Volume 12, Number 1

Printed ISSN: 1533-3604
PDF ISSN: 1533-3590

JOURNAL OF ECONOMICS AND ECONOMIC EDUCATION RESEARCH

Editors:
JoAnn and Jim Carland
Carland College

The *Journal of Economics and Economic Education Research* is owned and published by the DreamCatchers Group, LLC. Editorial Content is controlled by the Allied Academies, a non-profit association of scholars, whose purpose is to support and encourage research and the sharing and exchange of ideas and insights throughout the world.

The *Journal of Economics and Economic Education Research* is owned and published by the DreamCatchers Group, LLC, PO Box 1708, Arden, NC 28704, USA. Those interested in communicating with the *Journal,* should contact the Executive Director of the Allied Academies at info@.alliedacademies.org.

EDITORIAL REVIEW BOARD

EDITORIAL REVIEW BOARD

TABLE OF CONTENTS

EDITORIAL REVIEW BOARD III

LETTER FROM THE EDITORS VIIII

USING CURRENT AND UP-TO-DATE EXAMPLES AS A TEACHING TOOL IN ECONOMICS: A DESCRIPTION 1
Indranil Ghosh, Saint Xavier University
Faisal Rahman, Saint Xavier University

FIXED VERSUS SUNK COSTS: CREATING A CONSISTENT AND SIMPLIFIED COST FRAMEWORK 11
John Robert Stinespring, University of Tampa

CONVERGENCE OF STATE AND LOCAL FISCAL POLICIES: AN APPLICATION OF PANEL UNIT ROOT TESTS 27
Christopher N. Annala, State University of New York at Geneseo
Shuo Chen, State University of New York at Geneseo

HIGH SCHOOL STUDENTS' ACADEMIC PERFORMANCE AND INTERNET USAGE 41
Wesley Austin, University of Louisiana at Lafayette
Michael W. Totaro, University of Louisiana at Lafayette

THE VOLATILITY OF THE DOLLAR YEN EXCHANGE RATE:
CAUSE AND EFFECT 55
Mohammed Ashraful Haque, Texas A&M University-Texarkana
George Boger, Texas A&M University-Texarkana

THE KEYNESIAN-MONETARIST CONTROVERSY IN INTERNATIONAL ECONOMICS:
DISCRIMINATORY POWER OF SHORT-RUN EMPIRICAL TESTS..... 61
Kavous Ardalan, Marist College

LETTER FROM THE EDITORS

It is with great sadness that we announce the death of Dr. Larry Dale, the founding Editor of the *Journal of Economics and Economic Education Research.* Dr. Dale served as Editor from the inception of the *Journal* until last year when ill health forced his retirement. It was largely through his efforts that the *JEEER* has become a well recognized outlet for economic and economic education research. Dr. Dale was extremely active in the Allied Academies, having founded the Academy of Economics and Economic Education, one of the affiliates which comprise the alliance. He was a well respected professor of economics at Arkansas State University and Director of its Center for Economic Education. A prolific author, and a great mentor to junior faculty, Dr. Dale was also a respected educator and extremely popular with the legions of students he taught over his long career.

To memorialize his contributions, the Allied Academies has established a scholarship in his name. If you are interested in making a tax deductible contribution, please visit our charitable foundation: www.carlandfoundation.org/dale.html. We will greatly appreciate your support, and we will communicate that support to Larry's family.

As you know, the *JEEER* is dedicated to the study, research and dissemination of information pertinent to the improvement of methodologies and effective teaching in the discipline of economics. The *Journal* bridges the gap between the theoretical discipline of economics and applied excellence relative to the teaching arts. The Academy is an affiliate of the Allied Academies, Inc., a non profit association of scholars whose purpose is to encourage and support the advancement and exchange of knowledge, understanding and teaching throughout the world.

The Editorial Board considers two types of manuscripts: first is empirical research related to the discipline of economics. The other is research oriented toward effective teaching methods and technologies in economics. These manuscripts are blind reviewed by the Editorial Board members. The manuscripts published in this issue conform to our acceptance policy, and represent an acceptance rate of less than 25%.

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

JoAnn and Jim Carland
Carland College

USING CURRENT AND UP-TO-DATE EXAMPLES AS A TEACHING TOOL IN ECONOMICS: A DESCRIPTION

Indranil Ghosh, Saint Xavier University
Faisal Rahman, Saint Xavier University

ABSTRACT

In this paper we provide a pedagogical tool to make the experience of students in an Economics course more enriching, exciting and rewarding. We promote the idea of using examples from current events that are happening or have just taken place and relating them to economic concepts. This would involve the instructor researching and adding examples and case studies from real life events as they unfold. This would mark a change from using examples and case studies that are described in standard texts as they tend to be older and out of date, and are unable to excite students or hold their attention for very long. We provide examples and descriptions of a few examples and case studies that have been developed for MBA economics classes. We note that students are a lot more excited and are able to relate much more easily to current and up to date examples and some may have even experienced the events described in the examples. This leads to a positive externality for the class.

INTRODUCTION

There has been a multitude of new thinking and research about various teaching methods that can be used for economics courses, both for undergraduates and for graduate MBA courses (see Becker and Watts (2005) and Becker, Watts and Becker (2006)). The traditional chalk and talk methods as a pedagogical tool in all subjects have become less and less popular as students become more and more demanding about teaching methods that are more in tune with the 21st century technological revolution. A traditional "chalk and talk" pedagogical style tends to make students less and less interested in the happenings of the classroom and more likely to let their minds wander away to other thoughts. With the advent of smartphones and the use of laptops in the classrooms, students have every opportunity to tune out their boring "same old same old" professor and hop onto the internet where they can easily peruse the happenings of the day, catch up with their friends on Facebook, Twitter and other social media or could just carry on a text message conversation with their friends, some of whom might be sitting in the same classroom. In addition to this being a problem for all courses, economics courses have the rather unsavory reputation of being dry, boring, impossible to understand, too math and graph oriented, too abstract with little real life applications etc. The last comment is especially galling as the principle ideas of economics have everything to do with business, and it is really not too difficult

to come up with hundreds of examples of applications of each economic concept. If you open the pages of any Business news website, or periodical you will find a lot of events happening right then that demonstrate some application of an economic concept.

Mark Maier and Scott Simkins (2009) in a fundamental piece of pedagogical work called Just In Time Teaching (JITT) provide insights into the use of student assignments that students have to look at, grasp the concepts of the questions and finish in just a few hours before class starts. Despite the obvious thoughts of slap dash work and corner cutting by students, the pedagogy actually helps students develop skills of introspection and persistence as well as innovation of thought. The idea behind this is really simple and practical: when students enter the real life and are employed, they will face innumerable just in time assignments. They will have to process the information and come up with strategies and solutions in just a few hours. Students in a classroom realize this, and the excitement of having a project or homework that resembles a real life work assignment at least in terms of the time available makes students more eager to engage in their coursework. Following the JITT innovation, in this paper we explain the process of using cases and examples that are currently taking place in the real world and relating them as applications of an economic concept that is being taught in class. Current text books in economics both at the undergraduate level and at the MBA level have increased the use of examples and cases to help students grasp an economic concept and to illustrate its use in the real world. A brief scan of the latest texts in both Principles of Economics and MBA Economics courses reveals the following examples and cases: LeBron James choosing not to attend college (opportunity cost), outsourcing to China (international trade), Pricing Tickets for Broadway shows (price discrimination), FCC Auctions (Economics of information and uncertainty) and the managerial perils of Asian chipmakers at the height of the tech boom (perfect competition). Unfortunately none of these examples can be called "just in time" i.e. the stories in them have all taken place quite a while back. Thus, students find it difficult to relate to the examples and cases because they are not current, and they have either forgotten about it or they have never heard of it. We can thus understand their complaint that economics concepts have few real life examples. It is not that the concepts have few applications; it is that the students have no interest in an example that is not current. Students would be much better served if instructors use as applications to economic concepts current events that can easily be looked up and that students are aware of or still remember because it occurred in the not too distant past. This would require periodic update of examples by the instructor, rather than relying on examples provided by the textbook author. In this paper we describe a few applications that are described by stories and events that have just occurred or are currently occurring, are fresh in the minds of the students and will remain interesting to students for at least a few more months. We relate these stories to economic concepts that are taught in a standard undergraduate or MBA economics class, and provide anecdotal evidence of enhanced student participation and interest.

ELASTICITY AND PRICE DISCRIMINATION

An Example: Evidence from Sams Club and CVS

In a recent New York Times article, "Sam's Club personalizes Discounts for Buyers" (May 30 2010) the reporter Andrew Martin talks about an innovative discount idea from Sam's Club, the warehouse chain of Wal Mart. He describes a new program called "eValues" where Sams Club customers who are "Plus" members can go to a bright green kiosk near the entrance, swipe their membership card through the card-reader and get an individualized booklet of coupons. This individualized booklet is tailored to each individuals expected demand for products and provides them with coupons for products that they would most like to purchase using the discounts. This is significantly different from the standard across the board discounts offered by most retailers. For example warehouse clubs send out a booklet of coupons that any individual belonging to these warehouses could use. Similarly grocery stores have long used "Preferred Shopper Cards" to offer discounts on products on their shelves. For example, if you browse by the selves of a grocery store aisle, you will see the price tag for a particular product offering the information that the normal price is $x while if you use the preferred shopper card for that store the price will be $(x-a). A similar though more generic idea that has often been used by producers and distributors is the coupon booklet insert that comes with your Sunday newspaper. In that booklet you get a wide variety of product coupons that you can then use in any grocery store to get a discount on the particular products that you buy. Grocery stores often complement these coupons by offering "double coupon" deals. Retail consultants call this type of individual pricing the "holy grail" of the retail business and predict that more and more businesses will use data mining and the power of predictive analytics to target individual customers. Indeed, amongst retailers CVS and Kroger have already started offering individualized deals and coupons through kiosks while grocery giant Jewel offers individualized deals for a future shopping trip at the checkout counter.

The Standard Economic Theory

In standard undergraduate and graduate economics texts we often refer to coupons as a great example of price discrimination. In fact it is one of indirect price discrimination where the producer or seller cannot identify individuals belonging to any group separated by similar demands, thus has to provide coupons to (possibly) every customer. The seller consequently cannot make the discount available to only those that belong to a particular demand group. Thus there is always the possibility that an individual belonging to a different group may also use the coupon and thus the positive effects of price discrimination may be diminished for the seller. As an example consider a producer of toothpaste who wants to spur demand for their particular brand. In order to do this they provide an insert in the Sunday newspaper which has a coupon for

$2 off that particular brand. The rationale for the coupon is to expand the customer base for the product i.e. it would include all those customers who want to buy the brand of toothpaste but consider the current price too high i.e. they are willing to pay a lower price for the toothpaste. By bringing this new group into the market, the seller is able to increase their profits as long as the marginal cost of production is covered. However the basic idea of price discrimination is to provide the same product to different groups of customers at different prices – in this case the idea is to provide the toothpaste to well off customers at the higher price without the coupon, and to provide it to the not so well off at the lower price with the coupon. It is quite likely in this case that some customers of the well off group could easily use the coupon thus lowering the extra profit estimates for the seller. If however a seller is successful in correctly identifying the individuals in the different groups (i.e. Direct price Discrimination) that would imply a higher profit for the sellers than Indirect Price Discrimination. A great example would be differentiating prices in movie theaters with a lower price charged to individuals with a student ID card relative to individuals that are not students i.e. do not possess a student ID card. However this type of Price Discrimination has been considered difficult to achieve.

Explanation of the theory using the Real World Examples

As we can see, the cases and examples that we described to a large extent are applications of the economic theory of Price Discrimination. There is however a slight difference – the theory usually describes a more generic idea of Price Discrimination (indirect price Discrimination) where sellers can't exactly identify the individuals belonging to the different groups which of course leads to a potential lesser benefit situation for the sellers. So how does a seller limit the losses from this type of "cannibalizing" and move towards the Direct Price Discrimination model? The best solution would be to provide individualized deals to customers. Thus, customer A would get a different set of coupons than customer B, and thus coupon booklets would not be generic amongst all customers. Up until recently this has been practically impossible for the sellers to achieve primarily because they did not have hard information about the types of products an individual customer A would like to have coupons for – i.e. what would be the products that customer A would not buy if it was selling at its full price, but would buy if there was a coupon that took off $x from the full price. However with the advent of customer cards and the tremendous data gathering powers that such cards gave the sellers, it was only a matter of time before the sellers realized the enormous data mining reach that they held. As an example the sellers could easily track the purchases made by Customer A and the prices that Customer A paid – they would find that Customer A paid full price for a certain number of products while they only bought a certain other group of products with a discount coupon. In fact, the data would be able to pinpoint the brands that Customer A would buy at full price and the brands that they would buy at a discount. It is quite possible that Customer A would behave differently with respect to two different brands of the same product i.e. Customer A would pay full price for

Cereal X but they would only buy Cereal Y with a discount coupon of $C. Data Mining and Predictive Analytics in fact gives the sellers an incredible amount of information about the exact demand curve of Customer A and thus since they can estimate the demand curve for customer A they can find Customer As price elasticity of demand for various products. This of course is the textbook working of price discrimination where a customer with a higher elasticity of demand for a product pays a lower price (since by definition of elasticity they are relatively highly price conscious about that product) and vice versa. Thus armed with this knowledge of price discrimination and the elasticities, sellers can target certain customers with individualized coupons.

Sellers can also use the data to forecast the probable likes of their customers. For example, they can consider a group of products where a number of customers have exactly the same demand and using the data on the demand curve for other products that this group of customers have, they can forecast with some accuracy the demand curves of customers with similar initial choices. For example let us say that a group of customers have exactly identical demands for a group of products. The seller looks at the data for products outside the ones that constitute the identical demands of these customers and finds that customer A is willing to pay $K for product X while customer B is willing to pay $L for product Y. The seller, based on the similarity of demands for customers A and B can predict that customer A should be willing to pay about $L for product Y and customer B should be willing to pay $K for product X. Thus they can target customers A and B based on these projections. In a sense, using the power of data mining the sellers are moving towards the model of "perfect" price discrimination where they could charge each individual the price that they would be willing to pay through the use of highly individualized coupons. In fact, as the retail analyst in the case above seems to imply, individualized pricing is in a sense the best strategy from the point of view of the sellers because it can completely eliminate the surplus of the consumer.

Another Example: Rates for Medical Services

In healthcare –physicians, hospitals and other service providers charge different rates to different groups of patients. Depending on what kind of health plans (PPO, HMO --and there are variations within them) or Medicare or Medicaid the patients belong to, reimbursements rates to the healthcare providers vary significantly.

Explanation of the theory using the Real World Example

In this example, again we have a great application of price discrimination. A physician's office might have a collection of patients that belong to different types of health plans, and are thus paying different premiums, deductibles and co-pays. However the service rendered by a physician for an annual checkup as an example or the lab for a general blood test are exactly the

same. The service received by one patient cannot be transferred or "sold" to another patient and thereby meeting one of the key elements of price discrimination theory. The incentive for the physician's office in accepting different types of insurance coverage is to increase their pool of patients and capture additional revenue.

THE PRISONERS DILEMMA

One Example: AT&T versus Verizon

Recently the advertising world was intrigued by the epic advertising battle waged by rival wireless providers AT&T and Verizon. It all started in Fall 2009 when Verizon sharply escalated the battle with AT&T by mocking the latter's "There's an app for that" campaign by creating a "There's a map for that" campaign that showcased Verizon's superior 3G network and AT&T's supposed inferior network. As a result AT&T unsuccessfully took Verizon to court, and after that viewers were treated to Luke Wilson singing AT&T's praises – commenting about among others AT&T's superior 3G service and the ability to talk and surf the internet at the same time. The sparring on the airwaves continued until early 2010 when AT&T (and subsequently Verizon) changed their advertising strategies to a more non confrontational one which point out the benefits of each provider's service rather than pointing out the faults of their competitors' service. What were the results of this all out advertising war that captivated viewers for over 6 months? According to USA Today it ended pretty much in a draw, with neither side being able to gain an advantage over the other since they both added subscribers at pretty much the same pace. AT&T added 2.7 million subscribers while Verizon added 2.2 million. Data showed that most of the new subscribers came from their competitors Sprint and T-Mobile according to Charles Golvin of Forrester Research.

The Economic Theory

We have here a pretty standard example of the Prisoners Dilemma Game from Game Theory in play. In our standard textbook example, there are two prisoners who have been apprehended on suspicion of committing some misdeed. They are interviewed separately and each has two strategies "confess" or "not confess" with their payoffs dependant not only on their own strategies but also the other person's strategy. The standard textbook Prisoners Dilemma matrix is shown below.

The payoffs signify jail terms depending on the strategies chosen. Solving for the first prisoner Bonnie we find that she has a dominant strategy of "confess" i.e. no matter what the other prisoner does he is always better off with "confess". Similarly the other prisoner Clyde also has a dominant strategy of "confess". This implies that both prisoners will choose to confess, and as we can see from the matrix end up in a situation where both of them are worse off than (each)

choosing the strategy "not confess". As most economics textbooks explain, each prisoner is afraid that the other will choose to confess thus getting the benefit of a favorable outcome, while they are left significantly worse off if they choose to "not confess". The classic textbook example of a Prisoners Dilemma situation is that of a price war between two competitors.

