. Therefore, with an unchanged level of income, an excess supply of money has to be matched by an equivalent excess demand for goods and/or securities. Viewing the economy as a whole, what does the excess demand for goods and securities imply? In a closed economy, an excess demand for goods would lead to an increase in the domestic price level and a consequent fall in the real money balances the public holds. An excess demand for securities would increase their price (decrease the interest rate), increasing desired money balances. Price and interest rate changes eventually cause the existing nominal money supply to be willingly held by the public. However, in a small open economy with fixed exchange rates, the domestic price level has to maintain at parity with the price level in the rest of the world, and the domestic price of securities (and therefore the interest rate) is determined by the price of securities (and therefore the interest rate) in the world as a whole. So, in the absence of sales of domestic assets by the central bank, the desired level or real money balances is achieved by importing goods and/or securities from abroad. This creates a deficit in the money account, resulting in a fall in foreign assets of the central bank and, therefore, in the money supply.

The monetary approach is seen to have an appreciation of the inter-related nature of the various markets. The monetary approach insists that "when one market is eliminated from a general equilibrium model by Walras' law, the behavioral specifications for the included markets must not be such as to imply a specification for the excluded market that would appear unreasonable if it were made explicit." (Whitman, 1975, 497). The monetary approach focuses on stock and flow equilibrium, with emphasis on stock equilibrium for money. In this way it considers inter-relationships among various markets and, therefore, the inter-relationship between stock and flow equilibrium. The stock-flow consideration of the monetary approach is in fact the essential difference between the monetary approach and the elesticities and absorption approaches, where the latter two consider the flow equilibrium only.

The monetary approach, like the absorption approach, stresses the need for reducing domestic expenditure relative to income, in order to eliminate a deficit in the balance of payments. However, whereas the absorption approach looks at the relationship between real output and expenditure on goods, the monetary approach

concentrates on deficient or excess nominal demand for goods and securities, and the resulting accumulation or decumulation of money.

The monetary approach looks at the balance of payments as the change in the monetary base less the change in the domestic component:

H = change in the quantity of money demanded
D = domestic credit creation
$BP = DH - DD$ (3)

where the "italic D," i.e., *D*, appearing in front of a variable designates the "change" in that variable. That is, *D* is the first difference operator: $DX = X_{(t)} - X_{(t-1)}$.

Putting just monetary assets rather than all assets "below the line" contributes to the simplicity of the monetary approach. Other things being equal, growth in demand for money, and of factors that affect it positively should lead to a surplus in the balance of payments. Growth in domestic money, other things being equal, should worsen it. Thus, the growth of real output in a country with constant interest rates causes its residents to demand a growing stock of real and nominal cash balances. This means that the country will run a surplus in the balance of payments (Johnson, 1976, 283). In order to avoid a payments surplus, the increase in money must be satisfied through domestic open market operations. To produce a deficit, domestic money stock must grow faster than the growth of real income.

This analysis suggests that if a country is running a deficit, then assuming that the economy is growing at its full-employment growth rate with a given rate of technological progress, it should curtail its rate of domestic monetary expansion. Use of other measures like the imposition of tariffs, devaluation or deflation of aggregate demand by fiscal policy can succeed only in the short run (Johnson, 1976, 283).

The decision on which variables are exogenous and which are endogenous is made in the following manner: real income is assumed exogenous in the long run. Also, in the long run, prices and interest rates are exogenous for small countries. Thus, the quantity of money demanded is exogenous (Magee, 1976, 164). The monetary approach assumes that the domestic assets component of the monetary base is unaffected by balance of payments flows. This (the domestic assets) is the variable which the monetary authorities control, and, thereby, indirectly control the balance of payments.

Under fixed exchange rates, a small country controls neither its price level nor quantity of domestic money in anything but the short run. Its money supply is endogenous, and what it controls by open market operations is simply the

international component of the monetary base. In a system of flexible exchange rates, the focus of analysis shifts from determination of the balance of payments to the determination of the exchange rate (Frenkel & Johnson, 1976, 29).

REVIEW OF THE SEMINAL SHORT-RUN EMPIRICAL RESEARCH

Empirical work on the monetary approach to the balance of payments can be divided into two different approaches; one tests the theory in long-run equilibrium, the other considers the adjustment mechanism and the channels through which equilibrium is reached. The first approach is based on the reserve flow equation developed by H. G. Johnson (1972). Testing was undertaken by J.R. Zecher (1974) and others. For a comprehensive list of references which have estimated either the "reserve flow equation" or the "exchange market pressure equation" see appendix 1. For a comprehensive list of references which have estimated the "capital flow equation," which is a variant of the "reserve flow equation," see appendix 2. The second approach is based on theoretical work of S.J. Prais (1961), with corresponding empirical work undertaken by R.R. Rhomberg (1977) and others. For a comprehensive list of references which have estimated a short-run model in the tradition of the monetary approach to balance of payments see appendix 3. In this paper, seminal long-run approach is reviewed by representing the underlying theoretical model first, and then looking at a few well-known empirical estimations of the model.

This section reviews short-run models of the balance of payments. First, the typical theoretical formulation of the adjustment process elaborated by S.J. Prais (1961) is presented. Second, four well-known empirical studies that are based on Prais' (1961) formulation are reviewed. These four consist of one by Rudolph R. Rhomberg (1977), two by Mohsin S. Khan (1977, 1976), and the last one by Charles Schotta (1966). Finally, some points which are overlooked in these short-run models and tests are discussed.

S.J. Prais (1961) formulated the model in terms of continuous time, which allows precise specification of the relation between stock and flow variables. Prais (1961) specifies a domestic expenditure function which emphasizes the role of deviations of actual from desired money holdings as the link between the real and monetary sectors of the economy. This particular specification has come to be widely used in the recent literature (Dornbush, 1973a, 1973b, 1975).

The model, which is in differential equation form, may be set out with a system of six equations given by equations (4) through (9):

$$LD = k.Y \quad (4)$$
$$dL/dt = X - IM \quad (5)$$
$$E = Y + a.(L - LD) \quad (6)$$
$$IM = b.Y \quad \text{or} \quad IM = b.E \quad (7)$$
$$X = X(t) \quad (8)$$
$$Y = E + X - IM \quad (9)$$

In these equations LD is the desired level of liquidity as distinguished from the actual liquidity, L. The first equation is the familiar Cambridge equation relating a desired level of liquidity, LD, to the level of income. The second equation relates the change in actual liquidity to the balance of payments, which is represented in differential form. An additive term to represent any given rate of credit creation can be introduced on the right-hand side of (5) without altering the basic mathematics. Equation (6) indicates that domestic expenditure, E, equals income plus the excess of actual over desired liquidity. Imports, equation (7), are taken as a constant fraction of income. As an alternative, imports may be taken as a fraction of expenditure, E, so as to be proportionately influenced by the liquidity situation. However, this and other variations lead to rather similar results, apart from changes in the constants. Exports are assumed exogenous and given by equation (8). Finally, national income, in equation (9), is defined as domestic expenditure plus exports less imports.

In this system, a disequilibrium - for example a deficit in the balance of payments - is corrected by a fall in the money supply via (5), followed by a fall in domestic expenditure via (6), a fall in income via (9), and a fall in imports via (7). The reduction continues until the deficit in (5) is eliminated.