Table 1: The Prisoners Dilemma Matrix

		Clyde	
		Confess	Not Confess
Bonnie	Confess	(-5,-5)	(0,-10)
	Not Confess	(-10,0)	(-2,-2)

Explanation of the theory using the Real World Example

As we immediately notice, the application of this theory occurs exactly in the behavior of AT&T and Verizon with respect to their advertising campaigns. Both AT&T and Verizon would be better off if they choose not to directly confront the other in their advertising campaign. However both of them cannot let their rival get away with negative advertising. In fact, as an outcome this case exactly mirrors the standard Prisoners Dilemma outcome – neither of the competing firms is able to carve out an advantage over the other, in fact they are only able to increase their subscribers by poaching them from other smaller competitors. This is the point of difference with a standard textbook example, where there are only two firms. In this case obviously there are more than two competitors- in fact it is these other competitors that suffer a loss of subscribers because of the increased visibility of AT&T and Verizon's products. In fact it can be argued that both AT&T and Verizon could have had the same outcome spending a lot less money on a lot less advertising with a few more positive advertising spots.

Another Example: CVS versus Walgreens

Another interesting recent case involves two pharmacists CVS and Walgreens. Rather than a situation where the two indulge in a competitive battle against each other over advertising or a price war, they battle against each other on the services offered. In early June 2010, Walgreens announced that it would "no longer participate in new and renewed benefit plans from its rivals (CVS) drug benefits unit" (CNN Money, June 7 2010). The main grievance of Walgreens was CVS Caremark's Maintenance Choice Plan which started requiring patients that have chronic medical conditions to fill their prescriptions at CVS pharmacies only rather than giving them the choice to fill it at Walgreens (or other pharmacies). As a result of this announcement both companies shares fell – CVS fell 8% and Walgreens fell 2.7%. As a response CVS in a couple of days decided to drop Walgreens from its pharmacy benefits plan, which would force some of its benefits customers to pay a much larger amount to get their drugs

from Walgreens, leading to a potential loss of customers for Walgreens. As a result CVS shares fell 1.5% and Walgreens fell 3%. Eventually, about a week later the two pharmacies decided to end their war, coming to a compromise agreement the financial terms of which were not disclosed. As a result both firms saw their stock values increase.

Explanation of the theory using the Real World Example

Again in this case, the entire story follows a pretty predictable textbook example of Prisoners Dilemma. As evidenced by the movement of their stock prices – both companies would have been better off if they had initially come to the compromise agreement that happened at the end. However since they are fierce competitors in the pharmacy market, CVS chose the intense competition strategy rather than the compromise strategy. The intuition behind this choice is pretty simple: CVS was unsure about the actions of Walgreens in this competitive battle. It would have been better off for both to start out with the compromise strategy, but CVS knew that if it unilaterally chose to not to engage in a competitive battle, Walgreens would engage in a competitive battle. Similarly for Walgreens, if it chose to not engage in a competitive battle CVS best option would be to undercut Walgreens strategy. Thus each company's best or dominant strategy was to engage in competitive battle, as long as it was unsure of the other company's actions. This service war ended when both realized the futility of this Prisoners Dilemma type situation and came to a compromise agreement after which both companies are aware what their competitor's strategy is in this instance.

STUDENT REACTIONS

The examples/case studies listed above are currently being used in the MBA course Managerial Economics. Students are considerably more positive about the examples since they can actually remember the Verizon versus AT&T advertising wars involving the actor Luke Wilson, and are also more positively inclined towards the CVS versus Walgreens battle since it has happened very recently and some students were actually in the middle of the back and forth between the two companies. Some students have already used the kiosks in Sam's Club and CVS to get their personalized coupons and have received personalized discounts at the jewel checkout counter. Thus, the personal experiences of the students acts as a positive externality to all the students in the class and makes them a lot more enthusiastic about the concepts since they see the actual experiences related to these concepts. The current and future iterations of this course will also feature a survey that will note student reactions, and we can capture the reactions over time as we keep the examples/case studies current by incorporating newer ones.

CONCLUSIONS

In this paper we have offered a pedagogical tool to make the instruction of economics more appealing and interesting to students. We argue for the inclusion of new examples and case studies that serve as applications for economic concepts, developed and written by the course instructor that is taken from events that have happened recently or are currently happening. This keeps the instruction of economics fresh for the students and promotes significantly more student interest and participation relative to example s and case studies explained in the text that tends to be from several years ago and out of date. We describe a few examples and case studies that were developed using current events and relate them to economic concepts usually described in class and note the student satisfaction and engagement just by virtue of them being current and a part of the experience of some students. We are hopeful that we can continue providing new examples and case studies to enrich the student experience.

REFERENCES

Allgood, Sam, William Bosshardt, Wilbert van der Klaauw, and Michael Watts (2004). What Students Remember and Say about College Economics Years Later. *American Economic Review,* 94(2), 259-65.

Becker, William E., Michael Watts, Suzanne R. Becker (Eds.) (2006). *Teaching Economics: More Alternatives to Chalk and Talk,* Cheltenham, U.K. and Northampton, MA: Elgar.

Censky, Annalyn, Parija Kavilanz, Hibah Yousef (2010). CVS Stock hit by Walgreens letter, CNNMoney.com, Retrieved November 9, 2010, from http://money.cnn.com/2010/06/07/news/companies/ walgreens_cvs_caremark/ index.htm

Fredrix, Emily (2010). AT&T drops ad fight with Verizon, USA Today, Retrieved November 9, 2010, from http://www.usatoday.com/money/advertising/2010-04-13-att-verizon_N.htm

Martin, Andrew (2010). Sam's Club personalized discounts for Buyers, NYTimes.com, Retrieved November 9, 2010, from http://www.nytimes.com/2010/05/31/business/31loyalty.html?_r=1

Simpkins, Scott, Mark Maier, (2004). Using Just In Time Teaching Techniques in the Principles of Economics Course. *Social Science Computer Review* 22(4), 444-456

Watts, Michael, William E. Becker (2005). A Little More Than Chalk and Talk: Results from a Third National Survey of Teaching Methods in Undergraduate Economics Courses, Retrieved November 9, 2010, from http://www.aeaweb.org/annual_mtg_papers /2006/0106_0800_1201.pdf

FIXED VERSUS SUNK COSTS: CREATING A CONSISTENT AND SIMPLIFIED COST FRAMEWORK

John Robert Stinespring, University of Tampa

ABSTRACT

Common textbook presentations of fixed and sunk costs are often unclear and theoretically inconsistent. The introduction of this inconsistency into the firm cost structure can render the associated total cost and supply functions economically irrelevant. Even worse, using improperly specified functions can lead to sub-optimal production decisions. The confusion between fixed costs and sunk costs extends beyond the classroom and into the boardroom. Business managers allocate capital inefficiently when they treat fixed costs as sunk. This paper suggests a simple framework for specifying fixed and sunk costs that adds clarity to the common textbook treatment and eliminates confusion among students and practitioners. The framework begins with avoidable and unavoidable costs, their relationship to opportunity costs, and a suggestion for an intuitive and theoretically consistent specification of total cost. After specifying total cost in terms of opportunity costs, a simple derivation of the firm supply function and shut down rule results. The proposed framework avoids the pitfalls that arise in the standard analysis and has historical antecedents in the writings of Fritz Malchup, John Maurice Clark, Ronald Coase, and Joseph Stigler. The author has found that utilizing the opportunity cost principle in teaching fundamental theories of cost enables students to learn the principles of production theory with greater ease and understanding. Evidence also exists that consulting firms using a similar framework, such as Economic Value Added, have improved their clients' profitability.

INTRODUCTION

The distinction between fixed and sunk costs is a one of the most important concepts in production theory and one of the most likely to frustrate students. It is built upon the foundation of opportunity cost and is crucial to the construction of the total cost curve, the firm supply curve, the notion of economic profits, and the firm's shutdown condition. Common textbook presentations of fixed and sunk costs, however, are often unclear and theoretically inconsistent. When beginning production theory, students learn that opportunity costs are the only costs to be considered when making decisions. Opportunity costs are defined, in part, as costs that are avoidable and thus are factored into economic decision-making. Sunk costs, on the other hand, are unavoidable and, as such, should not affect decisions. After learning this opportunity cost rule, students are told that total costs are equal to the addition of fixed costs and variable costs.

Somewhere in the discussion, however, an implicit assumption is made that fixed costs are costs that cannot be avoided; that is, fixed costs are synonymous with sunk costs. Assuming fixed and sunk costs are synonymous creates unnecessary complications for producer theory and presents an inconsistency in the core concept of economic costs.

The assumption of equality between fixed and sunk costs appears in the majority of microeconomics texts and on some occasions is made explicit. For example, Steven E. Landsburg writes in *Price Theory and Applications* (2002)

> *"In the short run, fixed costs are unavoidable. As a result, they have no bearing on any economic decision . . . Because sunk costs are sunk, and because the firm's fixed costs are sunk in the short run, it follows that fixed costs are irrelevant to the firm's short-run supply decisions, including the decision about whether to shut down."*

Two potential problems arise from this assumption. First, some costs are fixed in both the short run and long run, an idea that contradicts the standard claim that fixed costs, by definition, do not exist in the long run. Second, many short-run fixed costs can be avoided and therefore are not sunk. These problems are resolved by categorizing all costs based on their "avoidability". This simple and intuitive remedy is founded on the core notion that the only costs that matter to economists are opportunity costs. The solution is shown to simplify cost analysis without sacrificing mathematical rigor or important cost relations such as the envelope theorem relating short-run to long-run costs. This simple revision to the principles analysis extends easily to the analysis at the intermediate and advanced levels and follows the early work on costs by writers including John Maurice Clark, Fritz Malchup, and Ronald Coase.

The rest of the paper is organized as follows. Section 2 discusses the standard incorporation of sunk costs into the total cost function and the resulting problem of measuring economic profits. The avoidability criterion is then introduced to remedy the problem. Section 3 discusses how using this criterion allows for a simple and theoretically consistent derivation of the firm supply curve and shutdown condition that improves upon the standard textbook exposition. Section 4 explores the nature of fixed and sunk costs. Section 5 shows how the avoidability criterion ensures important cost relations between the short run and long run that might be unwittingly compromised using the standard pedagogy. Section 6 illustrates the gains from these simple cost revisions with numerical examples. The simplicity of deriving of long-run and short-run cost functions from standard production functions under the avoidability framework is shown. Section 7 provides evidence that indicates the confusion between fixed and sunk costs may extend beyond the classroom to the boardroom in actual firm behavior. Various consulting firms have used techniques along the lines suggested herein to resolve the problem by attributing the relevant opportunity costs to fixed costs formerly assumed to be sunk. In the end, the gains from the proposed revisions appear to greatly outweigh the costs of adoption.

THE PROBLEM BEGINS WITH TOTAL COST

The standard microeconomics textbook treatment of production costs is as follows. Total cost is defined as the sum of all costs of production whether avoidable and unavoidable (e.g., Hall and Lieberman, 177). The definition of costs is then distinguished from the accounting definition by the inclusion of implicit costs. These implicit costs are opportunity costs, such as the value of an owner's time, unrecognized in the firm's accounting records but crucial for economic decision making. In the next step, total costs are categorized into variable costs and fixed costs. The "fixed costs" term includes non-sunk fixed costs and sunk fixed costs, where the former refers to costs that do not change with production but may be avoided if production ceases and the latter refers to costs that are incurred regardless of production.

$$\text{Total Costs} = \overbrace{\text{sunk fixed costs} + \text{non-sunk fixed costs}}^{\text{Fixed Costs}} + \text{variable costs.} \qquad (1)$$

This is where the problem begins. This total cost definition violates the opportunity cost principle of economic decision making by including sunk costs and as such, commits the proverbial problem of "adding apples and oranges". Non-sunk costs have an opportunity cost and factor into decisions. Sunk costs have no opportunity cost and do not factor into decisions. Using a total cost function with this theoretical inconsistency leads to an incorrect assessment of economic profits and may lead to incorrect decisions on the profit-maximizing production level.

To illustrate, consider Figure 1 which illustrates the standard textbook plots of total revenues, total costs and profits. Profit, π, is given by the difference between the total revenue function and the total cost curve, *TC*. Total cost includes a fixed cost of \$300 that is split between a sunk fixed cost of \$150 and a non-sunk fixed cost of \$150. Profits are maximized at a production level of $q = 15$ with profits of \$100. But what kind of profits are these? They cannot be accounting profits because the student has already been told that accounting profits neglect opportunity costs. Are they *economic profits*? The standard definition of economic profit is illustrated in Roger A. Arnold's *Microeconomics* (2001, 187) in which economic profit is defined as "total revenue less total opportunity cost". This definition appears in *Principles of Microeconomics* (2001, 272), *Microeconomics with Calculus* (1988, 249), *Intermediate Microeconomics: A Modern Approach* (1996, 318) and many others. If economic profit relies upon economic costs, and economic costs are comprised solely of opportunity costs, a theoretically-consistent total cost function must exclude sunk costs. Excluding sunk costs implies the economic profits are actually \$250 and the total cost and profit curves in Figure 1 are invalid.

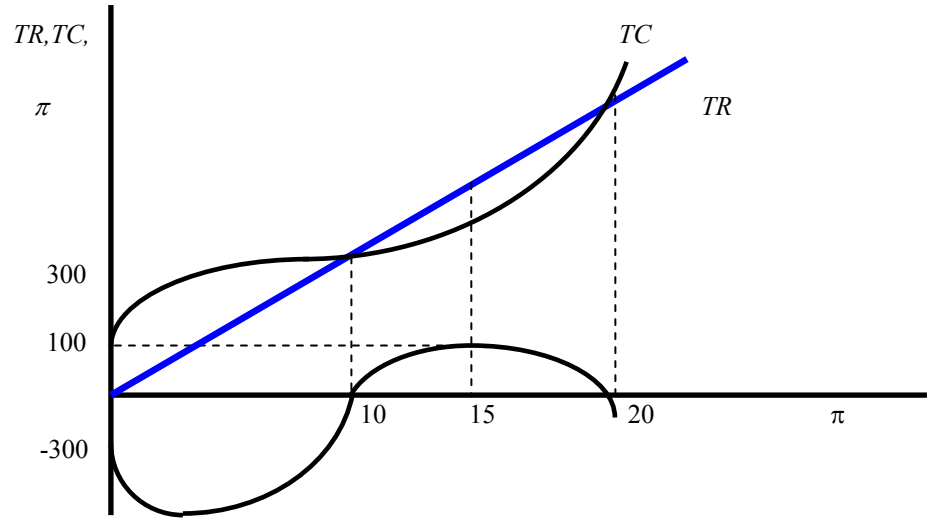


Figure 1 – Total Revenue, Total Cost and Profit

The mistake of including sunk costs in economic decisions would be fatal if the sunk cost were larger by $110. Figure 2 shows the original revenue, cost, and profit functions superimposed on a plot of those same cost and profit functions but with the additional $110 sunk cost. The latter curves are given as dotted lines and labeled as TC_{+110} and π_{+110}. The graph illustrates the danger of incorporating sunk costs into cost functions: were sunk costs $110 more, the firm would mistakenly conclude that there exists no output level at which profits are positive. The optimal production level would appear to be zero when in actuality, optimal production remains at q = 15 with economic profits unchanged at $250. Thus the inconsistency is not a mere difference of presentation or taxonomy. If total costs include sunk costs, the graph has no economic relevance. One cannot look at the graph of the totals and make an economic decision about whether production will occur or not. It shows neither accounting profits nor economic profits. The solution to this problem is simple and intuitive: exclude sunk costs from the total cost function.

Early 20th century economists converged on the simple opportunity cost principle of only including avoidable costs in the formulation of total costs. This distinction was important to these authors, many of whom were writing during the Great Depression about the relation between costs and production. Understanding firm costs was critical in thinking about policies that could stimulate production and employment. Writing in 1934, Fritz Machlup stated that "What one has to spend if one produces, and does not have to spend if one does not produce, is the cost of production" (p. 561). In an effort to edify accountants about costs in 1938, Ronald Coase wrote "[w]e may, however, lay down as a general rule that it will pay to expand production so long as marginal revenue is expected to be greater than marginal cost and *the*

avoidable costs of the total output less than the total receipts [italics added] . . . This particular concept of costs would seem to be the only one which is of use in the solution of business problems, since it concentrates attention on the alternative courses of action which are open to the businessman" (1938, *The Accountant*). Even before the 1930s, many economists proposed the avoidability criterion. In speaking about fixed costs, which he termed "overhead", John Maurice Clark wrote, "Should we, or should we not, count "overhead costs" in deciding whether a given thing is worth producing? . . . [I]n a general way the rule is: whenever a policy is being considered which will involve *'overhead expenditures' that could otherwise be avoided, they are part of the cost of that policy*" [italics added] (1923, 21).