Rudolf R. Rhomberg (1977) also focuses attention on the relation between money and expenditure and estimates the entire structure of the model by multiple regression technique. The basic equations of his model are given by equations (10) through (15):

$$LD(t) = k.Y(t) \quad (10)$$
$$E(t) = a_0 + a_1.Y(t) + a_2.Y(t-1) + a_3.\{[L(t-1)+L(t-2)]/2 - k.Y(t)\} \quad (11)$$
$$IM(t) = b_0 + b_1.E(t) \quad (12)$$
$$G(t) = g_0 + g_1.Y(t) \quad (13)$$
$$Y(t) = E(t) + G(t) + X(t) - IM(t) \quad (14)$$
$$L(t) = L(t-1) + X(t) + DK(t) - IM(t) + DD(t) \quad (15)$$

where *D*K is the net capital inflow, and D is the domestic component of the monetary base. The long-run desired demand for money, LD, is expressed by equation (10). Private expenditure is linearly dependent on current and last year's income, and on the excess of actual over desired cash balances. Since the stock of money, L(t), is measured at a moment of time (at the end of year t), while Y(t) is the flow of income during year t, Rhomberg (1977) expresses cash balances during year t as {[L(t) + L(t-1)]/2} and the deviation of actual from desired cash balances as {[L(t) + L(t-1)]/2 - [k.Y(t)]}. His private expenditure function is thus given by equation (11) because he assumes there is a one year lag in expenditure with respect to a change in the excess of desired over actual cash balances. Additionally, Rhomberg's (1977) model contains an import function specified by equation (12). Imports are assumed to depend on expenditures. In equation (13), Rhomberg (1977) argues that government expenditures on goods and services, G, are related to income, while, recognizing the fact that they (G) depend to a considerable extent on tax revenue, which is itself a function of income. The model is completed by the two identities defining income and the money supply.

The estimated behavioral equations (11), (12), (13) and their reduced forms for five countries of Norway, Costa Rica, Ecuador, Japan, and the Netherlands and for the period 1949-60 are given in Tables 1-A, 1-B, and 1-C.

Results show that for Norway and Japan, a change in the money supply appears to affect expenditure appreciably. The statistical significance of the coefficient of the money variable, however, is at a lower level than that of the other coefficients of the model.

Although the high values of coefficients of determination suggest a strong relationship, the results are not dependable because estimation is done in levels of the variables (Granger & Newbold, 1974). Since time series analysis is used, where variables like income, expenditure, and imports are highly auto-correlated, regression analysis in levels may have generated spurious correlation. In this respect, the knowledge of D-W statistic is of some help in the inference from the results obtained, but the author has not published the D-W statistic and interpretations of the coefficients should be treated with caution.

Like Prais (1961), Mohsin S. Khan (1977) expresses the model in continuous time. This allows him to estimate the time pattern of adjustment to the final equilibrium values via a system of linear differential equations. Khan (1977) specifies six equations containing three behavioral relationships - for imports, exports, and aggregate expenditure - and three identities - for nominal income, the balance of payments, and the money supply.

Table 1-A: Rhomberg's Model: Expenditure Function				
	Y(t)	Y(t-1)	[L(t-1) + L(t-2)]2	R-squared
Norway	0.53	0.13	0.90	0.99
	(0.10)	(0.11)	(0.47)	
Costa Rica	-	0.42	2.80	0.99
		(0.24)	(1.40)	
Ecuador	0.07	0.20	5.00	0.99
	(0.54)	(0.25)	(3.80)	
Japan	0.96	-0.20	0.12	0.99
	(0.14)	(0.17)	(0.53)	
Netherlands	0.54	-0.22	2.70	0.99
	(0.40)	(0.29)	(1.00)	
The numbers in parenthesis indicate standard errors.				

Table 1-B: Rhomberg's Model: Import Function and Government Expenditures					
	Import Function		Government Expenditures		
	E(t)	E(t) + G(t)	R-Squared	Y(t)	R-Squared
Norway	0.59	-	0.98	0.21	0.96
	(0.02)			(0.01)	
Costa Rica	-	0.23	0.93	0.20	0.89
		(0.02)		(0.02)	
Ecuador	0.25	-	0.97	0.18	0.96
	(0.01)			(0.01)	
Japan	0.16	-	0.93	0.19	0.95
	(0.01)			(0.01)	
Netherlands	0.69	-	0.99	0.20	0.92
	(0.02)			(0.02)	
The numbers in parenthesis indicate standard errors.					

Table 1-C: Rhomberg's Model: The Reduced Forms for Income and Imports				
		Y(t-1)	X(t)	[L(t-1) + L(t-2)]/2
Income (Y)				
	Norway	0.09	1.76	0.66
	Costa Rica	0.38	1.18	2.47
	Ecuador	0.23	2.03	2.42
	Japan	0.20	3.86	1.50
	Netherlands	-0.28	1.81	2.38
Imports (IM)				
	Norway	0.10	0.54	0.73
	Costa Rica	0.12	0.06	0.76
	Ecuador	0.07	0.13	1.43
	Japan	-0.03	0.59	0.24
	Netherlands	-0.06	0.59	2.54

Imports

Khan (1977) relates imports to aggregate domestic expenditure. In order to take account of quantitative restrictions and controls on imports, he also introduces the level of net foreign assets, R, of the country. His assumption behind the use of such a variable is the implied existence of a government policy reaction function in which controls are inversely related to reserves. The authorities are assumed to ease or tighten restrictions on imports as their international reserves increase or decrease. The import demand function is thus specified as:

$$IM^d(t) = a_0 + a_1.R(t) + a_2.E(t) + u_1(t) \qquad a_1>0,\ a_2>0 \qquad (16)$$

where IM^d is demand for nominal imports, and u_1 is a random error term with "white noise" properties. Actual imports in period t are assumed to adjust to the excess demand for imports:

$$D[IM(t)] = A.[IM^d(t) - IM^s(t)] \qquad A>0 \qquad (17)$$

where D(x) is the time derivative of x, i.e., D(x) = dx/dt. A further assumption is that import supply is equal to actual imports:

$$IM(t) = IM^{s}(t) \tag{18}$$

Substituting (16) into (17), the estimating equation becomes:

$$D[IM(t)] = A.a_0 + A.a_1.R(t) + A.a_2.E(t) - A.IM(t) + A.u_1(t) \tag{19}$$

Exports

Small countries are generally price takers in the world market and can sell whatever they produce. The volume of exports is therefore determined by domestic supply conditions. An increase in the capacity to produce in the export sector should lead to an increase in exports. Capacity to produce in the export sector is related directly to the capacity to produce in the entire economy. Khan (1977) considers permanent income to be a suitable indicator of capacity to produce, and specifies exports as a positive function of the permanent domestic income:

$$X(t) = b_0 + b_1.Y_P(t) + u_2(t) \qquad b_1>0 \tag{20}$$

where X is the nominal value of exports, and Y_P is the permanent nominal income in time period t; u_2 is a random error term. Permanent income is generated in the following way:

$$D[Y_P(t)] = B.[Y_P(t) - Y(t)] \qquad B<0 \tag{21}$$

Permanent income in time period t adjusts to the difference between permanent income and actual income, Y, in period t. Equation (21) is re-written as:

$$Y_P(t) = [- B/(D-B)].Y(t) \tag{22}$$

Substituting (22) into (20):

$$X(t) = b_0 + [(- B.b_1)/(D-B)].Y(t) + u_2(t) \tag{23}$$

and solving for D[X(t)], equation (24) is obtained:

$$D[X(t)] = b_0.(D-B) - B.b_1.Y(t) + B.X(t) + u_3(t) \quad (24)$$

where $u_2(t) = (D-B).u_3(t)$. Relation (24) is Khan's export estimating equation.

Aggregate Expenditure

Khan's (1977) equation for desired expenditure is specified as follows:

$$ED(t) = c_0 + c_1.M^s(t) + c_2.Y(t) + u_4(t) \qquad c_1>0,\ c_2>0 \quad (25)$$

where ED is desired aggregate nominal expenditure, and Y is nominal income, and u_4 is a random error term. The stock of money, M^s, is included because, given the stock of money that the public desires to hold, an increase in the money supply raises actual money balances above the desired level. This increases the demand for goods and services as the public attempts to reduce its excess cash balances. Moreover, the actual value of expenditure is assumed to adjust to the difference between desired expenditure and actual expenditure:

$$D[E(t)] = C.[ED(t) - E(t)] \qquad C>0 \quad (26)$$

By substituting (25) into (26), the differential equation in D[E(t)] is obtained:

$$D[E(t)] = C.c_0 + C.c_1.M^s(t) + C.c_2.Y(t) - C.E(t) + C.u_4(t) \quad (27)$$

this is the equation that is estimated.