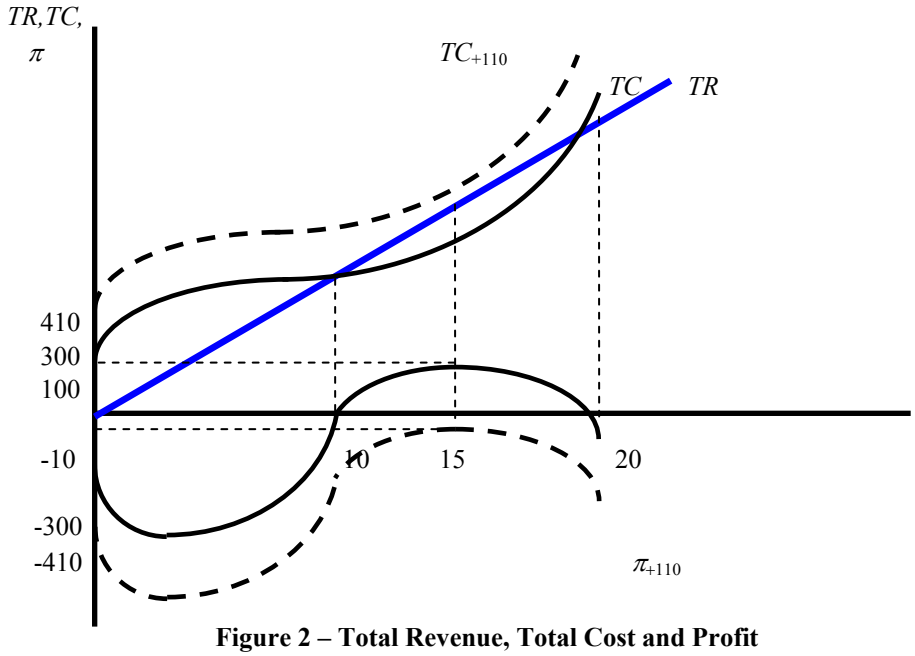


Figure 2 – Total Revenue, Total Cost and Profit

The avoidability criterion is easy to incorporate into modern cost analysis when distinguishing between sunk and fixed costs. A *sunk cost* is a fixed cost that cannot be avoided while an *avoidable fixed cost* is a fixed cost that can be avoided. A cost that is "fixed" in the sense that its associated input cannot be varied and has no alternative use, is sunk because it is unavoidable. Examples include a nontransferable, nonrefundable license to fish or practice law and a firm-specific asset that is undesirable to other firms and has no other productive use (e.g., a machine tool designed specifically for a particular plant or product). Avoidable fixed costs are costs that are fixed but may be avoided if the firm shuts down and costs whose associated inputs have alternative uses. Examples include fire and auto insurance policies that can be canceled if production stops and assets that are not firm-specific (e.g., computer servers that may be rented to other firms).

The direct link between the avoidability criterion and the opportunity cost rule is clear: if a cost is avoidable, it is an opportunity cost. If the cost is unavoidable, it has no opportunity cost and is therefore, sunk. A fixed asset that can be leased to other firms has an opportunity cost: every hour the asset is used in production is an hour of rent forgone. The only way the cost of an asset is an unavoidable fixed cost is if no alternative use of the asset exists and payments for it would occur whether or not production occurs. With this in mind, total cost may be defined as follows.

$$\text{Total costs} = \text{avoidable fixed costs} + \text{variable costs}. \qquad (2)$$

Given the notion that sunk costs are ignored in decision making and that the total cost function is specified for economic decision-making, the total cost function may equivalently be written in the standard form of fixed costs and variable costs. We will see that this definition of total cost is appropriate for both the short and long run. Thus we have our proposed change to the analysis.

Rule 1: Replace the current definition of total costs as

TC* = fixed costs + variable costs, *where sunk costs are included

with

TC* = fixed costs + variable costs, *where sunk costs are excluded.

Those who want to keep costs in terms of only opportunity cost may define total cost by stating *total cost is the sum of all opportunity costs of production.*

FIRM SUPPLY CURVE AND SHUTDOWN CONDITION

The analysis of the firm supply curve and shutdown condition provides the clearest examples of the problems associated with including sunk costs in total costs. The standard textbook definition for the firm supply curve is that it is "made up of the marginal cost curve at all prices above minimum average variable cost and the vertical axis at all prices below minimum average variable cost" (Parkins, *Economics 9th Edition*, p. 279). The addition of sunk costs to opportunity costs prevents a mathematical derivation of the supply curve from the initial total cost curve. Instead, a cumbersome heuristic derivation is given along with an equally cumbersome graphical depiction. This graph combines with marginal costs (*MC*), average total costs (*ATC*), average variable costs (*AVC*) and average fixed costs (*AFC*) as seen in Figure 3.

Figure 3

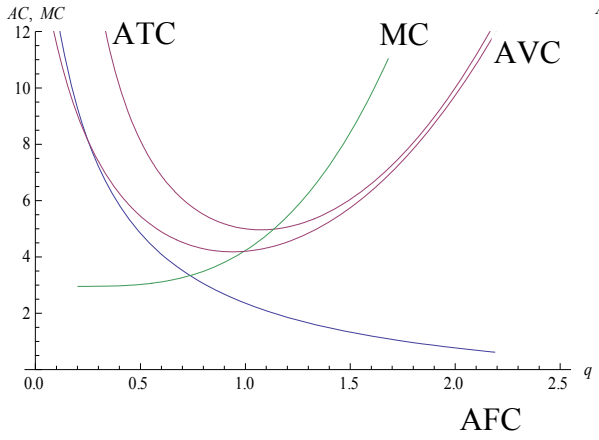
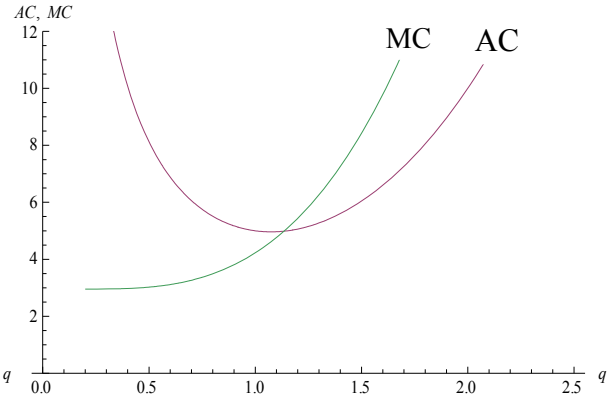


Figure 4



Because sunk costs were included in the initial cost function, the instructor must back-track to eliminate the sunk cost from the decision making rule for firms deciding how much to supply and at what price. The student is then told that the firm will shutdown if it cannot cover its *AVC*: that is, shutdown occurs if *P* falls below minimum *AVC*. Note the implicit reliance on the opportunity cost criterion: if fixed costs are truly fixed, they are not opportunity costs in the short run so they are irrelevant to the shutdown decision. As with the firm supply function, no mathematical derivation from earlier principles exists because of the theoretical inconsistency. Instead, what typically follows is an extensive explanation of the importance of variable costs in decision making and the unimportance of fixed costs in it. Students are invariably confused by this as they should be: the instructor has been carrying a cost throughout the analysis that the student must later be persuaded to ignore. This situation is made worse by the fact that the resulting supply curve is not relevant if any portion of the fixed costs from the total cost function is avoidable. If *TC* includes an avoidable fixed cost, such as a fixed capital that may be rented out to other firms, the standard decision rule for production may lead the firm to produce when it actually is not covering its opportunity costs.

Excluding sunk costs from the definition of total costs enables students to derive a firm supply function and shutdown condition mathematically. Because of its theoretical consistency, the result is a simpler and more intuitive firm supply curve and shutdown condition than the standard textbook presentation. Deriving the firm supply function with the avoidability criterion is done by using the production rule already taught to students: firms maximize profits when *MR* = *MC* as long as $TR \geq TC$. This is shown in two simple steps. In the first step, students use the profit maximization rule that $TR \geq TC$ and divide each side by output, $\frac{TR}{q} \geq \frac{TC}{q}$, to give

$$\boldsymbol{AR \geq AC} \qquad \textbf{(3)}$$

The second step is to substitute the relationship $AR = MR = MC$ under perfect competition into (1) giving the firm supply relationship of

$$\boldsymbol{MC \geq AC.} \qquad \textbf{(4)}$$

This condition states that the firm will supply output where marginal cost is greater than or equal to average cost. Note that average variable costs need not be addressed when the total cost function includes only opportunity costs. Because $MC = AC$ at minimum average cost, the supply curve is shown graphically to occupy the same locus of points as the marginal cost curve above minimum average cost. Figure 4 illustrates the firm supply curve under the opportunity cost criteria.

Deriving the firm supply curve and shutdown conditions requires instructors to jump through heuristic hurdles to convey what is simply the opportunity cost rule that they themselves have complicated by equating sunk and fixed costs. The shutdown rule for production is easily stated using the opportunity cost criterion:

The firm will shut down when it cannot cover its opportunity costs.

This is equivalent to saying the firm will shut down when it cannot produce profitably. Because (economic) profitability is defined as $TR \geq TC$ (where TC includes only opportunity costs) and is the same as saying $P \geq AC$ [a variant of Eq. (4)], the firm will shut down when the price it receives is lower than its average total costs. Basing the shutdown decision on opportunity costs is both intuitive and easy for students to learn. Two rules result.

Rule 2: Replace

The firm supply curve is represented by the $MC \geq AVC$

with

The firm supply curve is represented by the $MC \geq AC$ and zero elsewhere

and replace Figure 3 with Figure 4.

Rule 3: Replace

The firm will shut down if it cannot cover its average variable costs: that is, shutdown occurs if $P < AVC$

with

The firm will shut down if it cannot cover its opportunity costs: that is, shutdown occurs if $P < AC$

THE GENERAL NOTION OF FIXED COSTS

The more deeply one considers the notion of fixed costs, the more difficult it becomes to define a fixed cost. One must begin with the assumption that costs are determined by inputs: the cost of a fixed input is a fixed cost. Defining an input as "fixed" generally means one of two things, though they are not mutually exclusive: (1) production in the short run can be increased without varying the input or (2) the quantity of the input cannot be varied. The first definition is technical in nature while the second is based on costs. The first definition does not impose a restriction on obtaining the input while the second does.

To illustrate the distinction between the two definitions, consider short-run production occurring in a single fixed plant. Under (1), the plant is a fixed input if production may be increased by using more of the variable inputs holding plant size constant. Under (2), the plant is a fixed input in the sense that the owner is unable to alter the plant size during the current operating period. For example, a university may claim that its buildings represent fixed inputs as they cannot be expanded in the current school term. This is not a technical limitation but a cost limitation. The university could rent trailers overnight to use for classrooms or pay above-market prices to induce a builder to build another building. The second meaning was well articulated by Joseph Stigler who wrote

> *" . . . when a proprietor says that he can quickly buy more steel sheet, but requires 7 months to obtain a new stamping machine, he is not being precise. At a sufficiently high price, one can buy a stamping machine from another company and have it installed in 24 hours; at a very high cost one can have a new machine built in a month by working around the clock. When we say that in the short run some inputs are freely variable, we mean that their quantity can be varied without affecting their price (for given quality)*."
>
> *The Theory of Price* (p. 134)

Given Stigler's statement, definition (2) can be more accurately written as "the quantity of the input cannot be varied *without affecting its price*". From this discussion it is clear that (1) implicitly speaks of fixed inputs in the past tense as those inputs already purchased while (2) refers to future input purchases.

The difficulty in delineating fixed costs from variable costs may be the most persuasive reason to focus on opportunity costs. It is a clear, simple and economically consistent measure on which to make decisions. This is not to say that fixed costs have no value in economic analysis. The importance of fixed costs is that they do not affect decisions *at the margin*. How much a firm should produce is unaffected by fixed costs. Whether to produce at all, however, involves both variable and fixed costs. We ignore fixed costs at the margin not because they are sunk, but because they need not be altered to alter production levels.

LONG-RUN VERSUS SHORT RUN COST CURVES

The opportunity cost framework clarifies the relationship between long-run and short-run costs while preserving important principles such as the *envelope theorem* wherein long run costs are shown to be the envelope of short run costs. The preservation of these principles, however, requires theoretical consistency. For example, the long run is often defined as the period in which all costs are variable. Having clarified the notion of fixed costs, it should be clear that many investments, however, are fixed but avoidable before they are made. Various textbooks recognize this fact by describing investments that are lumpy or indivisible. Thus it is more accurate to state that the long run is the period in which all costs are avoidable.

Besides their real-world validity, an additional benefit of recognizing long-run avoidable fixed costs is that they simplify the mathematical modeling from production to costs. This strengthens the link of the qualitative analysis of the principles courses to the quantitative analysis in intermediate and advanced microeconomics courses. For example, Figure 5 shows the standard textbook plot of the envelope relation between long-run and short-run costs. Principles instructors use this graph to illustrate the various economies of scale so important to understanding industry structure. The standard discussion is of a firm that enjoys economies of scale by producing up to q_1, constant economies of scale (CEOS) from q_1 to q_2, and diseconomies of scale beyond. It becomes clear in intermediate courses, that assuming there are no fixed costs in the long run means the inverted-hyperbola LRAC graph can only be generated by assuming a cubic cost function. Unfortunately, the production function that generates a cubic cost function is mathematically daunting. To avoid this problem, a discrete jump occurs in intermediate textbooks from mathematically tractable production functions used to illustrate firm optimization (shown by the tangency between isocosts and isoquants) to the multiple-economies-of-scale average cost functions (shown in Figure 5). This complication is easily removed by allowing for the existence of long-run avoidable fixed costs.

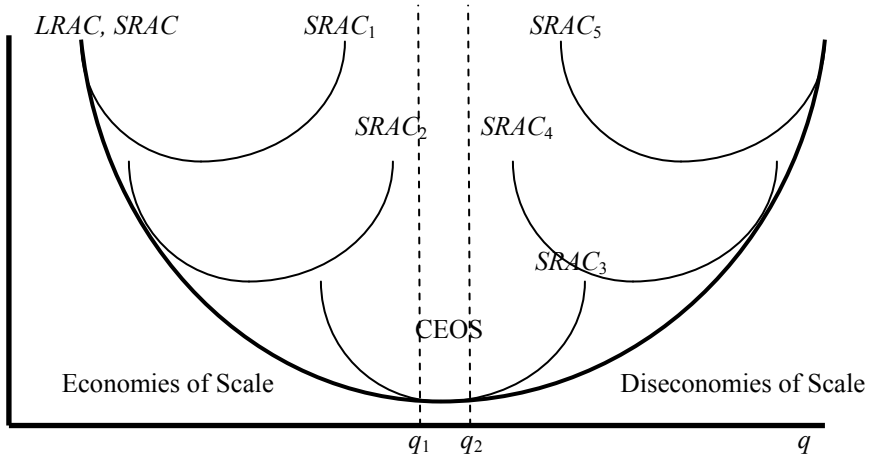


Figure 5

As will be shown in the next section, a simple production such as $q = 2K^{1/4}L^{1/4}$ with fixed factor prices and no long-run fixed costs generates a diseconomies of scale *LRAC* of

$$\boldsymbol{LRAC = Aq} \qquad \textbf{(5)}$$

where *A* represents a constant term. The associated *SRAC*s take the form

$$\boldsymbol{SRAC = C + Bq^4.} \qquad \textbf{(6)}$$

where *C* and *B* represent constant terms. The linear *LRAC* gives way to a quadratic *LRAC* once the existence of a long-run avoidable fixed cost – call it *Z* – is assumed. In this case, the *LRAC* becomes

$$\boldsymbol{LRAC = \frac{Z}{q} + Aq.} \qquad \textbf{(7)}$$

Such a *LRAC* function and its associated *SRACs*, have the general shapes seen in Figure 5. Instructors will find this closes the analytical gap between principles, intermediate, and advanced microeconomics courses. The recognition of long-run avoidable fixed costs is all that is required to make a mathematically-tractable production function generate the inverted-hyperbola *LRAC* curve and the various economies of scale. This change simultaneously simplifies the mathematical modeling while allowing for a complete mathematical framework within which all cost function can be derived from production functions and vice versa. The proposed change in terminology is as follows.

Rule 4: Replace

"In the long run, all costs are variable"

with

"In the long run, all costs are avoidable"

An ardent subscriber of the opportunity cost principle would simply state that "in the long run, all costs are opportunity costs."

NUMERIC EXAMPLE

As previously stated, the proposed changes greatly simplify terminology and analysis without sacrificing mathematical rigor. In fact, instructors are able to increase the rigor of

analysis easily. To illustrate these concepts, consider a firm that produces modems, q, given a production function of

$$q = 2K^{1/4}L^{1/4} \quad (8)$$

where K represents the factory and equipment that constitute the firm's capital and L represents the labor employed. The capital is fixed at 1 (K = 1) in the short run and cannot be adjusted quickly without paying a large premium above its market price. Output may be increased (up to a point) without an increase in K. Thus capital is fixed in a financial rather than a technical sense, as described in Stigler (1987). Capital is not firm-specific and could be leased out to other modem producers at a price of \$4 per hour. Assuming an hourly wage of \$16, the firm has the following two costs.

A variable cost of q^4 for costs associated with its workers.
An avoidable fixed cost of \$4 representing the imputed costs associated with the factory and equipment.

Using the opportunity cost framework, the short-run total cost function is

$$SRTC = 4 + q^4. \quad (9)$$

Note that whether the firm owns its capital, leases it, or is making loan payments on it, does not alter the *SRTC*: the firm incurs a \$4 opportunity cost every hour it uses the capital rather than renting it out. Assuming modems sell in a competitive market for \$32 each, the *TR* and *SRTC* and profit, π, plots are given in Figure 6 and Figure 7, respectively.

Figure 6

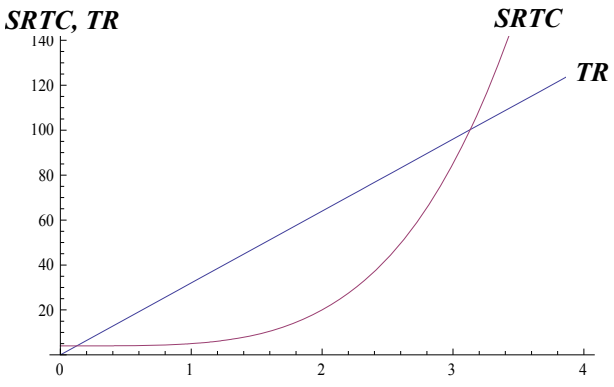
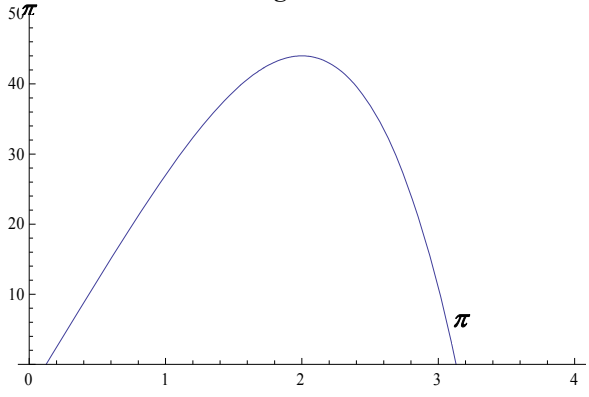


Figure 7



The short run supply curve exists where $MC \geq AC$ and is zero elsewhere. With $MC = \frac{dSRTC}{dq} = 4q^3$ and $AC = \frac{4}{q} + q^3$, the minimum average cost is found where $MC = AC$, at $AC =$ \$4.96 for an output level of $q = 1.075$. Thus the firm's supply curve is given by

$$\boldsymbol{P = MC = 4q^3 \text{ for } P \geq \min AC = 4.96 \text{ and } 0 \text{ otherwise.}} \qquad \textbf{(10)}$$

The supply curve is shown in Figure 8. For comparison, the standard textbook supply curve is shown in Figure 9. Because AVC is below MC for all positive values of output, the standard formulation of the supply curve dictates that supply begins at the origin and there is no minimum price. This mistakenly indicates that production will occur at any price and illustrates another problem of equating fixed and sunk costs.

Figure 8

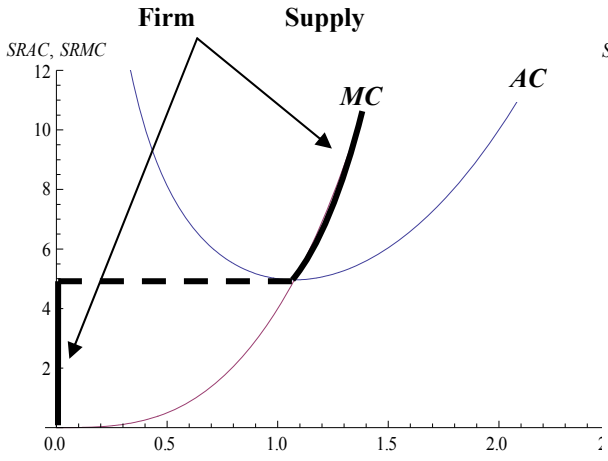
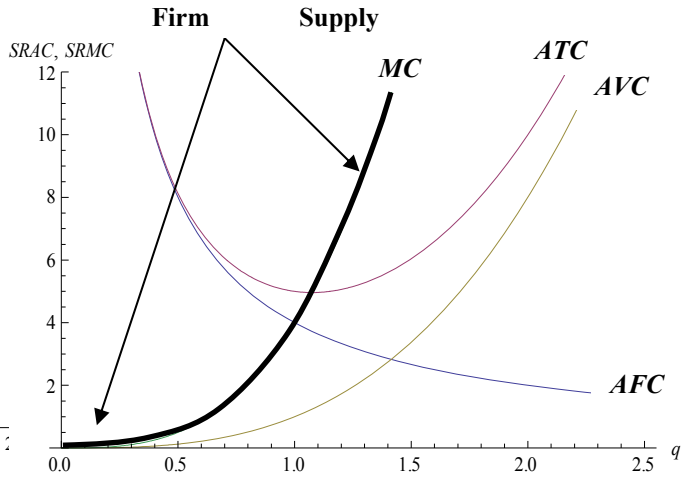


Figure 9

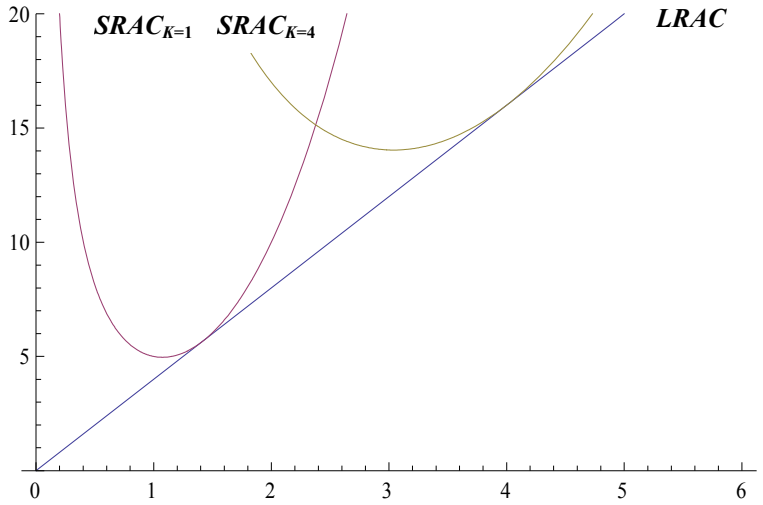


In the long run all costs are avoidable and the optimal value for capital and labor is determined by constrained optimization – for this example, the Lagrangian function is $\mathcal{L} = wL + rK + \lambda(q_0 - K^{1/4}L^{1/4})$ with $w =$ \$16 and $r =$ \$4. The optimal input values are found to be $L^* = 2$ and $K^* = 8$, which yields a long run total cost function of

$$\boldsymbol{LRTC = 4q^2.} \qquad \textbf{(11)}$$

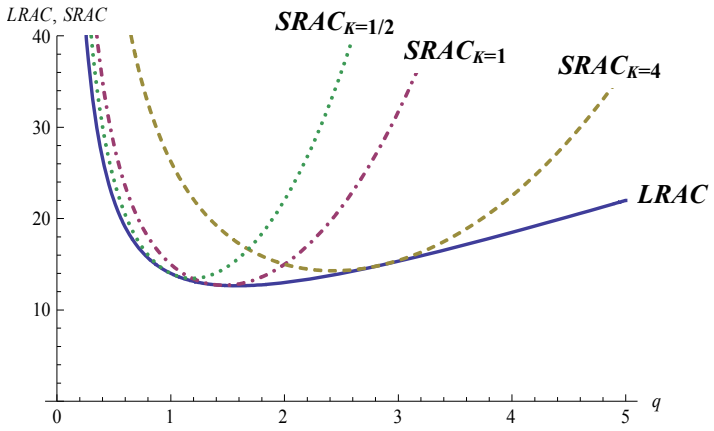
Figure 10 shows the resulting $LRAC$ and both the $SRAC$ with $K = 1$ and another $SRAC$ with $K = 4$. Together they illustrate the envelope relation for a firm producing with diseconomies of scale.

Figure 10



If we assume a long-run fixed cost of 10, say legal fees that do not vary by output but are avoidable each period of production, the *LRTC* and *SRTC*s will change. The resulting *LRAC* and *SRACs* can account for all possible economies of scale as shown in Figure 11. Economies of scale exist up to around q = 1.5 where constant economies of scale exist, and beyond which production is characterized by diseconomies of scale.

Figure 11



CONCLUSION: IMPORTANCE TO CLASSROOM AND BOARDROOM

Opportunity cost is the fundamental concept of decision making and indeed, economic theory. The idea of avoidability has been crucial to the notion of costs presented in this paper.

Determine whether a cost is avoidable and you have determined whether it has an opportunity cost. If the cost is unavoidable, it has no opportunity cost and is therefore sunk. Because opportunity costs are the only costs that matter to economists, sunk costs must be excluded from total costs. Instructors will thereby avoid the problematic practice of adding sunk costs and opportunity costs after imploring students that only opportunity costs matter for decision making. In addition, the confusion inherent in discussing minimum average variable costs as the criterion for shutdown and as a factor in the construction of the firm supply function is also avoided. Students, instead, need only be told that production occurs so long as the firm can cover its avoidable costs. All costs that are unavoidable, and therefore sunk, are ignored in production decisions. By relying on the opportunity cost principle to construct the total cost function, students are better able to grasp the principles of production and cost theory and instructors are able to quantify these concepts starting from production to costs all within a tractable mathematical framework.

Discussing proposed revisions to well-subscribed current cost analysis, such as Wang and Yang (2001), Colander (2002) states that any revision must pass two tests to be accepted. The first test, KISS (Keep it Simple Stupid), is passed because the analysis adds no unnecessary complications and instead, simplifies and eliminates confusion. It passes the second test, CLAP (Change as Little as Possible – of the standard text), as evidenced by the fact that the 4 Rules presented herein, appear as more of a change in emphasis than of substance. In fact, a movement to simplify pedagogy exactly along these lines is clear from Principles of Microeconomics textbooks such as Cowen and Tabarroc (2010) and Frank and Bernanke (2005) who have already adopted a similar pedagogy. The changes suggested herein add to these improvements and bring greater clarity to the standard exposition of costs.

In the end, it is worth asking whether the theoretical inconsistency has had any impact on the real world. That is, do businesses that actually have money on the line confuse avoidable fixed costs with sunk costs? There is evidence that the answer is "yes". Stern Stewart & Company, a financial consultancy, created a tool known as Economic Value Added (EVA) to provide an accurate measure of a corporation's economic profits by attributing an opportunity cost to firms' capital employed by their investments. (Other consulting firms employing similar techniques include Boston Consulting Group's HOLT Value Associates, KPMG Peat Marwick, and Marakon Associates.) Their results indicate that corporations commonly treat fixed costs as if they were sunk, causing an overestimation of their profits and a misallocation of their resources. Using EVA, the company CSX found that their managers were treating their existing stock of containers and trailers as sunk costs. To resolve this problem, divisions within the firm were required to "purchase" their opportunity costs. As a result, freight volume increased by 25%, while the number of freight trailers was reduced from 18,000 to 14,000 and the locomotive fleet fell from 150 to 100. This serves as a cautionary tale. Our students today are the workers, managers, and CEOs of tomorrow. The inconsistencies we pass on to them in the classroom may extend to the boardroom and beyond.

REFERENCES

Arnold, Roger A. (2001). *Microeconomics (Fifth Edition)*. Cincinnati, Ohio: South-Western College Publishing.

Binger, Brian R. and Hoffman, Elizabeth (1988). *Microeconomics with Calculus (First Edition)*. Scott, Foresman and Company, 249-250.

Clark, John Maurice (1923). *Economics of Overhead Costs*. University of Chicago Press.

Coase, Ronald H. (1938). Business Organization and the Accountant. *The Accountant*, October 1-December 17.

Colander, David (2002). On the Treatment of Fixed and Sunk Costs in Principles Texts. *Middlebury College Working Paper*.

Cowen, Tyler and Tabarroc, Alex (2010). *Modern Principles: Microeconomics*. Worth Publishers.

Frank, Robert H. and Bernanke, Ben S. (2005). *Principles of Microeconomics (Third Edition)*. McGraw-Hill/Irwin.

Hall and Lieberman (1998). South-Western College Publishing.

Landsburg, Steven E. (2002). *Price Theory and Applications (Fifth Edition)*. Cincinnati, Ohio: South-Western.

Machlup, Fritz (1934). A Note on Fixed Costs. *Quarterly Journal of Economics*, Volume 48 (3), 559-564.

Parkin, Michael (2010). *Economics (Ninth Edition)*. Pearson Education

Stigler, George Joseph (1987). *The Theory of Price* (*Third Edition)*. The Macmillian Company.

Varian, Hal R. (1996). *Intermediate Microeconomics: A Modern Approach (Fourth Edition)*. New York, N.Y.: W.W. Norton & Company, Inc.

Wang, X. Henry and Yang, Bill Z. (2001). Fixed and Sunk Costs Revisited. *Journal of Economic Education*, Spring: 178-185.

CONVERGENCE OF STATE AND LOCAL FISCAL POLICIES: AN APPLICATION OF PANEL UNIT ROOT TESTS

Christopher N. Annala, State University of New York at Geneseo
Shuo Chen, State University of New York at Geneseo

ABSTRACT

This paper uses two panel unit root tests to show that state and local tax revenues and spending exhibit unconditional convergence between the forty-eight contiguous United States. Results from the Im, Pesaran, and Shin test and the Levin, Lin, and Chu test provide evidence that tax revenues and most government expenditure categories are stationary, implying convergence. The two categories for which we do not find evidence of unconditional convergence are public welfare expenditures and health and hospital expenditures.

INTRODUCTION

Conventional wisdom holds that States compete for economic activity through a variety of policies and initiatives; one such method of attracting economic activity is through fiscal competition or more specifically, tax-competition. For example, Tiebout (1956) demonstrates that fiscal policy decisions are based on the response of economic agents, as they are free to move between jurisdictions to find their most preferred combination of taxes and spending. Simple observation reveals that on a case-by-case basis State governments provide large tax incentives and tax holidays to individual firms to encourage either new plant location or relocation of existing plants from one State to another. States have also developed a system of Enterprise Zones as a means of fostering economic development. In a survey article Wasylenko (1997) concludes that based on the existing evidence taxes do not have a significant impact on economic activity among states. These results must be somewhat disconcerting to policymakers who generally propose lower taxes in an effort to encourage firms and industries to enter their jurisdictions. Reed (2008) provides evidence that several of these studies lacked the appropriate lag structure for the impact of taxes on economic growth.

This paper employs the Im, Pesaran, and Shin test (IPS) (1997, 2003) and the Levin, Lin, and Chu test (LLC) (2002) to study the stationarity of real per capita State and Local tax revenues and broad categories of public spending, among the United States. Research has shown that per capita incomes in the U.S. have been converging both in the long-run and over shorter time periods. Barro and Sala-i-Martin (1995) and Mankiw, Romer and Weil (1992) cover the

topic of income convergence in detail, providing evidence of both unconditional and conditional convergence. The empirical methodology employed by Barro and Sala-i-Martin (1995) and Mankiw, Romer, and Weil (1992) has been used in the public finance literature to demonstrate that under the condition that taxes/expenditures are a constant share of income the Solow (1956) model of economic growth leads to convergence of fiscal policies. Under conventional assumptions where taxes are assumed to be proportional to income, (i.e. $T = \tau Y$, where T represents total tax revenue, τ represents the tax rate, and Y represents income), then convergence of income leads to convergence of taxes. Barro's (1990) endogenous growth model further implies that a government would hold taxes/government spending as a constant share of output, under certain assumptions. The work of Annala (2003) builds on previous research by Scully (1991), where it is shown that convergence in income leads to convergence in fiscal policies. Skidmore, et al. (2004) employ the same empirical techniques, however the authors provide a more formal theoretical explanation for convergence in fiscal policies. Skidmore et al. argue that diminishing marginal returns to government spending leads to convergence of government spending across countries. That is, nations with higher levels of government spending in the past will have lower growth rates in current government spending.

Recent research provides evidence that state and local taxes and expenditures exhibit convergence using a traditional estimation approach, based on Baumol (1986) and Barro and Sala-i-Martin (1995), where the growth rate of taxes and spending are regressed on the initial tax level or the initial spending level. There is also evidence that the distribution of taxes and spending have grown smaller, based on declining coefficients of variation. Using this traditional estimation method, Annala (2003), Merriman and Skidmore (2001), and Skidmore, et al (2004) provide evidence of convergence in government spending among states and across countries. Coughlin, et. al. (2007) extend this line of research through the use of spatial econometrics and show that state expenditure growth is dependent on expenditure growth in economically and demographically similar states.

The contribution of this paper is to provide a more robust test of unconditional convergence in fiscal policies among the United States. Past studies that rely on cross-sectional analysis usually have small sample size, especially in time dimension. Using panel data increases sample size, but applying simple OLS regression technique to panel data can show spurious relations. An alternative to the conventional regression estimation is to employ unit root tests to determine whether or not data exhibit convergence. According to Bernard and Durlauf (1995) convergence exists if the long-run differences between one or more countries tend to zero as the time series tends to infinity, that is the time series is stationary. Rejection of the null hypothesis of a unit root provides evidence of convergence; i.e. the data is stationary. A significant advantage of using panel unit root tests as opposed to univariate ADF tests is that the use of a panel introduces cross-sectional heterogeneity, which increases the power of the unit root test. A second advantage is that some time series are relatively short, and by using a panel unit root test approach the number of observations can be increased dramatically, as it is well known that the

ADF test has low power with a short time series as pointed out by Shiller and Perron (1985). Panel unit root tests have recently been used in a variety of applications including Lee and Wu (2001), Straus (2000), Funk and Strauss (2000), Coakley and Fuertes (1997). However, there has not been any application of panel unit root tests to fiscal policy convergence.

The paper is organized as follows, the next section briefly describes the panel unit root tests used here, the third section describes the data and results, and the fourth section provides some concluding remarks.