Nominal Income

The ex-post nominal income identity is:

$$Y(t) = E(t) + X(t) - IM(t) \quad (28)$$

The Balance of Payments (BP)

It is specified as:

$$BP(t) = D[R(t)] = X(t) - IM(t) + SK(t) \quad (29)$$

where SK represents the non-trade variable that contains services, short-term and long-term capital flows, and all types of foreign aid receipts or repayments. For the purposes of the model, this item (SK) is assumed to be determined outside the system.

The Supply of Money

It equals the international, R, and domestic, D, assets held by the central bank:

$$M^s(t) = R(t) + D(t) \qquad (30)$$

Khan (1977) estimates the monetary model for ten developing countries for the period 1952-70. Results are reported in Tables 2-A, 2-B, and 2-C. Certain common results emerge from the estimates. Despite some obvious dissimilarities between countries, most of the estimated coefficients in this study appear to be of the same order of magnitude. In the import equations, the coefficients for net foreign assets range from approximately 0.3 to 0.9 and the coefficients of aggregate expenditure from 0.02 to 0.10, with most of the figures at the lower end. The lag in adjustment of imports to a desired level varies from 1.340 to 6.098 years. The current income coefficients in the export equation lie between 0.02 and 0.1 and the expenditure coefficients between 0.1 and 0.7, with most between 0.3 and 0.5. With the exception of the results for one of the countries, the stock of money has a proportionally greater effect on nominal expenditure, with the estimated coefficients ranging from 1.4 to 2.2. Differences among countries as to the estimated income coefficient in the nominal expenditure equation are much greater. The lag in the adjustment of expenditure to a desired level is generally similar among countries, varying from four to six quarters; with the exception of one country, where the lag varies from one to two years.

Simulations show that Khan's (1977) first model is able to explain the behavior of the balance of payments and income in a satisfactory manner for a wide variety of countries.

The second model developed by Khan (1976), which is applied to Venezuela, is also concerned with the short-run implications of the monetary approach. The results are very encouraging for the monetary approach, as the model is able to explain a great deal of the quarterly fluctuations in the balance of payments for Venezuela during the period 1968-73.

The model is concerned with the short-run implications of the monetary approach. In this framework, an excess supply of real money balances leads to an excess demand for goods and financial assets, which in turn changes domestic prices and interest rates; this leads to disequilibrium in the foreign exchange market and the balance of payments. The model decomposes the balance of payments into the trade and capital accounts, which permits a simultaneous study of the behavior of the individual accounts rather than simply the trade account or the overall balance of payments.

Table 2-A: Khan's First Model: Import Function

	Constant	B(t)	E(t)	IM(t)
Argentina	0.105	0.419	0.018	-0.194
		(3.34)	(4.16)	(2.47)
Columbia	0.370	0.962	0.035	-0.355
		(4.19)	(2.34)	(2.17)
Dominican Republic	0.019	0.607	0.093	-0.623
		(4.36)	(6.58)	(7.04)
India	3.077	-0.327	0.045	-0.746
		(0.90)	(3.70)	(4.12)
Mexico	0.003	0.841	0.013	-0.368
		(5.94)	(3.30)	(5.15)
Pakistan	0.300	0.798	0.015	-0.269
		(4.88)	(2.18)	(3.42)
Peru	0.353	0.980	0.037	-0.164
		(7.32)	(2.86)	(1.76)
Philippines	-1.136	0.789	0.107	-0.536
		(2.44)	(5.45)	(4.35)
Thailand	0.001	0.263	0.069	-0.419
		(4.07)	(3.02)	(3.53)
Turkey	0.001	0.259	0.019	-0.296
		(2.04)	(2.37)	(3.23)

The numbers in parenthesis are t-statistics

The model contains seven stochastic equations determining the following variables: real imports, real expenditures, the rate of inflation, the currency to deposit ratio, the domestic rate of interest, short-term capital flows, and the excess reserves to deposits ratio of the commercial banks. There are also four identities defining real income, the change in international reserves, the stock of money, and the stock of high-powered money. Each of these equations is discussed below.

Table 2-B: Khan's First Model: Export Function

	Constant	Y(t)	X(t)
Argentina	0.147	0.087	-0.569
		(4.77)	(3.92)
Columbia	0.202	0.061	-0.310
		(2.05)	(1.32)
Dominican Republic	0.069	0.054	-0.385
		(2.03)	(3.22)
India	0.068	0.028	-0.258
		(5.64)	(3.52)
Mexico	0.003	0.019	-0.270
		(2.73)	(2.64)
Pakistan	0.483	0.035	-0.418
		(6.51)	(5.60)
Peru	0.198	0.136	-0.333
		(4.16)	(3.06)
Philippines	0.775	0.209	-0.712
		(5.81)	(4.82)
Thailand	0.001	0.029	-0.126
		(0.87)	(0.82)
Turkey	0.001	0.043	-0.370
		(5.15)	(4.31)

The numbers in parenthesis are t-statistics.

Table 2-C: Khan's First Model: Expenditure Function				
	Constant	$M^s(t)$	Y(t)	E(t)
Argentina	0.305	1.697	0.031	-0.842
		(41.18)	(0.36)	(29.33)
Columbia	0.177	1.387	0.816	-0.748
		(6.34)	(3.18)	(7.13)
Dominican Republic	0.054	1.232	1.364	-0.764
		(5.21)	(2.72)	(8.87)
India	3.262	1.915	0.292	-0.991
		(17.53)	(2.43)	(21.17)
Mexico	0.001	2.025	0.072	-0.983
		(9.46)	(0.27)	(10.14)
Pakistan	1.397	0.897	0.698	-0.519
		(3.02)	(2.42)	(4.01)
Peru	1.182	1.505	1.993	-0.927
		(3.19)	(7.10)	(3.64)
Philippines	0.021	1.492	0.328	-0.742
		(10.67)	(1.57)	(9.48)
Thailand	0.004	1.359	0.269	-0.629
		(9.20)	(1.75)	(9.19)
Turkey	0.002	2.155	-0.196	-1.013
		(13.63)	(1.29)	(18.62)
The numbers in parenthesis are t-statistics.				

Real Imports

The real value of imports is specified as a linear function of real expenditures on all goods, E, and the ratio of import prices, PIM, to domestic prices, P:

$$[IM(t)/PIM(t)] = a_0 + a_1.[PIM(t)/P(t)] + a_2.[E(t)/P(t)] + u_1(t) \qquad a_1<0,\ a_2>0 \qquad (31)$$

The variable u_1 is a random error term and has the classic properties. Khan (1976) introduces real expenditures as an explanatory variable rather than the more commonly used demand variable, real income. His reasoning behind this formulation is that demand for foreign goods (imports) should properly be related to domestic demand for all goods rather than to domestic demand for domestic goods plus foreign demand for domestic goods (exports). The use of real income would involve the latter. Import prices are treated as exogenous to the model, since Venezuela is a small country with a fixed exchange rate.

Real Expenditures

Real expenditures are defined as equal to real income less the level of the flow demand for real money balances, F:

$$[E(t)/P(t)] = [Y(t)/P(t)] - F(t) \qquad (32)$$

where Y is the level of nominal income. The flow demand for money is assumed to be a proportional function of the stock excess demand for real money balances:

$$F(t) = a.\{[M^d(t)/P(t)] - [M(t)/P(t)]\} \qquad 0<a<1 \qquad (33)$$

where M is the stock of nominal broad money balances and M^d refers to nominal money demand. The stock demand for real money balances is specified as a linear function of real income and rate of interest:

$$[M^d(t)/P(t)] = a_3 + a_4.[Y(t)/P(t)] + a_5.i_{vz}(t) \qquad a_4>0,\ a_5<0 \qquad (34)$$

where i_{vz} is the short-term rate of interest in Venezuela. Substituting equations (33) and (34) into (32), yields the following equation:

$$[E(t)/P(t)] = -a.a_3 + (1-a.a_4).[Y(t)/P(t)] - a.a_5.i_{vz}(t) + a.[M(t)/P(t)] + u_2(t) \qquad (1-a.a_4)>0,\ a.a_5<0,\ a>0 \qquad (35)$$

where u_2 is a stochastic random error term.