PANEL UNIT ROOT TESTS

The following section provides a brief description of panel unit root tests, the Im Pesaran and Shin (IPS) test, the Levin, Lin and Chu (LLC) test. The IPS panel unit root test allows for individual unit root processes so that the autoregressive lag may vary across cross-sections. The equation to be estimated for each cross-section is given by equation (1). For consistency, notation in this section follows that of EViews 5 User's Guide, 2004, Quantitative Micro Software, LLC (see pages 518-525).

$$\Delta y_{i,t} = \alpha y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{i,j} \Delta y_{i,t-j} + X'_{i,t}\delta + \varepsilon_{i,t} \qquad (1)$$

For each cross-sectional unit an ADF test is performed where the lag length is selected by the Schwarz Information Criteria. The test statistic is derived by taking the average of the individual t-statistics on α_i from the individual ADF regressions above and used to estimate equation (2).

$$t_{NT} = \frac{\sum_{i=1}^{N} t_{i\tau_i}(p_i)}{N} \qquad (2)$$

where t_i represent the individual ADF test statistics for each cross-section, with potentially varying autoregressive lags, (p_i). Im, Pesaran, and Shin (1997, 2003) calculate exact sample critical values for the test statistic for varying T and N. The null hypothesis of the IPS panel unit root test is that each series contains a unit root.

Im, Pesaran, and Shin (1997, 2003) show that a properly standardized t_{NT} has an asymptotic standard normal distribution and is represented by the IPS W-statistic. The IPS test has the null hypothesis that each individual time series in the panel has a unit root, against the alternative that all individual units taken as a panel are stationary.

The LLC test statistic also begins with the basic ADF estimation given by equation (1), however in this case it is assumed that the unit root process is common across all cross-sections with potentially varying AR lags. From the above estimation results the proxies $\Delta\bar{y}_{i,t}$ and $\bar{y}_{i,t}$ can be created using the following two equations (3) and (4):

$$\Delta\bar{y}_{i,t} = y_{i,t} - \sum_{j=1}^{p_i} \beta_{i,j} \Delta y_{i,t-j} - X'_{i,t}\delta \quad (3)$$

$$\bar{y}_{i,t-1} = y_{i,t-1} - \sum_{j=1}^{p_i} \beta_{i,j} \Delta y_{i,t-j} - X'_{i,t}\delta \quad (4)$$

At this point $\Delta\bar{y}_{i,t}$ and $\bar{y}_{i,t}$ are standardized by dividing by the standard error from the estimated regression equation (1) to create $\Delta\tilde{y}_{i,t}$ and $\tilde{y}_{i,t}$, and are used to estimate the pooled regression given by equation (5).

$$\Delta\tilde{y}_{i,t} = \alpha\tilde{y}_{i,t-1} + \varepsilon_{i,t} \quad (5)$$

According to LLC the resulting modified t-statistic for α (t_α^*) is asymptotically normally distributed. The LLC test has the null hypothesis that there exists a common unit root. Levin, Lin, and Chu (2002) provide critical values for the test statistic as well as an adjustment for the t-statistic under different assumptions regarding the deterministic trend.

DATA AND RESULTS

The data used to test for convergence of state and local tax revenue and expenditures are from the United States Census Bureau series, *State and Local Government Finances,* and cover the forty-eight contiguous States from 1977 through 2000, for a total of 1,152 observations (U.S. Census Bureau *State and Local Government Finances* series can be found on the Internet at: www.census.gov/govs/www/estimate.html. The Census Bureau does not provide state and local finance data, by state, for 2001-2002). To account for differences in state size, total tax revenues are deflated by state population, so that the unit of analysis is the per capita value. The fiscal variables under consideration in this paper are: Total Taxes, Property Taxes, Sales and Gross Receipts Taxes, Individual Income Taxes, Corporate Income Taxes, Total Income Taxes, Direct General Expenditures, Education Expenditures, Public Welfare Expenditures, Health and Hospital Expenditures, and Highway Expenditures. All fiscal policy variables are converted to real values, based on the seasonally adjusted CPI for all goods, for all urban consumers with base year 1982-84.

Table 1 provides basic descriptive statistics for each of the real per capita fiscal variables. The state of New York has eleven of the fifteen highest values for real per capita total taxes over all states and all years, with the state of Connecticut filling the other four spots. The state of Connecticut had the highest real per capita total tax value for the entire period, which occurred in the year 2000. The lowest level of real per capita taxes over all states for all years occurred in Arkansas in 1981, additionally, Arkansas had six of the lowest fifteen values for real per capita

taxes. In terms of direct general expenditures, New York again dominates the highest real per capita spending over all years and states, with ten of the highest fifteen levels, the other five highest values all occurred in Wyoming. Not surprisingly, eight of the lowest fifteen values for real per capita spending occurred in Arkansas.

Table 1: Descriptive Statistics for all years, all states, 1,152 observations for each series. [All data in real per capita terms (1982-84 = Base-year)]

	Mean	Standard Deviation	Minimum	Maximum
Total Taxes	1378.19	338.17	743.94	2668.62
Property Tax	430.56	192.31	91.59	1092.92
Total Sales & Gross Receipts Tax	490.95	163.47	93.02	1131.27
Individual Income Tax	264.71	181.51	0.00	876.49
Corporate Net Income Tax	59.16	37.91	0.00	204.57
Total Income Tax	323.86	204.45	0.00	1061.57
Direct General Expenditure	2373.44	523.76	1390.63	4285.24
Education Expenditure	854.99	168.55	484.66	1553.26
Public Welfare Expenditure	313.07	140.61	74.67	898.17
Health & Hospital Expenditure	201.01	81.01	48.36	546.77
Highway Expenditure	215.65	72.32	70.39	653.86

Table 2: Correlation Matrix for all years, all states, 1,152 observations for each series. [All data in real per capita terms (1982-84 = Base-year)]

	TT	PT	SGRT	IIT	CIT	TIT	TGEX	EEX	PWEX	HHEX	HIEX
Total Taxes	1.000										
Property Taxes	0.733	1.000									
Sales & Gross Receipt Taxes	0.318	0.002	1.000								
Individual Income Taxes	0.567	0.213	-0.247	1.000							
Corp. Income Taxes	0.466	0.327	-0.219	0.539	1.000						
Total Income Taxes	0.590	0.250	-0.260	0.988	0.664	1.000					
Total General Expenditures	0.886	0.591	0.326	0.451	0.311	0.458	1.000				
Education Expenditures	0.738	0.514	0.176	0.394	0.158	0.379	0.871	1.000			
Public Welfare Expenditures	0.706	0.478	0.215	0.557	0.470	0.582	0.737	0.528	1.000		
Health & Hospital Expenditures	0.267	-0.007	0.337	0.104	0.020	0.096	0.433	0.303	0.259	1.000	
Highway Expenditures	0.197	0.211	0.058	-0.180	-0.218	-0.200	0.392	0.484	-0.043	0.038	1.000

Table 2 presents the correlation matrix for each of the fiscal policy variables, for all states and all years. Interestingly, the revenue category most highly correlated with real per capita Total Taxes is real per capita Property Taxes. This is also represented on the expenditure side where the highest correlation among expenditure variables is between real per capita Direct General

Expenditures and real per capita Education Expenditures. This would seem logical as education is the largest component of state and local spending and much of the revenue for education expenditures is generated through property taxes. To better appreciate the data used in this analysis we present a comparison of real per capita Total Taxes and real per capita General Expenditures in 1977 and 2000 and also the average annual growth rate over the time period, displayed in Table 3. Over this time period the highest average annual growth rate in real per capita taxes occurred in Connecticut, with an average annual growth rate of 2.59 percent. The lowest growth rate in real per capita taxes occurred in Wyoming, with an average annual growth rate of 0.40 percent. On the expenditures side the highest average annual growth rate of real per capita expenditures during this period occurred in South Carolina, with an average annual growth rate of 3.00 percent. The lowest growth rate in real per capita expenditures occurred in Nevada, with an average annual growth rate of 1.05 percent.

Table 3A: All data in real per capita terms
(1982-84 = Base-year)

	Real Per Capita Total Taxes			Real Per Capita Direct General Expend		
	Year		Average	Year		Average
State	1977	2000	Growth Rate	1977	2000	Growth Rate
AL	818.85	1229.55	1.77%	1644.40	2881.21	2.44%
AR	789.26	1295.19	2.15%	1412.65	2402.33	2.31%
AZ	1308.96	1509.15	0.62%	1981.17	2632.91	1.24%
CA	1762.14	2058.60	0.68%	2409.32	3356.51	1.44%
CO	1317.54	1784.53	1.32%	2143.22	3041.77	1.52%
CT	1470.13	2668.62	2.59%	1955.85	3652.19	2.72%
DE	1345.58	1939.75	1.59%	2364.24	3474.60	1.67%
FL	990.97	1523.88	1.87%	1723.42	2735.88	2.01%
GA	976.18	1649.70	2.28%	1646.41	2701.39	2.15%
IA	1225.91	1605.80	1.17%	2007.47	3088.87	1.87%
ID	1021.19	1478.46	1.61%	1832.52	2615.54	1.55%
IL	1396.71	1882.49	1.30%	2075.79	3011.68	1.62%
IN	1050.26	1563.00	1.73%	1536.08	2745.16	2.52%
KS	1200.47	1645.53	1.37%	1960.66	2783.66	1.52%
KY	959.58	1461.56	1.83%	1634.04	2732.81	2.24%
LA	1026.30	1414.82	1.40%	1912.48	2894.91	1.80%
MA	1664.51	2199.15	1.21%	2356.55	3454.84	1.66%
MD	1452.18	2005.63	1.40%	2336.98	3009.72	1.10%
ME	1070.70	1941.36	2.59%	1788.53	3167.78	2.49%
MI	1435.76	1839.26	1.08%	2252.93	3199.45	1.52%
MN	1492.09	2145.53	1.58%	2393.19	3679.57	1.87%
MO	993.72	1485.75	1.75%	1535.61	2576.07	2.25%
MS	848.09	1285.89	1.81%	1638.10	2844.00	2.40%
MT	1247.13	1372.57	0.42%	2240.14	2912.09	1.14%

Table 3B: All data in real per capita terms (1982-84 = Base-year)						
	Real Per Capita Total Taxes			Real Per Capita Direct General Expend		
	Year		Average	Year		Average
State	1977	2000	Growth Rate	1977	2000	Growth Rate
NC	950.26	1546.93	2.12%	1593.38	2917.41	2.63%
ND	1129.88	1599.42	1.51%	2232.81	3323.19	1.73%
NE	1293.67	1687.93	1.16%	1973.68	2853.14	1.60%
NH	999.06	1540.38	1.88%	1806.42	2661.21	1.68%
NJ	1547.91	2266.53	1.66%	2215.74	3259.93	1.68%
NM	1007.61	1532.67	1.82%	1882.65	3224.21	2.34%
NV	1376.53	1693.07	0.90%	2228.78	2835.54	1.05%
NY	2082.83	2658.54	1.06%	2901.47	4285.24	1.70%
OH	1038.20	1751.44	2.27%	1807.09	2948.95	2.13%
OK	969.94	1388.58	1.56%	1670.13	2316.82	1.42%
OR	1281.01	1597.74	0.96%	2262.00	3422.55	1.80%
PA	1258.15	1729.86	1.38%	1920.60	3114.94	2.10%
RI	1278.69	1890.95	1.70%	2035.81	3081.12	1.80%
SC	870.21	1381.36	2.01%	1470.58	2932.66	3.00%
SD	1037.88	1335.05	1.09%	1962.86	2648.77	1.30%
TN	904.54	1269.01	1.47%	1587.47	2579.87	2.11%
TX	1022.97	1454.56	1.53%	1629.80	2667.06	2.14%
UT	1035.12	1527.46	1.69%	1917.25	2864.09	1.75%
VA	1101.76	1729.61	1.96%	1771.23	2848.95	2.07%
VT	1304.48	1788.54	1.37%	2115.51	3286.42	1.92%
WA	1313.67	1845.89	1.48%	2192.53	3298.38	1.78%
WI	1446.70	2008.00	1.43%	2210.68	3330.54	1.78%
WV	999.43	1401.22	1.47%	1711.61	2798.18	2.14%
WY	1615.21	1768.88	0.40%	2592.89	3914.39	1.79%

Table 4 presents the results of the IPS panel unit root tests for each of the fiscal policy variables. The null hypothesis is that the series contains a unit root, therefore rejecting the null hypothesis of a unit root, indicates that the series is stationary, or mean reverting, in other words the rejection of a unit root implies convergence of the fiscal policy variable. In the estimation of the IPS W-statistic the AR lag is selected based on the Schwarz Information Criterion (SIC). The IPS W-statistic presented is based on individual intercepts and linear trends for all series, all tests are performed on the data in levels. One perceived potential advantage of the IPS test over the LLC test is that the IPS test allows for individual unit root processes for each cross-section, whereas the LLC test assumes a common unit root process for a given series. Below we discuss the results of the IPS test in detail and briefly summarize the results of the LLC test presented in Table 5.

The results of the IPS test indicate that we can reject the null hypothesis of a panel unit root at the 5-percent level for all of the fiscal variables except real per capita public welfare expenditures and real per capita health and hospital expenditures, implying convergence of most

of the fiscal policy variables over the period 1977 to 2000 (The number of AR lags by cross-section are available from the authors upon request). A summary of the results of the IPS test is provided in Table 4. The IPS statistic for the Total Taxes variable is -8.663, therefore we reject the null hypothesis and conclude that Total Taxes exhibit convergence.

Table 4: Results of IPS Panel Unit Root Test on Real Per Capita Values. Null Hypothesis is Individual Unit Root Process. [P-values are computed assuming asymptotic normality.]

	IPS W-Statistic	P-value	AR Lags	Cross-Sections	Obs.
Total Taxes	-8.663	0.000	0 to 4	48	1057
Property Tax	-6.516	0.000	0 to 4	48	1060
Total Sales & Gross Receipts Tax	-6.839	0.000	0 to 4	48	1053
Individual Income Tax	-4.185	0.000	0 to 4	45	995
Corporate Net Income Tax	-4.532	0.000	0 to 3	44	991
Total Income Tax	-2.616	0.005	0 to 3	45	1008
Direct General Expenditure	-6.131	0.000	0 to 4	48	1049
Education Expenditure	-5.377	0.000	0 to 4	48	1063
Public Welfare Expenditure	-0.768	0.221	0 to 4	48	1075
Health & Hospital Expenditure	-1.580	0.057	0 to 4	48	1075
Highway Expenditure	-3.650	0.000	0 to 4	48	1074

The AR lag length varies between 0 and 4, depending upon the cross-section, based on SIC. There were a total of 48 cross-sections used in the analysis resulting in 1,057 observations after lags are accounted for. The IPS statistic for the Property Tax variable is -6.516, therefore we reject the null hypothesis and conclude that Property Taxes exhibit convergence. The AR lag length varies between 0 and 4 depending upon the cross section, based on SIC. There were a total of 48 cross-section used in the analysis resulting in 1,057 observations after lags are accounted for. The IPS statistic for the Sales and Gross Receipts Tax variable is -6.839, therefore we reject the null hypothesis and conclude that Sales and Gross Receipts Taxes exhibit convergence. The AR lag length varies between 0 and 4, depending upon the cross-section, based on SIC. There were a total of 48 cross-sections used in the analysis resulting in 1,053 observations after lags are accounted for.

The IPS statistic for the Individual Income Tax variable is -4.185, therefore we reject the null hypothesis and conclude that Individual Income Taxes exhibit convergence. The AR lag length varies between 0 and 4 depending upon the cross section, based on SIC. There were a total of 45 cross-section used in the analysis resulting in 995 observations after lags are accounted for. The three cross-sections excluded from the analysis were Nevada, Washington, and Wyoming. The other states that have no state individual income taxes, Florida, South Dakota, and Texas, were included in the analysis, given that during the time period under consideration each of these states collected a very small amount of individual income taxes in at

least one year, according to the *Census Bureau* data. Obviously, for those states that do not utilize individual income taxes (or corporate income taxes) we will not see convergence among all states. However, the data indicates that we do see convergence in individual income taxes among those states that do utilize individual income taxes as part of a state's revenue system. The IPS statistic for the Corporate Income Tax variable is -4.532, therefore we reject the null hypothesis and conclude that Corporate Income Taxes exhibit convergence. The AR lag length varies between 0 and 3 depending upon the cross section, based on SIC. There were a total of 44 cross-section used in the analysis resulting in 991 observations after lags are accounted for. The four cross-sections excluded from the analysis because they collected zero revenue from corporate income taxes were Nevada, Texas, Washington, and Wyoming. When all income taxes are combined, the IPS statistic for Total Income Taxes is -2.616, therefore we reject the null hypothesis and conclude that Total Income Taxes exhibit convergence. The AR lag length varies between 0 and 3 depending upon the cross section, based on SIC. There were a total of 45 cross-section used in the analysis resulting in 1,008 observations after lags are accounted for.

We now turn to the expenditure categories and find that for Direct General Expenditures the IPS statistic is -6.131, therefore we reject the null hypothesis and conclude that Direct General Expenditures exhibit convergence. The AR lag length varies between 0 and 4 depending upon the cross section, based on SIC. There were a total of 48 cross-section used in the analysis resulting in 1,049 observations after lags are accounted for. The IPS statistic for the Education Expenditure variable is -5.377, therefore we reject the null hypothesis and conclude that Education Expenditures exhibit convergence. The AR lag length varies between 0 and 4 depending upon the cross section, based on SIC. There were a total of 48 cross-section used in the analysis resulting in 1,063 observations after lags are accounted for. The IPS statistic for the Highway Expenditure variable is -3.650, therefore we reject the null hypothesis and conclude that Highway Expenditures exhibit convergence. The AR lag length varies between 0 and 4 depending upon the cross section, based on SIC. There were a total of 48 cross-section used in the analysis resulting in 1,074 observations after lags are accounted for.

Using a 5-percent level of significance, the two fiscal categories for which we do not find evidence of convergence are Public Welfare Expenditures and Health & Hospital Expenditures. The IPS statistic for the Public Welfare Expenditure variable is -0.768, therefore we fail to reject the null hypothesis and conclude that Public Welfare Expenditures do not exhibit convergence. The AR lag length varies between 0 and 4 depending upon the cross section, based on SIC. There were a total of 48 cross-section used in the analysis resulting in 1,075 observations after lags are accounted for. The IPS statistic for the Health & Hospital Expenditure variable is -1.580, therefore we fail to reject the null hypothesis and conclude that Health & Hospital Expenditures do not exhibit convergence. The AR lag length varies between 0 and 4 depending upon the cross section, based on SIC. There were a total of 48 cross-section used in the analysis resulting in 1,075 observations after lags are accounted for. The results for these two categories are discussed in more detail below.

Table 5 presents the results of the LLC panel unit root tests for each of the fiscal policy variables. The AR lag length in this case is also chosen based on the SIC, additionally the Bartlett kernel technique is used to estimate the necessary ratio, and the Newey-West techniques is used to select the bandwidth for the kernel. Here the null hypothesis is that there exists a common unit root process. In this case we also include individual intercepts and linear trends and all tests are performed on the data in levels. The results of the LLC test support those of the IPS test, where all of the fiscal policy variables exhibit stationarity, (rejection of the null hypothesis), of real per capita values at the 5-percent level, except for real per capita public welfare expenditures and real per capita health and hospital expenditures. The results of the LLC test provide additional evidence of unconditional convergence among most fiscal policy variables during the period 1977 to 2000 among the contiguous United States.

Table 5: Results of LLC Panel Unit Root Test on Real Per Capita Values. Null Hypothesis is Common Unit Root Process. [P-values are computed assuming asymptotic normality.]

	LLC-Statistic	P-value	AR Lags	Cross-Sections	Obs.
Total Taxes	-4.361	0.000	0 to 4	48	1057
Property Tax	-4.982	0.000	0 to 4	48	1060
Total Sales & Gross Receipts Tax	-3.980	0.000	0 to 4	48	1053
Individual Income Tax	-2.301	0.012	0 to 4	45	995
Corporate Net Income Tax	-1.681	0.046	0 to 3	44	991
Total Income Tax	-2.165	0.015	0 to 3	45	1008
Direct General Expenditure	-4.132	0.000	0 to 4	48	1049
Education Expenditure	-4.514	0.000	0 to 4	48	1063
Public Welfare Expenditure	-1.522	0.064	0 to 4	48	1075
Health & Hospital Expenditure	-0.422	0.337	0 to 4	48	1075
Highway Expenditure	-3.165	0.001	0 to 4	48	1074

The lack of unconditional convergence of real per capita public welfare and real per capita health and hospital expenditures presents a puzzling and interesting area for future research. Using an alternative estimation technique over a similar time period, Wang (2009) found that there was evidence of moderate unconditional convergence in health care expenditures. However the estimated coefficient was only significant at the 15 percent level. Wang did find evidence of conditional convergence in health care expenditures, and in this case the convergence coefficient is significant at the 5 percent level. Given the findings of Wang, it may be the case that both public welfare and health and hospital expenditures may be experiencing conditional convergence and not unconditional convergence. This implies that these two fiscal categories are approaching state specific steady-states, or perhaps "group" specific steady-states. Assuming that states may be approaching different steady-states in public welfare and health and hospital expenditures, some potential reasons for the lack of

unconditional convergence would include differences in population growth rates and demographics across states and across time, for example age distributions. There are also potential issues with our system of funding both public welfare and health and hospitals through both the federal government and state and local governments, however, this should be less of a problem given that the variables under consideration are in fact state and local expenditures and would have included intergovernmental transfers from the federal government. Aside from these two categories the evidence strongly supports unconditional convergence in fiscal policies between states.

CONCLUDING REMARKS

The results from the panel unit root tests in this paper support the findings by previous researchers, including Scully (1991), Annala (2003), and Skidmore et. al. (2004), that there is consistent empirical evidence of unconditional fiscal convergence among the United States over the past twenty-four years. Using the broad categories of taxes and expenditures we find strong, and supportive, evidence of unconditional convergence of real per capita total taxes, real per capita property taxes, real per capita sales and gross receipts taxes, real per capita individual income taxes, real per capita corporate income taxes, real per capita total income taxes, real direct general expenditures, real per capita education expenditures, and real per capita highway expenditures. We reject the notion of unconditional convergence in real per capita public welfare expenditures and real per capita health and hospital expenditures. The conclusions are based on similar results from two different panel unit root tests, the Im, Pesaran, and Shin test and the Levin, Lin , and Chu test. The results indicate that over the period 1977 to 2000 fiscal policies have become increasingly similar, or have exhibited unconditional convergence over that time period. These results have implications for cross-state comparisons studying the impact of taxes on economic growth. Reed (2008) discusses the reasons why previous research may have had difficulties identifying the relationship between taxes and state economic growth, and the convergence of taxes and spending may be a part of the issue. Tables A1 and A2 in the Appendix provide the results of the IPS test and the LLC test on each of the fiscal policy variables as a share of state personal income. These results support the per capita results discussed in the paper with the exception of (health and hospital expenditure$_i$)/(Personal Income$_i$) for which the IPS test rejects the null hypothesis of a unit root, whereas the LLC test fails to reject the null of a unit root process.

The convergence of tax revenues has important implications for models of fiscal competition such as Case, Rosen, and Hines (1993) where state fiscal policies have spillover effects on neighboring States. With evidence that state and local tax revenues are converging this implies that differences in taxes *among* States will have less of an effect on policymakers attempting to attract economic activity. The ramifications of convergence in state and local taxes are important for both policymakers and economic agents. The results indicate that policymakers

may have to seek alternative means of attracting economic activity to their region, such as emphasizing educational levels, amenities, etc. Furthermore, convergence of fiscal policy variables also has an impact on an agents ability to "vote with her feet" as in Tiebout (1956), that is if all states become increasingly similar it will become more difficult for individuals to move to states where they receive their most preferred package of taxes and public goods. As with states attempting to attract firm location, states also compete for labor and if state fiscal policies become increasingly similar states will have to attract labor through alternative means.

REFERENCES

Annala, C. (2003). Have state and local fiscal policies become more alike? Evidence of Beta convergence. *Public Finance Review*, 31(2), 144-165.

Baumol, W. (1986). Productivity growth, convergence, and welfare: What the long-run data show. *American Economic Review*, 76(5), 1072-1085.

Barro, R. (1990). Government spending in a simple model of endogenous growth, *Journal of Political Economy*, 98(5), 103-125.

Barro, R.& X. Sala-i-Martin (1995). *Economic growth*. New York: McGraw-Hill.

Bernard, A.B. & S.N. Durlauf (1995). Convergence of international output. *Journal of Applied Econometrics*, 10(2), 97-108.

Campbell, J. & P. Perron (1991). Pitfalls and opportunities: What macroeconomists should know about unit roots. Technical Working Paper 100, NBER Working Paper Series, April.

Case, A.C., H.S. Rosen & J. Hines (1993). Budget spillovers and fiscal policy interdependence: Evidence from the states. *Journal of Public Economics* 52(3), 285-307.

Coakley, J. & A.M. Fuertes (1997). New panel unit root tests of PPP. *Economics Letters*, 57(1), 17-22.

Coughlin, C.C., T.A. Garrett & R. Hernández-Murillo (2007). Spatial dependence in models of state fiscal policy convergence. *Public Finance Review*, 35(3), 361-384.

Funk, M. & J. Strauss (2000). The long-run relationship between productivity and capital. *Economics Letters*, 69(2), 213-217.

Im, K.S., M.H. Pesaran & Y. Shin (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), 53-74.

Lee, H.Y. & J.L. Wu (2001). Mean reversion of inflation rates: Evidence from 13 OECD countries. *Journal of Macroeconomics*, 23(3), 477-487.

Levin, A., C.F. Lin & C.J, Chu (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1), 1-24.

Mankiw, N.G., D. Romer & D.N. Weil (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 107(2), 407-437.

McLure, C.E. (1986). Tax competition: Is what's good for the private goose also good for the public gander? *National Tax Journal*, 39(3), 341–348.

Merriman, D. & M. Skidmore (2001). Convergence in state government health care spending and fiscal distress. *Proceedings of the Ninety-Fourth Annual Conference of the National Tax Association*, 81-89.

Reed, R.W. (2008). The robust relationship between taxes and U.S. state income. *National Tax Journal*, 61(1), 57-80.

Scully, G.W. (1991). The convergence of fiscal regimes and the decline of the Tiebout effect. *Public Choice*, 72(1), 51–94.

Shiller, R.J. & P. Perron (1985) Testing the random walk hypothesis: Power versus frequency of observation. *Economics Letters*, 18(4), 381-386.

Skidmore, M., H. Toya & D. Merriman (2004). Convergence in government spending: Theory and cross-country evidence, *Kyklos*, 57(4), 587-620.

Solow, R. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics*, 70(1), 65-94.

Straus, J. (2000). Is there a permanent component in US real GDP. *Economics Letters*, 66(2), 137-142.

Tiebout, C. (1956) A pure theory of local public expenditures, *Journal of Political Economy*, 64(5), 416-24.

Wang, Z. (2009). The convergence of health care expenditures in the US states. *Health Economics*, 18(1), 55-70.

Wasylenko, M. (1997). Taxation and economic development: The state of the economic literature. *Federal Reserve Bank of Boston New England Economic Review*, Mar, 37-52.

Wildasin, D.E. (1991). Some rudimentary "duopoly" theory. *Regional Science and Urban Economics*, 21(3), 393–421.

Wilson, J.D. (1986). A theory of interregional tax competition. *Journal of Urban Economics*, 19 (3), 296–315.

APPENDIX

Table A1: Results of IPS Panel Unit Root Test on Share of Personal Income. Null Hypothesis is Individual Unit Root Process. [P-values are computed assuming asymptotic normality.]		
	IPS W-Statistic	P-value
Total Taxes	-8.915	0.000
Property Tax	-5.217	0.000
Total Sales & Gross Receipts Tax	-6.440	0.000
Individual Income Tax	-6.049	0.000
Corporate Net Income Tax	-5.488	0.000
Total Income Tax	-5.880	0.000
Direct General Expenditure	-4.185	0.000
Education Expenditure	-7.089	0.000
Public Welfare Expenditure	2.295	0.989
Health & Hospital Expenditure	-2.893	0.002
Highway Expenditure	-6.850	0.000

Table A2: Results of LLC Panel Unit Root Test on Share of Personal Income. Null Hypothesis is Common Unit Root Process. [P-values are computed assuming asymptotic normality.]		
	LLC-Statistic	P-value
Total Taxes	-6.575	0.000
Property Tax	-3.652	0.000
Total Sales & Gross Receipts Tax	-3.820	0.000
Individual Income Tax	-4.529	0.000
Corporate Net Income Tax	-2.781	0.003
Total Income Tax	-4.429	0.000
Direct General Expenditure	-3.359	0.000
Education Expenditure	-6.668	0.000
Public Welfare Expenditure	0.461	0.678
Health & Hospital Expenditure	-0.004	0.499
Highway Expenditure	-6.482	0.000

HIGH SCHOOL STUDENTS' ACADEMIC PERFORMANCE AND INTERNET USAGE

Wesley Austin, University of Louisiana at Lafayette
Michael W. Totaro, University of Louisiana at Lafayette

ABSTRACT

Considerable controversy surrounds the effects technologies such as the Internet have on human capital accumulation. As with most media, the Internet and related services are capable of delivering enriched learning experiences. However, there are large potential costs to using the Internet and its concomitant services, which may result in degradation of high school students' scholastic performance. In this study, we explore two related questions. First, does Internet usage harm the grades of high school students? Second, to what degree does the intensity of Internet usage affect grades? We utilize data from the 2005 National Survey on Drug Use and Health (NSDUH), which measures educational outcomes, internet use and a host of other correlates. Probit results indicate that excessive Internet use lowers the probability of earning top grades while more moderate use has a positive impact on the probability.

INTRODUCTION

Several reasons might lead technology to assist or impair human capital attainment by students. Youths may employ the Internet in educational matters such as writing papers, searches for answers to questions and communicating with classmates on homework. However, time spent in activities where "surfing the net" occurs could substitute away from time allocated to reading, studying and completing homework. This may hurt academic performance in the short term, which might also diminish the ability or incentive to continue schooling over the longer term.

Within the past decade, the Internet and WWW use have increased substantially – for example, according to Pew Internet & American Life Project Surveys, the percentage of U. S. online users has increased from 40-45% in March 2000 to nearly 80% in April 2009 (Pew Internet & American Life Project Surveys, 2009). Recent expansion of adolescent use of the Internet is the result of an ongoing shift in adolescents' daily behavior patterns. The majority of adolescents from a sample in one study compared their online behaviors to the phenomenon of placing telephone calls, which are typically mundane, the purposes for which are both social and nonsocial (Gross, 2004). Hence, adolescents' Internet use occurs without much thought or consideration – it has become, in effect, just a normal daily activity.

Why is the potential impact of Internet use on educational outcomes relevant for the discipline of economics? Human capital accumulation bears directly and heavily on earning

potential (see Grossman, 1972 and Mincer, 1974) and it is widely accepted that strong and statistically significant relationships link individual health and human capital formation. Moreover, the impact of educational policies and factors that affect learning continues to generate widespread public policy concern. Thus, for economists and policy makers, gauging the relationship that technology use has on educational outcomes is worthy of study.

MOTIVATION

Computer access and use among adolescents and other ages have grown considerably over the past decade (Louge, 2006). In fact, more than 80% of U.S. adolescents between the ages of 12 and 17 use the Internet, with roughly half going online daily (Lenhart et al., 2005). The significance of Internet use by children and adolescents has even spawned a new field of inquiry in developmental psychology (Greenfield and Yan, 2006). With the likelihood that Internet usage by adolescents will continue to increase over time, concerns about the impact on high school students' academic performance should be researched. Stakeholders – parents, teachers, administrators, and the students themselves – would benefit from knowing more about the digital environment within which learning occurs. Regardless of whether academic performance is positively or negatively impacted by Internet use, a better understanding and greater awareness about such issues might facilitate changes in pedagogy by educators, as well as learning on the part of students and the support they receive from their parents.

In a conceptual context, we tacitly assume that students utilize the Internet for both academic and non-academic purposes, with the most *intense* users (which is described in the Data section) spending the most time in non-academic pursuits (e.g. Facebook, downloading music). And our general modeling framework is one of optimization, where there are both educational benefits and costs to the Internet, and where the primary benefit of Internet use is increased human capital accumulation as evidenced by higher grades. At a basic level, Internet use denotes a certain amount of technical savvy which emanates from a student actually learning a new skill – this alone can translate into higher grades. Benefits derived from Internet use usually come about at significant costs, including deployment of the required infrastructure for providing Internet access to students (which this study does not directly address) as well as monetary and time costs devoted to the Internet that detract from educational achievement (see Angrist and Lavy, 2002).

The central issue is to determine what, if any, level of Internet use raises or lowers grades. This entails a quintessential marginal benefit/ marginal cost analysis. This article begins the process by examining quasi-defined levels of Internet utilization (where *more venues of use* in a defined time period is assumed to equate to *more money and time devoted to use*) and the resulting impact on student grades.

LITERATURE OVERVIEW

The controversy over whether technology actually improves student learning is one that stirs debate and motivates research. The articles reported in the economics literature have been limited both in quantity and scope with methods and results varying across studies. The literature has focused primarily on the impact of technologies in general on student learning; few studies have examined the direct link between educational outcomes such as GPA and Internet use.

Gratton-Lavoie and Stanley (2009) compare undergraduate students who opted to enroll in online microeconomics classes against those who opted for the traditional in-class course. Results show a higher average score on exams for students enrolled in online classes. However, after accounting for selection bias, results indicate that age positively affects students' average exam scores, with the online teaching mode having a very small effect on average exam scores. Kubey et al. (2001) uses a small survey of 572 students at a public university and finds that heavy Internet use is highly correlated with poor academic performance.

Angrist and Lavy (2002) argue that most studies covering enhancements of learning through technology focus on qualitative factors, such as participant perceptions. Thus, an empirical approach is undertaken which compares outcomes between students who supplement learning with computer aides against those students who do not. Their results show that increased educational use of computers seems to have little or no effect on students' test scores. Ordinary least squares regression estimates demonstrate no relationship between computer-aided instruction and academic achievement, with the exception of a negative effect on eight-grade mathematics scores.

Ball et al. (2006) examine the effect of employing wireless handheld technology by students on academic performance in undergraduate principles of economics courses by way of a controlled experiment. One group of students (experimental group) were equipped with wireless handheld devices that allows interactive participation with standard economics games, multiple choice tests, and communication with the instructor during class time. The second group (control group) was not given the devices. Course content, assignments, exams, and so on, were identical between both groups. Results show that students in the experimental group earned final grades that were an average of 3.2 points higher than did the students in the control group.

Anstine and Skidmore (2005) assess whether MBA students in online economics classes learn as much of the material (measured by average exam scores) as did their counterparts in the traditional economics classes. Specifically, a small sample of MBA students was given the option to enroll in either an online or traditional class. Accounting for sample selection bias, regression analysis proffers that students in the online classes did not learn as much, suggesting that the online learning environment is less effective than the traditional classroom environment.