Rate of Inflation

The rate of inflation is assumed to be equal to the "expected" rate of inflation plus a function of the general level of excess demand in the economy and the proportionate rate of change of import prices. Khan (1976) represents this general level of excess demand by the difference between expected, or "permanent" real income and actual real income:

$$[D\mathrm{P}(t)/\mathrm{P}(t)] = a_6 + a_7.\{Y_P(t) - [\mathrm{Y}(t)/\mathrm{P}(t)]\} + a_8.\mathrm{EIP}(t) + a_9.[D\mathrm{PIM}(t)/\mathrm{PIM}(t)] + u_3(t) \qquad (36)$$

where Y_P is the level of permanent real income and EIP is the expected rate of inflation, and u_3 is a random error term. The estimated parameters are expected to carry the following signs:

$$a_7<0,\ a_8=1,\ a_9>0$$

Permanent real income and the expected rate of inflation are generated by an adaptive expectation model and then used in estimation.

Currency to Deposit Ratio

The ratio of currency to the deposit liabilities of commercial banks is specified as a negative function of the opportunity cost of holding currency, as measured by the domestic interest rate, and as a negative function of the level of income, since individuals and corporations tend to become more efficient in their management of cash balances as their income rises:

$$\mathrm{CDR}(t) = a_{10} + a_{11}.i_{vz}(t) + a_{12}.\mathrm{Y}(t) + u_4(t) \qquad a_{11}<0,\ a_{12}<0 \qquad (37)$$

where CDR is the ratio of currency to total private deposits at commercial banks, and u_4 is the error term.

Rate of Interest

Khan's (1976) equation for the determination of the rate of interest is obtained simply by solving the equation for the demand for real money balances, equation (34), for i_{vz}:

$$i_{vz}(t) = a_{13} + a_{14}.[Y(t)/P(t)] + a_{15}.[M(t)/P(t)] + u_5(t) \quad (38)$$

where $a_{13} = a_3/a_5$, $a_{14} = a_4/a_5$, $a_{15} = 1/a_5$. Since $a_4>0$ and $a_5>0$, then $a_{14}>0$, and $a_{15}<0$.

Short-Term Capital Flows

Khan (1976) assumes private short-term capital flows, *D*K, are a linear function of the change in the rate of interest in Venezuela and the change in the foreign interest rate. He argues that since most capital flows take place between Venezuela and the United States, the foreign rate is taken to be the U.S. rate, i_{us}. As there were substantial speculative inflows to Venezuela in December 1971, there is a dummy variable, DU, for the fourth quarter of 1971:

$$DK(t) = a_{16} + a_{17}.Di_{vz}(t) + a_{18}.Di_{us}(t) + a_{19}.DU + u_6(t) \quad a_{18}<0,\ a_{19}>0 \quad (39)$$

where u_6 is a random error term.

Ratio of Excess Reserves to Deposits

The ratio of excess reserves of commercial banks to their total deposits liabilities, ER, is specified as a linear function of the rate of interest. As the rate of interest rises, the opportunity cost of holding reserves in the form of non-income yielding assets rises, and commercial banks can be expected to lower their demand:

$$DER(t) = a_{20} + a_{21}.i_{vz}(t) + u_7(t) \quad a_{21}<0 \quad (40)$$

where u_7 is a random error term. As the commercial banks may adjust this ratio to the desired level, DER, with a lag, an adjustment function is assumed:

$$DER(t) = F.[DER(t) - ER(t-1)] \quad 0<F<1 \quad (41)$$

Substituting (40) into (41) and solving for ER, the estimating equation is obtained:

$$ER(t) = F.a_{20} + F.a_{21}.i_{vz}(t) + (1-F).ER(t-1) + F.u_7(t) \quad (42)$$

Real Income

The level of real income is equal to real private expenditure plus the real value of exports less the real value of imports:

$$[Y(t)/P(t)] = [E(t)/P(t)] + [X(t)/PX(t)] - [IM(t)/PIM(t)] \quad (43)$$

where PX is the price of exports, and both X and PX are assumed to be exogenous to the model.

Balance of Payments

The balance of payments, BP, is equal to the current account balance of the non-petroleum sector plus that of the petroleum sector, plus short-term capital flows, plus a residual item, COB, which includes long-term capital flows, government capital flows, etc.:

$$BP(t) = DR(t) = X(t) - IM(t) + [XOIL(t) - IMOIL(t)] + DK(t) + COB(t) \quad (44)$$

where (XOIL - IMOIL) is the current account balance of the petroleum sector. The variables (XOIL - IMOIL) and COB are assumed to be exogenously determined.

Money Supply

The nominal stock of money is determined by the following non-linear identity:

$$M(t) = [(1 + CDR)/(CDR + ER + RRR)].H(t) \quad (45)$$

The expression within the brackets is the money multiplier and H is the stock of high-powered money. RRR is the proportion of total required reserves to total deposit liabilities of commercial banks, and this ratio is assumed to be under the influence of the monetary authorities as it can be altered by manipulating various legal reserve ratios.

High-Powered Money

The stock of high-powered money is equal to the stock of international reserves and the domestic asset holdings of the central bank:

$$H(t) = R(t) + D(t) \quad (46)$$

D, along with RRR, represent monetary policy variables.

Results

Since the data are not seasonally adjusted, seasonal dummies (S_1, S_2, and S_3) for the first three quarters are introduced into each equation. The method of estimation is two-stage least squares. Table 3 shows the estimated values of the parameters for each of the seven equations with "t-values" in parenthesis.

In the import function, both explanatory variables have coefficients with the expected sign, and these coefficients are significantly different from zero at the 5 percent level. The equation appears to be well specified, with a fairly high coefficient of determination and no significant auto-correlation. There is the possibility, of course, that the good fit of the equation is due in part to real imports and real expenditures following a common time trend. For this reason Khan (1976) estimated the equation in first difference form as well. Its results are reported by equation (47):

$$
\begin{aligned}
D[\mathrm{IM}(t)/\mathrm{PIM}(t)] = {} & -0.781 + 2.446\, D[\mathrm{PIM}(t)/\mathrm{P}(t)] + 0.019\, D[\mathrm{E}(t)/\mathrm{P}(t)] \\
& \quad (1.30) \qquad\quad (0.64) \qquad\qquad\quad (2.64) \\
& + 0.009\, S_1 + 0.099\, S_2 + 0.013\, S_3 \\
& \quad (0.31) \qquad (1.31) \qquad (0.41) \\
& \text{adjusted R-squared} = 0.179, \qquad \text{D-W} = 3.11 \qquad\qquad (47)
\end{aligned}
$$

The fit of the import function is substantially reduced when the variables are transformed into first-difference form. The coefficient of relative prices has an incorrect positive sign and is not significantly different from zero. The coefficient of real expenditures, though significant, is much reduced in size. On the face of it, the estimates in equation (47) would tend to support the hypothesis that real imports and real expenditures are only spuriously correlated. However, there is another plausible explanation for the relatively poor results obtained in (47) compared to the import equation estimated in terms of levels as reported in Table 3. If the original errors are independent, first differencing introduces negative auto-correlation into the model, and this biases both the estimated standard errors of the coefficients and the coefficient of determination (Granger & Newbold, 1974). Judging by the value of the D-W statistic, the errors in equation (47) do have significant negative

auto-correlation in them. Although negative serial correlation probably is not as serious as positive serial correlation (Granger & Newbold, 1974).