Jackson et al. (2006) studies the impact of home Internet use on academic performance of 140 low-income children between December 2000 and June 2002. The degree of Internet use is calculated using four measures: minutes per day spent online, logins per day, number of

domains visited per day, and number of emails sent per day. Academic performance of participants was measured by GPA and standardized test scores on the Michigan Educational Assessment Program (MEAP). Results suggest that children with greater Internet use had higher GPAs and higher MEAP scores. However, the higher MEAP scores were only in the reading portion, with Internet use having no effect on the mathematics portion of the MEAP test.

It is worth noting that at least one study examined adolescents' activities while online (Hunley, Evans, Delgado-Hachey, Krise, Rich, Schell, 2005). Employing a logbook approach whereby students documented their time for a seven-day period, Hunley et al. (2005) found that at least 50% of the students (N = 101) logged the following activities while online (hours per week indicated in parenthesis): visiting web sites (1.27), playing games (4.43), reading the news (0.73), researching information (1.22), and emailing (1.13). Fewer than 50% of the students spent time chatting (2.12), word processing (2.13), shopping (1.60), and "other" (2.00).

Many studies have limited sample sizes and education-related variables. In contrast, our analysis employs a much larger sample size of students for which there is substantially greater information on demographics and household characteristics. Moreover, the number of variables available in our dataset is large and generally exceeds the number of variables found in the datasets in the above studies.

DATA

Since its inception in 1979, the National Survey on Drug Use and Health (NSDUH), sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA), is administered annually to approximately 55,000 civilian, non-institutionalized individuals age 12 and over, chosen so that the application of sample weights produces a nationally representative sample with approximately equal numbers of respondents from the 12–17, 18–25, and 26 and over age groups.

Variables on Internet use are collected and compiled by SAMHSA administrators only for the 2005 survey; hence these are the data we analyze. Our sample consists of 12,184 enrolled high school students. Data from the NSDUH allow for both breadth and depth of coverage on the topic. Breadth comes from the ability to study aspects of educational outcomes using data from an elaborate questionnaire administered to 12–17 year olds on a wide array of youth experiences. An assortment of variables are observed, therefore, that have the potential to serve as predictors for grades in the proposed model. Depth is provided by variables on race, gender, family income, family composition, religion and health.

A potentially problematic attribute of the data is non-random measurement error emanating from the self-reported nature of responses. However, studies on the quality of self-reported academic variables data suggest that such reporting bias should be minimal. Cassady (2001) finds that self-reported GPA values are "remarkably similar to official records" and therefore are "highly reliable" and "sufficiently adequate for research use." Hunley et al. (2005)

address concerns about self-reported survey data by way of demonstration of the reliability of survey data as "appropriate" for measuring accurately adolescents' Internet use. Specifically, students provided estimates of their Internet use, and then logged their actual daily Internet use for a one week period. Comparisons between estimated Internet use and actual use showed reliability of the self-reported estimates. Their conclusion is that researchers should feel confident about self-reported survey data pertaining to Internet use.

RESEARCH METHOD AND EMPIRICAL SPECIFICATION

Consider the following equation, in which Grades is a function of exogenous factors with Internet usage of prime importance,

$$\text{Grades} = \beta_0 + \beta_1 IU + X\beta_2 + \varepsilon$$

In the above equation, which applies to individual NSDUH respondents (with the corresponding observation-level subscript suppressed), IU represents venues of Internet usage in the past 30 days. Vector X represents a set of other exogenous variables that conceivably affect grades. The β's are parameters to be estimated and ε is the error term.

Grades

We investigate effects on grades by analyzing the probability the student receives an 'A' or 'B' average or an average of 'D' or below. Grades is measured using a 1-4 scale with '4' representing A+, A, A- ; '3' representing B+, B, B-; '2' representing C+, C, C- and '1' representing D or below.

Internet Usage

When the survey is administered, respondents are queried on venues of Internet utilization in the past 30 days. We categorize Internet users in three forms: Level 1; Level 2; and Level 3. For individuals in Level 1, the Internet was utilized at home, at school, at a friend's house, at a café with Internet access, over a cell phone and *some other place* – this variable is "open" and does not have specific options. For those in Level 2, the Internet was utilized at home and at school. For those in Level 3, the Internet was utilized only at school. We term those in Level 1 as *intense* Internet users; those in Level 2 as *moderate* users; and those in Level 3 as *light* users. For *light* usage, Internet access is subject to time constraints (i.e. hours of operation for schools), whereas for *intense* and *moderate* usage, there is virtual 24 hour access. To avoid the "dummy variable trap" in the regressions, those that did not use the Internet (*no* use) in the past 30 days is the omitted category and is used as the category of comparison.

Explanatory Variables

Several variables from the NSDUH data are considered explanatory in equation (1): age indicators are included for whether the student is 14, 15, 16 or 17 years old with age 13 as the omitted category to avoid the "dummy variable trap." Binary indicators are included for whether the mother or father resides in the household, for whether parents assisted the student with homework always or sometimes in the past 12 months, with "never" as the omitted category, and for whether the student is currently classified as a sophomore or junior/ senior, with "freshman" as the omitted category. We also include a binary variable for school type (public or private). Potential endogeneity (stemming from students' "self-selecting" into certain learning environments by choosing to attend certain schools) should be mitigated in that location of high school attendance is largely determined by parental preferences in occupation, living conditions, as well as other correlates.

To control for the possibility that a student subscribes to a "work hard-play hard" ethos and therefore heavily utilizes the Internet yet maintains high grades, a binary indicator is incorporated for a student that heavily uses the Internet and also states that school work is important/ meaningful, and is thus more likely to have good grades. We term this a "high motivation" student.

Family income is measured in four categories: $10,000-$19,999; $20,000-$49,999; $50,000-$74,999; and $75,000 or greater, with $10,000-$19,999 as the omitted category. A measure for the number of times the student moved in the past year is incorporated as is a binary indicator for gender. For race, indicators are specified for Caucasians, African Americans and Asians, with non-white Hispanics as the omitted category. Further, student physical health is measured as follows: great health, good health and fair health with "poor health" as the omitted category. A factor for religiosity is also included given that this may proxy for increased academic discipline. For this factor, a binary variable is created and coded as '0' if religion does not influence decisions and '1' if it does. Religiosity has been linked to educational outcomes (Wolaver, 2002).

EMPIRICAL FINDINGS

Table 1 presents select summary statistics. *Intense* Internet use is 0.047 and *moderate* Internet use is 0.491 while *light* use is lower with a mean of 0.350 – all indicating abundant exposure to the Internet. Approximately eight percent of students attend private schools. Fathers are less likely to be present in the household than are mothers and the proportion of parents that always help with homework is also quite high (0.54). Caucasians comprise approximately 63 percent of the sample, African Americans about 14 percent, while non-white Hispanics and Asians account for about 15 percent and three percent, respectively. About one third of students

report being in excellent health, with 41 percent reporting good health, and a large proportion (0.651) state that religion influences decision making.

Table 1. Descriptive Statistics
(n=12,184)

Variable	Mean	Standard Deviation
Probability of an 'A' or 'B' grade	0.684	0.465
Probability of a 'D' or lower grade	0.070	0.256
Intense Internet Use (past 30 days)	0.047	0.213
Moderate Internet Use (past 30 days)	0.491	0.499
Light Internet Use (past 30 days)	0.350	0.407
No Internet Use (past 30 days)	0.112	0.315
High Motivation Student: heavy internet use/ positive school attitude	0.713	0.452
Mother in household	0.918	0.275
Father in household	0.732	0.443
Respondent is female	0.501	0.500
Attending private school	0.082	0.274
Age of student (13 years old)	0.134	0.340
Age of student (14 years old)	0.215	0.410
Age of student (15 years old)	0.228	0.420
Age of student (16 years old)	0.222	0.415
Age of student (17 years old)	0.192	0.394
Race (Caucasion)	0.631	0.483
Race (African American)	0.136	0.342
Race (Asian)	0.030	0.170
Race (non-white Hispanic)	0.152	0.359
Sophomore	0.220	0.414
Junior or Senior	0.324	0.468
Family income (less than $20,000)	0.180	0.344
Family income ($20,000-$49,999)	0.345	0.475
Family income ($50,000-$74,999)	0.202	0.402
Family income ($75,000 or more)	0.286	0.452
number of times moved (past year)	0.322	0.696
Parents help with homework (always)	0.547	0.498
Parents help with homework (sometimes)	0.230	0.421
Student health status (great)	0.331	0.471
Student health status (good)	0.418	0.493
Student health status (fair)	0.213	0.410
Religion influences decisions	0.651	0.477

The Effects of Internet Use on the Probability of Obtaining an 'A' or 'B'

As shown in Table 2, *intense* Internet use is significant and lowers the probability of earning an 'A' or 'B' versus lower grades; *light* Internet use also lowers the probability while *moderate* use elevates the probability of an 'A'/ 'B'. The Log Pseudolikelihood is -6707.84. *Intense* Internet use reduces the probability of achieving an 'A'/ 'B' by 0.03 – for students that are *intense* Internet users, the probability of having an 'A'/ 'B' average is undercut by approximately 5 percent compared to students who did not use the Internet at all in the past 30 days (to which, for parsimony, we refer to as *'no* use' for the remainder of the section). If a student reports *moderate* usage, the probability of having an 'A'/ 'B' increases by 0.08 compared to *no* use – *moderate* users have a roughly 12 percent increased probability of earning this average compared to *no* use. *Light* internet users have about a 6 percent lower probability of earning an 'A'/ 'B' versus *no* use.

The negative effects associated with *intense* Internet utilization may indicate that this level of usage actually impairs the learning process (perhaps by lowering attention span) which, in turn, reduces the capability of the student to earn top grades. Also, students using the Internet at a friend's house or café may be distracted by non-academic conversations even when using the Internet for academic purposes. In addition, *intense* use may translate into less time spent on and homework and studying, compared to *no* use; hence, grades are lower for those in the *intense* use category versus *no* use.

Interestingly, *light* users have a diminished probability of an 'A'/ 'B' versus *no* use. This may provide evidence that when students have Internet access only at school, that time is utilized "surfing the net" for recreational purposes (e.g. Facebook), which is time subtracted from studying; therefore, grades are actually lower for those in the *light* use category compared to *no* use. Overall, *moderate* use (which includes home use as a major component) has the most positive impact on grades, which could indicate that home Internet use by students is more focused on academic pursuits compared to other venues.

As stated in our Motivation section, there is an opportunity cost involved in using the Internet, which includes reduced study time and possibly increased devotion of the students' monetary resources to Internet services that detracts from the prospect of receiving an 'A'/ 'B' average. These results imply that those costs are salient. This is an interesting contrast to the study done by Jackson et al. (2006), which (as discussed earlier) found that adolescents who used the Internet more had higher grade point averages. An additional contrast to our results and the results of the Jackson et al. (2006) study are the results of Hunley et al. (2005), which did not show a significant relationship between time spent on the computer at home and grades.

Table 2. Probit estimates for the probability of an 'A' or 'B'
(n=12,184)
Log Pseudolikelihood=-6707.84

Explanatory variables	Coefficient	Robust Standard Error
Intense Internet use	-0.034***	(0.021)
Moderate Internet use	0.082*	(0.014)
Light Internet use	-0.039*	(0.014)
High Motivation Student	0.116*	(0.011)
Mother in household	0.057*	(0.016)
Father in household	0.012	(0.011)
Respondent is female	0.145*	(0.008)
school type (private)	0.082*	(0.015)
Age of student (14 years old)	-0.047*	(0.016)
Age of student (15 years old)	-0.127*	(0.019)
Age of student (16 years old)	-0.193*	(0.024)
Age of student (17 years old)	-0.191*	(0.028)
Race (Caucasian)	0.089*	(0.020)
Race (African American)	-0.011	(0.022)
Race (Asian)	0.198*	(0.018)
Sophomore	0.073*	(0.014)
Junior or Senior	0.137*	(0.018)
Family income ($20,000-$49,999)	0.006	(0.013)
Family income ($50,000-$74,999)	0.037**	(0.015)
Family income ($74,999 and over)	0.097*	(0.014)
number of times moved (past year)	-0.035*	(0.006)
Parents help with homework (sometimes)	0.021**	(0.006)
Parents help with homework (always)	0.057*	(0.008)
Student health status (great)	0.217*	(0.019)
Student health status (good)	0.164*	(0.021)
Student health status (fair)	0.062*	(0.022)
Religion influences decisions	0.064*	(0.009)

*statistically significant at 1%
**statistically significant at 5%
***statistically significant at 10%

The Effects of Internet Use on the Probability of a 'D' or Lower Average

Table 3 presents the regression estimates for the probability the respondent has a 'D' or lower grade versus other grades. The Log Pseudolikelihood is -6707.84. *Intense* Internet use elevates the probability of achieving a 'D' or lower grade by almost 0.02. If a student reports *moderate* usage, the probability of having a 'D' or lower average falls by 0.03 compared to *no* use, but rises by 0.01 for *light* use (compared to *no* use). *Intense* users have a higher probability of a 'D' or lower grade (about 25 percent), while *moderate* users have a decreased probability (approximately 28 percent) of having this average, compared to students who report *no* use. *Light* users have a roughly 13 percent increased probability of a 'D' or lower average compared to *no* use.

The estimated effect for *intense* use is rather large, even accounting for the fact that the outcome incorporates grades of 'D' and 'F'. Again, there may be large opportunity costs associated with such rigorous Internet use which undermines academic achievement. Thus, grades are lower and higher failure rates may account for some of the largeness. Moreover, *moderate* users fare better academically compared to *no* use: *moderate* users have a decreased probability of earning a 'D' or less versus those students' that report *no* Internet use. For *light* users, the probability of earning 'D' or lower is higher compared to *no* use, again potentially indicating that students who only have Internet access at school spend this time in recreational use and hence suffer lower grades as study time falls.

The Effects of Other Explanatory Variables on Grade Probabilities

Many of the other explanatory variables have a significant impact on grades. Interestingly, "High Motivation" students have a greater probability (0.12) of earning an 'A'/ 'B' average but the probability of earning a 'D' or lower is reduced by 0.06. The presence of mothers in the households generally has a favorable impact on 'A'/ 'B' grades, while the presence of fathers is not significant. However, parental involvement does have profound effects as assisting with homework raises student grades. For example, if a parent *always* helps with homework, the probability of an 'A'/ 'B' rises by approximately 0.06; the probability of 'D' or lower falls by 0.02.

Those that attend private schools have a 12 percent greater probability of earning an 'A'/ 'B' and a 27 percent lower probability of having a 'D' or lower average. In addition, Caucasians and Asians have higher probabilities of achieving an 'A'/ 'B' average versus African Americans, while females enjoy a higher probability of 'A'/ 'B' and versus males. Higher levels of income are also significant in some instances. Students in families earning $20,000-$49,999 and $50,000-$74,000 a year have a greater probability of obtaining an 'A'/ 'B' average (0.037 and 0.197 respectively) and lower probability of having a 'D' or less (-0.008 and -0.017 respectively), compared to families earning $10,000-$19,999.

Table 3. Probit estimates for the probability of a 'D' or lower
(n=12,184)
Log Pseudolikelihood=-2697.80

Explanatory variables	Coefficient	Robust Standard Error
Intense Internet use	0.018**	(0.010)
Moderate Internet use	-0.021*	(0.005)
Light Internet use	0.009***	(0.005)
High Motivation Student	-0.053*	(0.006)
Mother in household	-0.007	(0.007)
Father in household	0.001	(0.004)
Respondent is female	-0.025*	(0.003)
school type (private)	-0.019*	(0.006)
Age of student (14 years old)	0.011	(0.007)
Age of student (15 years old)	0.033*	(0.009)
Age of student (16 years old)	0.065*	(0.014)
Age of student (17 years old)	0.053*	(0.016)
Race (Caucasian)	-0.012	(0.008)
Race (African American)	-0.013***	(0.007)
Race (Asian)	-0.037*	(0.006)
Sophomore	-0.002*	(0.005)
Junior or Senior	-0.048*	(0.006)
Family income ($20,000-$49,999)	0.005	(0.005)
Family income ($50,000-$74,999)	-0.008	(0.006)
Family income ($74,999 and over)	-0.017*	(0.006)
number of times moved (past year)	0.011*	(0.002)
Parents help with homework (sometimes)	-0.001*	(0.002)
Parents help with homework (always)	-0.020*	(0.003)
Student health status (great)	-0.057*	(0.006)
Student health status (good)	-0.051*	(0.007)
Student health status (fair)	-0.021*	(0.006)
Religion influences decisions	-0.025*	(0.004)

*statistically significant at 1%
**statistically significant at 5%
***statistically significant at 10%

As students advance in age, the probability of having an 'A'/ 'B' mildly decreases and the probability of a 'D' or lower increases. Of course, this may indicate an increasing opportunity cost involved in studying and in other educational activities as students learn to drive, enjoy more personal freedom and possibly rebel against parents. The effects are opposite for class standing where students that are juniors/ seniors have enhanced probabilities of earning an 'A'/ 'B' and lower probabilities of earning a 'D' or less. This could imply that at least some students study more in an effort to "drive-up" GPA's for approaching college entrance.

In keeping with broader literatures on human capital, students that are in better health also earn higher grades (higher probability of 'A'/ 'B'; lower probability of 'D' or less), while those that relocate more often have lower 'A'/ 'B' probabilities and higher 'D' and below probabilities. In addition, religiosity impacts grades: students who state religious beliefs influence decisions have a 0.064 greater probability of having an average 'A'/ 'B' average and a 0.025 diminished probability of having a 'D' or less than 'D' average. For the most part, our results demonstrate that the number of venues of Internet use have an impact on the academic achievement of high school students even after controlling for a host of other factors.