All three estimated coefficients in the equation for real expenditure (in Table 3) have the expected signs. However, the estimated coefficient of the interest rate is not significantly different from zero at the 5 percent level. This could be a result of the fairly high degree of correlation between the interest rate and the stock of real money balances. Both real income and real money balances have a positive impact on real expenditures, and the coefficients are significantly different from zero at the 5 percent level.

Table 3: Khan's Second Model: Structural Equation Estimates

$(IM/PIM) = 2.046 - 2.287\ (PIM/P) + 0.062\ (E/P) + 0.011\ S_1 - 0.165\ S_2 + 0.0283\ S_3$
(0.97) (2.05) (10.74) (0.17) (2.51) (0.42) adjusted R-squared = 0.871 D-W = 2.14
$(E/P) = 0.069 + 0.027\ i_{vz} + 0.849\ (Y/P) + 0.744\ (M/P) + 0.187\ S_1 - 0.366\ S_2 - 0.481 S_3$
(0.06) (0.98) (9.07) (2.06) (0.76) (2.20) (2.72) adjusted R-squared = 0.996 D-W = 2.51
$(DP/P) = 0.001 - 0.004\ [YP - (Y/P)] + 1.062\ EIP - 0.70\ (DPIM/PIM) - 0.001\ S_1 - 0.001\ S_2 - 0.001\ S_3$
(2.92) (4.37) (10.42) (1.12) (0.70) (2.85) (2.78) adjusted R-squared = 0.998 D-W = 1.71
$CDR = 0.397 - 0.009\ i_{vz} - 0.003\ Y + 0.021\ S_1 + 0.005\ S_2 - 0.003\ S_3$
(21.45) (3.95) (15.17) (7.15) (1.77) (0.97) adjusted R-squared = 0.962 D-W = 1.56
$i_{vz} = 3.982 - 1.410\ (M/P) + 0.295\ (Y/P) + 0.473\ S1 + 0.196\ S2 + 0.547\ S3$
(2.22) (1.98) (2.21) (1.10) (0.60) (1.38) adjusted R-squared = 0.585 D-W = 1.83
$DK = -0.025 + 0.005\ i_{vz} - 0.016\ i_{us} - 0.096\ DU + 0.044\ S_1 - 0.031\ S_2 + 0.028\ S_3$
(1.35) (2.08) (1.91) (1.97) (1.62) (1.18) (1.20) adjusted R-squared = 0.256 D-W = 2.52
$ER(t) = 0.019 - 0.001\ i_{vz} + 0.582\ EB(t-1) + 0.001\ S_1 + 0.013\ S_2 + 0.003\ S_3$
(1.65) (2.16) (3.10) (0.09) (2.57) (0.70) adjusted R-squared = 0.681 D-W = 1.91
The numbers in parenthesis are t-statistics.

Summarizing these structural equation results, it can be observed that all but two of the economically meaningful parameters have the correct signs and are significantly different from zero at the 10 percent level. Most of the structural equations appear with a general absence of auto-correlation and a high coefficient of determination.

Khan (1976) conducts simulation experiments in order to determine the tracking ability of the model, and to see what the response of the model is to shocks. The overall performance is good, but the results have to be viewed with some caution due to the deficiencies mentioned above.

Charles Schotta's (1966) study, "sketches two extreme variants of a short-run model for the prediction of changes in money national income in Mexico." (Schotta, 1966). The monetary and Keynesian models are compared. This type of analysis is followed by others (Baker & Falero, 1971; LeRoy Taylor, 1972).

In building his monetary model, Schotta (1966) starts with a short-run theoretical model as suggested by Prais (1961), but he reasons that, "Since the data used for estimation are annual data, it has been assumed that the equilibrium in the money markets exists at all times." (Schotta, 1966).The model is specified with four definitional equations, three structural equations, and one that defines equilibrium in the money market. They are described by equations (48) through (55):

$$D\mathrm{M}^{d} = a_1 + k.D\mathrm{Y} + u_1 \quad (48)$$

$$D\mathrm{M}^{s} = a_2 + a_3.\mathrm{BT} + a_4.D\mathrm{LK} + a_5.\mathrm{GD} + u_2 \quad (49)$$

$$D\mathrm{M}^{d} = D\mathrm{M}^{s} \quad (50)$$

$$\mathrm{BT} = \mathrm{X} - \mathrm{IM} \quad (51)$$

$$\mathrm{IM} = a_6 + a_7.\mathrm{Y} + u_3 \quad (52)$$

$$\mathrm{X} = \mathrm{X}(t) \quad (53)$$

$$D\mathrm{LK} = D\mathrm{LK}(t) \quad (54)$$

$$\mathrm{GD} = \mathrm{GD}(t) \quad (55)$$

where LK is long-term liabilities to foreigners, and GD is the government cash deficit. The explanation of equations are as follows: Equation (48) is a money demand equation in which the demand for money (or the change in the demand for money) is some constant fraction of money national income (or the change in money national income). Equation (49) is a money supply equation, stating that the change in the money supply is some fraction of the current account, BT, the long-term capital inflow, *D*LK, and the federal government cash deficit, GD. Equation (50) defines equilibrium in the money market and is assumed to hold continuously.

Equation (51) defines the current account balance, while equation (52) states that imports are a simple function of money income. Equations (53), (54), and (55) define exports, the change in long-term liabilities to foreigners, and the cash deficit as exogenous.

Schotta (1966) estimates the model for Mexico using the ordinary least squares technique for the 1937-63 period. The results are reported below, and the numbers in parenthesis are the standard errors of the estimated coefficients.

$$D\mathrm{M}^{d} = 0.40 + 0.80\ D\mathrm{Y} \qquad (56)$$
$$(0.003)$$
R-squared = 0.31, D-W = 1.37

$$D\mathrm{M} = 0.50 + 0.32\ \mathrm{BT} + 0.47\ D\mathrm{LK} - 0.82\ \mathrm{GD} \qquad (57)$$
$$(0.13) \quad (0.12) \quad (0.32)$$
R-squared = 0.60, D-W = 1.65

$$\mathrm{IM} = -1.06 + 0.19\ \mathrm{Y} \qquad (58)$$
$$(0.005)$$
R-squared = 0.98, D-W = 1.68

All the coefficients are significantly different from zero at the 5 percent level, except for the government cash deficit. The values of D-W statistic lie above the upper bound for the critical value at the 1 percent level; hence, the hypothesis of positive auto-correlation may be rejected for the three structural equations.

Schotta (1966) combines equations (48) and (49) to form the money multiplier of the external variables on the money national income. When the resultant equation was estimated, equation (59) was obtained. He also combines equation (56) and (57) to obtain equation (60):

$$D\mathrm{Y} = 3.32 + 2.45\ \mathrm{BT} + 4.96\ D\mathrm{LK} \qquad (59)$$
$$(0.77) \quad (0.81)$$
R-squared = 0.70, D-W = 1.72

$$D\mathrm{Y} = 1.3 + 4.0\ \mathrm{BT} + 5.09\ D\mathrm{LK} \qquad (60)$$

He then tests the hypothesis of equality of the regression coefficients of equation (59) with corresponding parameters in equation (60), at the 5 percent level. The null hypothesis of a significant difference is rejected in each case.

Schotta's (1966) Keynesian model is:

$$Y = C + I + G + X - IM \quad (61)$$
$$C = c.Y_d \quad (62)$$
$$Y_d = Y - T \quad (63)$$
$$T = g.Y \quad (64)$$
$$IM = m.Y \quad (65)$$
$$I = I(t) \quad (66)$$
$$G = G(t) \quad (67)$$
$$X = X(t) \quad (68)$$

where Y_d is disposable income. Equation (61) defines income. Equation (62) gives consumption as a function of disposable income. Equation (63) defines disposable income as the income left after taxes are paid. Equation (64) gives the tax structure. Equation (65) shows that the value of imports is determined by the level of nominal income. The last three equations show that investment, government expenditure, and exports are exogenous.

He solves the above system for income to yield:

$$DY = \{1/[1-c(1-g) + m]\}.(DI + DX + DG) \quad (69)$$

and this multiplier formulation is then estimated to test the explanatory power of the Keynesian model.

In order to test the explanatory power of the model, Schotta (1966) estimates structural equations (62), (64), and (65), so that the values for the parameters for the multiplier equation (69) may be determined.

$$C = 1.69 + 0.87\ Y_d \quad (70)$$
$$(0.05)$$
R-squared = 0.99, D-W = 1.07

$$T = 0.17 + 0.07\ Y \quad (71)$$
$$(0.002)$$
R-squared = 0.98, D-W = 0.80

Positive auto-correlation may be present in equation (70), since the value for D-W statistic lies between the upper and lower bounds for the critical value at the 1 percent level; the hypothesis of positive auto-correlation cannot be rejected for equation (71) at the same level. He uses the marginal propensity to import which was estimated in equation (58), together with other parameters from equation (70) and (71), to form the multiplier for changes in money national income:

$$DY = 2.63\ (DI + DG + DX) \qquad (72)$$

When the exogenous variables are regressed against income, all in first difference form, one should expect that the regression coefficients would each be equal to the value of the multiplier and to each other.

$$DY = 2.55 + 0.72\ DI + 3.37\ DG + 0.96\ DX \qquad (73)$$
$$\qquad\qquad (1.55) \quad (2.48) \quad (0.97)$$
R-squared = 0.50, D-W = 2.09

The hypothesis of the investment multiplier being different from zero cannot be rejected at the 5 percent level of significance. Multi-collinearity is present, and when correlation between variables was checked, it was confirmed. When DY is regressed on DI, the results are:

$$DY = 2.98 + 2.73\ DI \qquad (74)$$
$$\qquad\qquad (0.74)$$
R-squared = 0.44, D-W = 2.04

When the null hypothesis that the regression coefficient in equation (74) is not equal to 2.63 is tested, it is rejected at the 5 percent level. Positive auto-correlation is not present when the D-W statistic is tested at the 1 percent level.

Statistically, the multiplier theory explains between 44 and 50 percent of the variance of money national income in Mexico, in contrast to the 70 percent of the variance explained by the monetary model. The comparison suggests that the monetary model is likely to be a better predictor of changes in income and prices in Mexico than the income level. The final conclusion is that a composite model is probably the most fruitful approach.

At this point a few comments on the short-run approach are in order. These comments are divided into two categories - the specification and the estimation of the model.

Specification of the Model

Short-run monetary models are based on an adjustment process in which an excess supply of real money balances results in increased expenditures on goods and services in general, and imports in particular. There are a few points that are overlooked in these short-run models. In order to demonstrate these points, let us

start with the simpler case where only commodity and money markets are considered. In this case, an excess supply of real money balances spills over to the commodity market and results in excess demand for commodities. If so, then presumably both exports and imports are affected so that imports increase and exports decrease. In the specification of the existing empirical short-run models, this point is usually ignored, and exports are assumed to be either exogenous or determined by factors other than the excess supply of real money balances. It may be argued that if countries specialize in the production and export of one or, at most, a few commodities, their exports are not substantially affected by disequilibrium in their domestic money market. This explanation, of course, applies to those countries where domestic demand for exportables is not elastic; it is not, however, applicable to other countries where domestic consumption of exportables is significant.

In the more general case, where the model includes commodities, money, and bonds, the excess supply of real money balances also spills over into the bond market. On this basis, one should expect capital flows to be affected by the excess supply of real money balances. In the specification of the short-run empirical models, capital flows are either not considered, or when considered they are determined by levels or changes in rates of interest. The models of Rhomberg (1977) and Schotta (1966), and Khan's (1977) first model are examples of the first case. Their reasoning may be defended on the grounds that there is no developed capital market in the countries under consideration, which are mostly under-developed countries. Khan's (1976) second model is an example of the second case.

In the specification of some of the models that are made for short-run analysis, and therefore for consideration of disequilibrium and the adjustment process, one encounters the assumption of equilibrium in the money market. Some models make this assumption at the estimation stage of the analysis, i.e., a short-run disequilibrium model is set up, but a long-run equilibrium model is actually estimated. Others keep the assumption of monetary equilibrium at both the model-building and estimation stages of the analysis. Charles Schotta's (1966) model is an example of keeping the assumption of monetary equilibrium throughout the analysis. The second model presented and estimated by M.S. Khan (1976), is an example of dropping monetary disequilibrium just before estimation. If the model is carefully analyzed, the adjustment process in Khan's (1976) second model is assumed to take place through disequilibrium in the money market, as summarized in the expenditure equation, equation (37), and yet, at the same time, the interest rate is determined through equilibrium in the money market, as specified by equation (40).

Estimation of the Model

Estimation of the models is mostly done in levels. In economic time series analysis, where variables are often highly correlated, regression analysis undertaken in terms of levels may generate spurious correlation. Also, the high degree of collinearity between explanatory variables makes statistical inference difficult. In such a case it is advisable to filter the data so that the variables approximate "white noise." In most cases, first differences are adequate (Granger & Newbold, 1974).

The positive relationship between expenditures and imports in the expenditure function is consistent with other behavioral relationships. For convenience, expenditure equations of previous empirical studies are repeated here. Rhomberg (1977) specifies the following expenditure function, which is equation (11), mentioned earlier.

$$E(t) = a_0 + a_1.Y(t) + a_2.Y(t-1) + a_3.\{[L(t-1) + L(t-2)]/2 - k.Y(t)\}$$

Khan (1977), in his first model, uses the following two expenditure functions, where the second one is the transformed version of the first one. These were previously denoted as equations (25) and (27) in Khan's (1977) Model:

$$ED(t) = c_0 + c_1.M^s(t) + c_2.Y(t) + u_4(t) \qquad c_1>0,\ c_2>0$$
$$D[E(t)] = C.c_0 + C.c_1.M^s(t) + C.c_2.Y(t) - C.E(t) + C.u_4(t)$$

Khan (1976), in his second model, uses the following real expenditure function, denoted as equation (35) previously.

$$[E(t)/P(t)] = -a.a_3 + (1-a.a_4).[Y(t)/P(t)] - a.a_5.i_{vz}(t) + a.[M(t)/P(t)] + u_2(t)$$
$$(1-a.a_4)>0,\ a.a_5<0,\ a>0$$

The positive relationship between expenditures and money is also consistent with the demand for real money balances. It is known that level of expenditure is one of the determinants of the real money balances, i.e., the transaction demand for money. On this basis a positive relationship between money demand and expenditure is implied, which is consistent with the expenditure equations listed above. So, a significant positive relationship between expenditure and money may be due to other behavioral relationships.

The positive relationship between expenditure and income is quite predictable on a purely accounting basis. If variations in net exports are relatively

low, then expenditure constitutes a good proxy for income through the national income accounting identity. In this respect a positive relationship between income and expenditures is expected. So, it may be argued that a significant positive coefficient for income in the above expenditure functions may give undue support to the specification of the expenditure equations. If the variance of the excess of exports over imports is small relative to the variance of real expenditures, a strong relationship between (real) income and (real) expenditure exists because expenditure is the main component of income, through the income identity, $Y = E + X - IM$.

This paper provided a review of the seminal short-run empirical research on the monetary approach to the balance of payments with a comprehensive reference guide to the literature. The paper reviewed the three major alternative theories of balance of payments adjustments. These theories were the elasticities and absorption approaches (associated with Keynesian theory), and the monetary approach. In the elasticities and absorption approaches the focus of attention was on the trade balance with unemployed resources. The elasticities approach emphasized the role of the relative prices (or exchange rate) in balance of payments adjustments by considering imports and exports as being dependent on relative prices (through the exchange rate). The absorption approach emphasized the role of income (or expenditure) in balance of payments adjustments by considering the change in expenditure relative to income resulting from a change in exports and/or imports. In the monetary approach, on the other hand, the focus of attention was on the balance of payments (or the money account) with full employment. The monetary approach emphasized the role of the demand for and supply of money in the economy. The paper focused on the monetary approach to balance of payments and reviewed the seminal short-run empirical work on the monetary approach to balance of payments. Throughout, the paper provided a comprehensive set of references corresponding to each point discussed. Together, these references would exhaust the existing short-run research on the monetary approach to balance of payments.

APPENDIX 1

This is a comprehensive list of references which have estimated either the "reserve flow equation" or the "exchange market pressure equation."

Aghevli and Khan (1977), Akhtar (1986), Akhtar, Putnam, and Wilford (1979), Arize, Grivoyannis, Kallianiotis, and Melindretos (2000), Asheghian (1985), Bean (1976), Beladi, Biswas, and Tribedy (1986), Bhatia (1982), Bilquees (1989), Blejer (1979), Bourne (1989), Boyer (1979), Brissimis and Leventakis (1984), Burdekin and Burkett (1990), Burkett, Ramirez, and Wohar (1987), Burkett and Richards (1993), Civcir and Parikh (1992), Cobham (1983), Connolly (1985), Connolly and Da Silveira (1979), Connolly and Taylor (1976, 1979), Coppin (1994), Costa Fernandes (1990), Courchene and Singh (1976), Cox (1978), Cox and Wilford (1976), Farhadian and Dunn, Jr. (1986), Feige and Johannes (1981), Fontana (1998), Frenkel, Gylfason, and Helliwell (1980), Genberg (1976), Girton and Roper (1977), Grubel and Ryan (1979), Guitian (1976), Gupta (1984), Hacche and Townend (1981), Hodgson and Schneck (1981), Ibrahim and Williams (1978), Jager (1978), Jayaraman (1993), Jimoh (1990), Johannes (1981), Joyce and Kamas (1985), Kamas (1986), Kemp and Wilford (1979), Kenneally and Finn (1985), Kenneally and Nhan (1986), Khan (1973, 1990), Killick and Mwega (1993), Kim (1985), Laney (1979), Lee and Wohar (1991), Leiderman (1980), Leon (1988), Looney (1991), Luan and Miller (1979), Mah (1991), McCloskey and Zecher (1976), McNown and Wallace (1977), Miller (1978), Modeste (1981), Pentecost, Van Mooydonk, and Van Poeck (2001), Phaup and Kusinitz (1977), Putnam and Wilford (1986), Rasulo and Wilford (1980), Roper and Turnovsky (1980), Sargen (1975, 1977), Sheehey (1980), Sohrab-Uddin (1985), Sommariva and Tullio (1988), Spanos and Taylor (1984), Taylor, M.P. (1987a, 1987b), Thornton (1995), Tullio (1979, 1981), Watson (1988, 1990), Weymark (1995), Wilford (1977), Wilford and Wilford (1977, 1978), Wilford and Zecher (1979), Wohar and Burkett (1989), Wohar and Lee (1992), and Zecher (1974).

APPENDIX 2

This is a comprehensive list of references which have estimated the "capital flow equation."

Argy and Kouri (1974), Artus (1976), Brunner (1973), Darby (1980), De Grauwe (1975), Fratiani (1976), Herring and Marston (1977), Hodjera (1976), Kouri (1975), Kouri and Porter (1972, 1974), Kulkarni (1985), Laskar (1981, 1982), Luan and Miller (1979), Murray (1978), Neuman (1978), Obstfeld (1980, 1982), Porter (1972, 1974), and Stockman (1979).

APPENDIX 3

This is a comprehensive list of references which have estimated a short-run model in the tradition of the monetary approach to balance of payments.

Agenor (1990), Aghevli (1975, 1977), Aghevli and Khan (1980), Aghelvi and Sassanpour (1982), Akhtar (1986), Ardito Barletta, Blejer, and Landau (1983), Argy (1969), Baker and Falero (1971), Bergstrom and Wymer (1976), Blejer (1977, 1983), Blejer and Fernandez (1975, 1978, 1980), Blejer, Khan, and Masson (1995), Blejer and Leiderman (1981), Bonitsis and Malindretos (2000), Borts and Hanson (1977), Brissimis and Leventakis (1984), Cheng and Sargen (1975), De Silva (1977), Dornbusch (1973a), Fleming and Boissonneault (1961), Franco (1979), Guitian (1973), Horne (1979, 1981), International Monetary Fund (1977, 1987, 1996), Jonson (1976), Jonson and Kierzkowski (1975), Kanesathasan (1961), Khan (1974, 1976, 1977), Khan and Knight (1981), Kieran (1970), Knight and Mathieson (1979, 1983), Knight and Wymer (1976, 1978), Knoester and Van Sinderen (1985), Lachman (1975), Laidler (1975), Laidler, Bentley, Johnson, and Johnson (1981), Laidler and O'Shea (1980), Leon and Molana (1987), Leventakis (1984), Levy (1981), Miller (1980), Miller and Askin (1976), Mussa (1974), Myhrman (1976), Otani and Park (1976), Parikh (1993), Parkin (1974a, 1974b), Polak (1957, 1998), Polak and Argy (1971), Polak and Boissonneault (1960), Prais (1961), Rhomberg (1977), Rodriguez (1976), Sassanpour and Sheen (1984), Schotta (1966), Spinelli (1983), Taylor, L. (1972), Taylor, M.P. (1986), Teal and Giwa (1985), Vaez-Zadeh (1989), Wallich (1950), Wilford (1977), and Yusoff (1988).

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WHICH IS LONGER, THE SHORT RUN OR THE LONG RUN?

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ABSTRACT

This paper focuses on a common oversimplification in the presentation of one of the most basic concepts that we teach: the distinction between short run and long run in the theory of production. This paper illustrates how the terms "long run" and "short run" do not mean the same thing in demand and supply analysis they mean in the theory of production. In supply and demand analysis, short run and long run refer to the length of periods of chronological time. In the theory of production, the short run and long run refer to how time is used, not how much time is used. The long run refers to the planning process while the short run refers to operations. A survey of commonly available principles of economics textbooks reveals that this conceptual difference is not being taught.

Albert Einstein instructed us to explain the complex as simply as possible, but no simpler. Oversimplification will at the very least rob a subject of richness, and at worst mislead. Economics is based upon simplifying assumptions, and part of the science is the avoidance of misleading oversimplification. The purpose of this paper is to point out a common oversimplification in the principles of economics course, involving one of the most basic concepts that we teach: the distinction between short run and long run in the theory of the firm. The common definitions of these terms are so well accepted that a survey of available texts shows uniformity in the use of the overly simple definition. We then offer a simple way to resolve the issue with an explanation that clears up the potential for confusion, is economically correct, and is intellectually fun.

HOW THE "LONG RUN" AND "SHORT RUN" DIFFERS IN SUPPLY AND DEMAND VERSUS THE THEORY OF PRODUCTION

The basic problem is that the terms "long run" and "short run" do not mean the same in demand and supply analysis as they mean in the theory of the firm.

Unfortunately, none of the textbooks book we examined points this out. In supply and demand analysis, short run and long run refer to the length of periods of chronological time. In the theory of the firm, the short run and long run refer to how time is used as a resource, not how much time is used. In the long run firms plan; in the short run they operate the facility that they decided to install during their planning.

Our examination of widely available principles texts (see Table 1) reveals that in supply and demand analysis, authors correctly explain that demand is more elastic in the long run than in the short run because decision makers have more time to adjust to changes in prices. Similarly on the supply side, supply is more elastic in the long run than in the short run, again, because decision makers have more time to adjust. So, we give the students the clear and correct instruction that we are referring to the length of periods of chronological time.

Without proper explanation, students naturally think that the terms "long run" and "short run" in the theory of the firm are once again referring to chronological time as was the case in supply and demand analysis. In fact, many texts appear to reinforce misunderstanding when they explain that the short run is a period so short that only the variable factors of production can be varied as is the case in the standard Q = F (K,L) total product function, when only L can be varied in the short run. The implication is that K cannot be varied because there isn't enough time.

A FIRM CAN BE SIMULTANEOUSLY IN THE LONG RUN AND THE SHORT RUN

Two Ironies Flow from this Discussion

First, the long run can occupy a much shorter period of chronological time than the short run. An example that is both familiar and instructive is McDonalds. All students have been in a McDonalds restaurant, many of them hundreds of times. They can see the capital and the labor in a short run setting. They cannot see the long run planning, but that can be described: To establish a new McDonald's franchise, the franchisee works with planners from corporate headquarters to estimate demand, and, in turn, the size, shape and equipment that will maximize profits for the firm. The planning stage is the long run. Prior to installation, no hamburgers are being flipped when people are planning. Only when the best assortment of capital is chosen and installed can labor be applied to its operation.

Table 1 Short Run and Long Run Analysis

Author	Publisher and Year	The concepts of long and/or short run are explained properly with reference to chronological time in the supply and demand analysis	The concepts of long and/or short run are explicitly explained as not necessarily involving chronological time in the analysis of the theory of the firm	Explicit vocabulary of long range planning and short range operations is used
Karl E. Case & Ray C. Fair	Prentice Hall, 1996	Yes	No	No
David C. Colander	Irwin McGraw Hill, 2001	Yes	No	No
David N. Hyman	Irwin, 1997	Yes	No	Yes
N. Gregory Mankiw	Dryden, 1999	Yes	No	No
Campbell R. McConnell & Stanley L. Brue	McGraw Hill, 1999	Yes	No	No
Paul A. Samuelson & William D. Nordhaus	Irwin McGraw Hill, 1998	Yes	No	No
Bradley R. Schiller	Irwin McGraw Hill, 1997	Yes	No	No
Stephen L. Slavin	Irwin McGraw Hill, 1999	Yes	No	No
Joseph Stiglitz	Norton, 1997	Yes	No	No
Irvin B. Tucker	South-Western, 2000	Yes	No	No

The operation of the installed capacity takes place in the short run. A typical McDonalds can be planned, built, and ready for operation in a matter of a few months, and operated for many years. That is, the short run operating period is a much longer period of chronological time than the long run planning period. In fact, the better the long run planning decisions, the longer the short run will last.

Second, a firm can be in the long run and the short run at the same point in time. How can this be? Firms typically have operating divisions and planning divisions working at the same time. Operating divisions work in the short run as they produce goods and services. At the same time, across the hall or across the world, others in the firm are working in the long run. These are the planners who are deciding what changes are to be made to capital and how labor is to be deployed in the future. Not only can the long run and the short run take place at the same time, the long run can precede or succeed the short run. For example, the long run must precede the short run in the installation of a new McDonalds, then after the short run has expired and the restaurant goes out of the fast food business, the planners must return to determine how the land and building will be used in future, a long run exercise that may not take much chronological time.

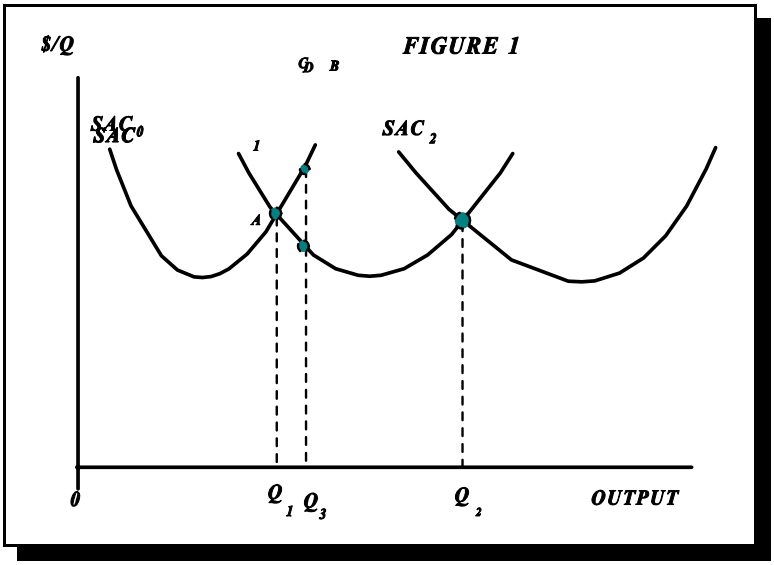
In the planning mode of the firm, all factors of production are variable and, because of the nature of the long run, not much chronological time may be involved. In the long run, planners are considering different combinations of capital and labor by examining blueprints and computer-aided design programs. For example, an architect can now use computer programs to draw up plans for a building, and not only have computer generated pictures of the building exterior and interior, but actually move virtual walls right on the screen and simultaneously have a spreadsheet re-calculate costs. Thus the planner can see several of the long-run alternatives before committing to the best short run choice.

LONG RUN AND SHORT RUN AVERAGE COST CURVES

There is no need to alter the traditional diagram that shows the geometric relationship between the long run average cost curves and the short run average cost curves. But the proper definition of long run and short run is essential to understanding what these curves actually display. It is more a matter of enriching the interpretation of the graphs to include the fact that real firms can be both planning and operating at the same time. Moreover, firms may be planning without operating, or operating without further planning. The long run average cost curve

shows only the envelope of the short run curves, and cannot therefore include the costs of planning and adjusting capital.

Figure 1 displays the standard depiction in which three SAC curves are drawn. For a firm that has three scales of plant from which to choose, SAC0 and SAC1 intersect at point A, and SAC1 and SAC2 intersect at point B. Therefore, if the firm is planning on an output range between zero and Q1, the planner will install the scale of plant associated with SAC0. Similarly if the output range is expected to be between Q1 and Q2, the planner will install SAC1; and for an output range above Q2, SAC2.



But what if things change and the original output expectation is not what actually happens? Suppose that SAC0 is selected and installed but output averages Q3 rather than the expected zero to Q1 range. Then average costs will be at the height of point C, whereas the same output could be produced at lower cost at the larger scale of plant shown by SAC1 at point D. The planner in the firm now has to evaluate whether the reduction in cost that will be available at the larger scale of plant outweighs the cost of making the additional capital investment. The cost of making the investment is sunk once capital is installed, and the only costs that are reflected in the cost curves are the opportunity costs of capital and labor in the short run.

This new way of looking at the short run and long run distinction is not inconsistent with the treatment in the standard texts, but rather enriches it. For example, the short run is a period in which some factors, usually called capital, are fixed. But they are not fixed because the short run is a short period of chronological time, as the texts state. Rather the fixed factors are fixed either because the cost-minimizing scale of the plant has been chosen or because the cost of adjusting capital from one scale of plant to another is greater than the present value of expected savings to be derived from changing to the cost-minimizing scale of plant. The better the choices made in the long-run planning phase, the smaller will be the incentives to change the scale of the plant. Therefore, the short run may last a long period of chronological time, much longer than the long run.

This distinction works outside the theory of the firm as well. Consider marriage. Many of your college students are unmarried people seeking spouses. Spouse-seeking unmarried people are selecting potential mates from alternatives found on campus and elsewhere. This process of sorting is long run planning. But, marriage changes everything because it requires a choice of a scale of plant. The married state is actually the short run since once married, people find it financially and emotionally expensive to change their spouse, i.e., their fixed factor of production. Married spouses who engage in long run activity are bound to shorten the marriage's short run. In marriage, it is fine to be in it for the long haul, but not the long run.

SUMMARY

The purpose of this paper is to caution teachers of the principles of economics course that the terms "long run" and "short run" do not mean the same thing in demand and supply analysis as they mean in the theory of production. In supply and demand analysis, short run and long run refer to the length of periods of chronological time. In the theory of the firm, the short run and long run refer to how time is used, not how much time is used: the long run refers to the planning process while the short run refers to operations.

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