CONCLUDING REMARKS

For this study, there is evidence that the grades of high school students are lowered when additional venues of Internet access are utilized. Specifically, when all venues of Internet use are exhausted, which we refer to as *intense* use, grades are lower when compared to students that report *no* Internet use. Moreover, students that only use the Internet at school, which we term *light* use, also suffer from lower grades compared to those that did not utilize the Internet. Conversely, students that used the Internet at school *and* at home, which we term *moderate* use, enjoy higher grades versus those that did not use the Internet. Our model supports a hypothesis of "optimal" Internet use. Results indicate that grades are higher when students undertake *moderate* Internet use; however, grades decline when students are below or surpass a certain threshold (i.e. optimum). Potentially large opportunity costs of Internet use (in the possible form of detractions from time spend studying and engaging in other activities that enhance grades) may be present for *intense* and *light* Internet users.

The results provide useful information to high school administrators, teachers, counselors, parents, and students, when they consider implications for use of the Internet in an educational setting. Moreover, university administrators and faculty will find the results helpful, since many high school graduates continue their education by way of college and university studies. From a policy perspective, high school administrators may wish to consider guidelines that curtail non-academic Internet use in schools.

Our data did not explicitly outline whether students' Internet use was for academic or social purposes; therefore, future research that incorporates this data would provide more information. In addition, the costs of deploying the required infrastructure needed to provide

Internet access to students would prove useful in continued analyses of the benefits and costs of the Internet.

REFERENCES

Angrist, J. & V. Lavy (2002). New evidence on classroom computers and pupil learning. *The Economic Journal*, *112*(482), 735-765.

Anstine, J. & M. Skidmore (2005). A small sample study of traditional and online courses with sample selection adjustment. *Journal of Economic Education*, *36*(2), 107-127.

Ball, S. B., C. Eckel, & R. Christian (2006). Technology improves learning in large principles of economics classes: Using our WITS. *The American Economic Review*, *96* (2): 442-446.

Cassady, J.C. (2001). Self-reported gpa and sat: A methodological note. *Practical Assessment, Research & Evaluation, 7*(12). Retrieved December 13, 2010, from http://PAREonline.net/getvn.asp?v=7&n=12.

Gratton-Lavoie, C. & D. Stanley (2009). Teaching and learning principles of microeconomics online: An empirical assessment. *Journal of Economic Education, 40*(1), 3-25.

Greenfield, P. & Z. Yan (2006). Children, adolescents, and the internet: A new field of inquiry in developmental psychology. *Developmental Psychology, 42*(3), 633-649.

Gross, E. (2004). Adolescent internet use: What we expect, what teens report. *Applied Developmental Psychology*, *25*(6), 633-649.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy, 80*(2), 223-255.

Hunley, S.A., J. H. Evans, M. Delgado-Hachey, J. Krise, T. Rich, & C. Schell (2005). Adolescent computer use and academic achievement. *Adolescence*, *40*(158), 307-318.

Jackson, L.A., A. von Eye, F.A. Biocca, G. Barbatsis, Y. Zhao & H.E. Fitzgerald (2006). Does home internet use influence the academic performance of low-income children? *Developmental Psychology, 42*(3), 429-435.

Kubey, R.W., M.J. Lavin & J.R. Barrows (2001). Internet use and collegiate academic performance decrements: Early findings. *Journal of Communication, 51*(2), 366-382.

Lenhart, A., M. Madden & P. Hitlin (2005). Teens and technology: Youth are leading the transition to a fully wired and mobile station. *Pew Internet & American Life Project*, 27 July 2005. Retrieved June 10, 2009, from http://www.pewinternet.org/~/media//Files/Reports/2005/PIP_Teens_Tech_July2005web.pdf.pdf.

Louge, N. (2006). Adolescents and the internet. *ACT for Youth Center of Excellence*. Retrieved June 15, 2009, from http://www.actforyouth.net/documents/Oct061.pdf.

Mincer, J. (1974). *Schooling, experience and earnings.* New York: National Bureau of Economic Research.

Pew Internet & American Life Project Surveys (2009). *Internet adoption*. Retrieved August 4, 2009, from http://www.pewinternet.org/Trend-Data/Internet-Adoption.aspx.

Wolaver, A M. (2002). Effects of heavy drinking in college on study effort, grade point average, and major choice. *Contemporary Economic Policy*, *20*(4), 415–428.

THE VOLATILITY OF THE DOLLAR YEN EXCHANGE RATE: CAUSE AND EFFECT

Mohammed Ashraful Haque, Texas A&M University-Texarkana
George Boger, Texas A&M University-Texarkana

ABSTRACT

The volatility of exchange rate between currencies has a great deal of impact on foreign trade. This is especially true of the yen/dollar exchange rate because of the trade volume between these two countries. U.S. interest rate, Japanese interest rate, U.S. exports, current account balance, CPI Japan, CPI U.S.A were used in a stepwise regression as independent variable with exchange rate as dependent variable. It was found that U.S. interest, U.S. export, U.S. import, current account balance of U.S. and CPI U.S. has a significant impact on the dollar/yen exchange rate. It is concluded that the above variables determine the exchange rate between the yen and dollar. When there is a drastic change in any of the above variables, it causes volatility in the dollar/yen exchange rate. This has a significant impact on U.S. Japan trade volume.

INTRODUCTION

Basically there are two well established theories that explain and determine exchange rates. First, purchasing power parity (PPP), which quantifies the inflation exchange rates relationship, in other words it attempts to explain that exchange rates adjust based on the respective inflation rates in the two different countries. There are two forms of PPP theory.

The absolute form of PPP states that given that there are no international trade barriers, consumers will tend to shift their purchases for goods and services to the country where the price os lower as measured by common currency. For example, exchange rates will eventually adjust where a basket of goods will cost the same both in the U.S. and Japan using a common currency. If the price in Japan is higher for the same basket, it will increase the price in the U.S. and decrease the price in Japan. This means the price in both countries should be the same when measured in common currency.

The second theory of exchange rate determination is the interest rate parity theory. This theory states that one cannot make a greater profit by taking advantage of an interest rate differential in two different countries. Because the currency of the higher interest rate will depreciate either in the forward market or appreciate in the spot market.

Suppose for example the interest rate in the U.S. is eight percent and the interest rate in Japan is four percent. A Japanese investor will be tempted to invest in the U.S. for the higher

return. The increased demand for the dollar will tend to appreciate the spot rate of the dollar. On the other hand, at the end of the investment horizon when the Japanese investor demands to convert the dollars to yen, this increased demand in the forward market will increase the value of the yen in the forward market. Because of these two reasons, the gain made by the Japanese investor from higher interest rate will be wiped out, because of the adjustment in exchange rates. The interest rate parity must hold based on the following equation

$$1 + d_i = 1 + F_i \left(\frac{forward\ rate}{spot\ rate} \right)$$

where d_i = domestic rate and F_i = foreign rate.

The exchange rate must be a direct quote, that is, it must be yen per dollar. It must be foreign currency per unit of domestic currency. Here the U.S. is considered domestic and Japan is considered foreign.

PURPOSE AND METHODOLOGY

The purpose of this study is to determine the cause and effect of the volatility of the dollar/yen exchange rate because of the volume of trade between the two nations. The exchange rate of the dollar/yen has a great deal of impact on trade between the two nations.

Several variables were considered as independent variables and exchange rate was used as the dependent variable. The independent variables are U.S. interest rates, Japanese interest rates, U.S. export, U.S. import, current account balance, CPI in Japan and the CPI in the U.S. These variables have been chosen because historically they have been found to be the ones that impact the exchange rate. Stepwise regression was used to include those variables that have the greatest impact on the exchange rates. Data on these variables were used from 1996 to 2007. The CPI for 2000=100.

LITERATURE REVIEW

There are many models that attempt to prove the interest rate parity theory of exchange rates. The article by Atkeson and Kehoe attempts to demonstrate how several of the economic models which attempt to predict changes to the conditional means of two variables (marginal utility growth and inflation). It does not take into consideration the changes in the conditional variances of how movements in the interest rates are mostly reflected in excess bond returns. The presented data show how the models fail to account for the excess returns from interest rate differentials (Atkeson & Kehoe, 2007) because based on interest rate parity covered interest arbitrage is not possible. The article coming from the Federal Reserve Bank of Minneapolis is

crucial in establishing that the very entity partially responsible for fluctuations in rates which lead to the parity in foreign exchange seem to clarify that their own approach to understanding their actions is flawed. This article does not engage in much discussion of the interest rate parity, but does raise several questions about the outlook towards root causes. This indicates that if exchange rates are random walks then everything we say about monetary policy is wrong (Atkeson, & Kehoe, 2007). In October of 2008 the dollar fell against the yen but the dollar gained against other key currencies immediately the following day. However, two major currencies recovered followed by panic selling of risky assets. Funds were repatriated into dollars and unwinding of carry-trade.

The dollar/yen declined significantly and force liquidation were factors in international equity and commodity markets. Hedge funds and others have for many years borrowed in the low yield yen (and dollar) and have bought assets and commodities in higher yielding currencies and benefited both from borrowing and buying assets. According to uncovered interest rate parity, the difference in interest is equal to the expected depreciation of the higher yielding currency. For many years speculators and investors borrowed in yen, bought assets in high yielding currencies and therefore benefited both from low yen borrowing rates and the depreciating yen, which is contrary to uncovered interest parity.

A study conducting empirical investigation based on CPI-based real interest rates is used to conclude that real interest rate parity is not supported in a paper by Lin Wu and Lin Chen (Wu & Chen, 2007).

The validity of real interest rate parity is a very important issue to all policy makers. Equality of real rates across countries implies that the influence of the domestic monetary authority of real interest rates is limited by the extent to which monetary policy can influence the world real interest rate. Feldstein in 1991 pointed out that unless real rates can differ across countries, policies which are directed with the intention of increasing domestic savings cannot increase the rate of capital formation thereby increasing productivity.

There is no doubt about the importance and significance of real interest parity, however there is a lack of empirical support for this theory.

Currency depreciation and appreciation tend to change the relative competitiveness of producers in different countries which are not desirable from a global perspective, because it usually leads to relative prices that usually do not reflect the true relative cost of production. From the perspective "external balance" does not indicate that trade balance could be zero, but instead if forces global resources to be allocated efficiently. This implies that we should explore monetary policy in determining exchange rates (Engel, 2009). This article challenges some of the arguments put forth in favor of full floating exchange rates. The study also explores the role of sterilized intervention and international reserves.

When exporters set prices in their native currency and there is nominal price stickiness, in that case exchange rate movements will change a country's terms of trade (Engel, 2009).

There is a general theme followed by modern Keynesian macroeconomics which state that monetary policy should be directed at adjusting for economic inefficiencies (Engel, 2009).

During the nineteenth century London was the financial capital of the world. Its downfall was due to large amounts spent on World War I which ultimately resulted in overvalued currency and the loss of credible gold convertibility. This put Britain in great amount of debt. Is the U.S. in the same path due to its involvement in Iraq and Afghanistan? But even if the U.S. struggles, the world still relies on the dollar base system (Harold, 2008).

Interest rate parity has very important implications in foreign trading markets. It is a link to short term interest rates, spot and forward exchange rates of two or more different currencies. If the theory is violated, arbitrage opportunity is created. Interest rate parity is a non-arbitrage condition (Kim, 2006).

A test for interest rate parity among seven countries were conducted over a period of eighteen years from 1975-1993. The countries included the U.S., Germany, Japan, Canada, Great Brittan, Switzerland, and France. The study found that the difference between the U.S. dollar and the British pound was as big as six percent positive or negative due to pricing errors prior to 1982. This variance led to significant gain and loses between currencies exchange rates and interest rate changes after the parity variances in the mean values were closed to zero. However, since April 1983 global markets were transformed with interest rate parity which eventually denied traders to destabilize markets through speculation in exchange rates based on interest rates (Guin & Maxwell, 1996).

The real interest rate is a key variable in theoretical models of consumption and investment and of financial asset valuation. According to fisher effect, nominal interest rates move along with expected inflation on a one for one in the long run based on rational expectations. This implies that the real export interest rate should follow mean-reversion. However, empirical tests have shown no consensus to that theory (Kanas, 2006).

RESULTS

The results of the regression included the following variables, U.S. interest rate, U.S. export, U.S. import, CPI Japan and CPI U.S. The R-square for the regression was 0.608, which indicates that about 61 percent of the variation is explained by the regression model

$$-877.543735054779 + 4.950775619(U.S.\,interest) + 0.002837509(U.S.\,export) + 5.449884674(CPI\,Japan) + 2.880979132(CPI\,U.S.)$$

Based on the above equation, it is believed that if the above variables are stable, then the dollar/yen exchange rate would be stable.

CONCLUSIONS

The reason for the volatility in the dollar/yen exchange rate is the fluctuation in the volume of U.S. exports, fluctuation of the U.S. interest rates, fluctuation in the Japanese CPI and fluctuation in the U.S. CPI. Because of fluctuations in the above variables the dollar/yen exchange rate seem to fluctuate a great deal which causes problems in trade between the two countries and also causes problems in the global foreign exchange market and global economy.

REFERENCES

Chang, Yoosoon (2002). Nonlinear IV Unit Root Tests in Panels with Cross Sectional Dependency. *Journal of Econometrics*, 110(2).

Cruickshank, G. MacDonald (2002). Purchasing Power Parity-Evidence from a New Panel Test. *Applied Economics*, 34(11).

Devereux, Michael B., Engel, Tille (1999). Exchange Rate Pass-through and the Welfare Effects Of the Euro. Working paper.

Engel, Charles (2009). Exchange Rate Policies. *Staff Papers, Federal Reserve Bank of Dallas*.

Erlat, Haluk (2003). The Nature of Persistence in Turkish Real Interest Exchange Rates. *Emerging Markets Finance and Trade*, 39(2).

Eun, Resnick (2002). *International Financial Management*, (*Second Edition*). Irwin McGraw Hill Publishing.

France, Philip and Dijk (2002) A Simple Test for PPP Among Traded Goods. *Econometric Institute Repor,* El.

Guin, Maxwell (1996) A Test for Interest Rate Parity Among Seven Nations. *The International Trade Journal*, 10(3).

Harold James (2008) Will the Dollar Go the Way of the Pound? *The International Economy,* 22(2).

Hegwood, Papell (2002) Purchasing Power Parity Under the Gold Standard. *Econometric Institute Report*, El.

Hung, Mao-Wei, Yin Ching, Jan (2002) Use of Deviation of Purchasing Power Parity and Interest Rate Parity to Clarify the 1997 Asian Financial Crisis. *Review of Pacific Basin Financial Markets and Policies*, 5(2).

IMF, (2007) *International Financial Statistics Yearbook*.

Kanes, Angelos, (2008) On Real Interest Dynamics and Regime Switching. *Journal of Banking and Finance*, 31(31).

Kim, Reconsidering Real Interest Parity for Traded and Nontraded Goods. *Review of International Economics*,14(2).

Razzaghipur, Alipasha, Fleming, Grant & Heanly, Richard (2001) Deviation and Mean Reversion to Purchasing Power Parity in the Asian Currency Crisis of 1997. *Applied Economics*, 33(9).

Rose, Engel (2002/2003) Currency Unions and International Integration. Working paper, NBER series.

Smithin, John (2002/2003) Interest Parity, Purchasing Power Parity, 'Risk Premia' and Keynesian Economic Analysis. *Journals of Post Keynesian Economic Analysis*, 25(2).

Tawadros, George B (2002) Purchasing Power Parity in the Long Run: Evidence from Australia's Recent Float. *Applied Financial Economics*, 12(9).

Vachris, Michelle (1999) International Price Comparisons Based on Purchasing Power Parity. *Monthly Labor Review*.

Ward, Michael (2001) International Price Levels and Global Inflation. *Statistical Journal of the UN Economic Commission for Europe*, 18 (1).

.

Ward, Michael (2002) Purchasing Power Parities vs Exchange Rates in International Comparisons. *Statistical Journal of the UNICE*, 19.

THE KEYNESIAN-MONETARIST CONTROVERSY IN INTERNATIONAL ECONOMICS: DISCRIMINATORY POWER OF SHORT-RUN EMPIRICAL TESTS

Kavous Ardalan, Marist College

ABSTRACT

Two major theories in the area of balance of payments are the Keynesian and monetarist theories. There have been many short-run tests of the monetary approach to the balance of payments and the evidence has been used to support the monetary approach. This paper argues that most of the existing empirical work does not have any discriminatory power because it assumes equilibrium in the money market. This paper recommends that Keynesian and monetarist views about the transmission mechanism and the homeostatic mechanism are fundamentally different and provide bases for discriminatory tests.

INTRODUCTION

Keynesian and monetarist theories dominate macro-economics in general and balance of payments theories in particular. There have been many short-run tests of the monetary approach to the balance of payments and the evidence has been used to support the monetary approach. This paper argues that most of the existing empirical work does not have any discriminatory power.

Ardalan (2003, 2005a, 2005b) has reviewed three alternative theories of balance of payments adjustments. They are the elasticity 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.

Ardalan (2003, 2005a) has comprehensively reviewed the relevant empirical work dealing with the monetary approach. 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 Johnson (1972). Testing was undertaken by Zecher (1976) and others (See Ardalan, 2005a). The second approach is based on theoretical work of Prais (1977), with corresponding empirical work undertaken by Rhomberg (1977) and others (See Ardalan, 2003).

This paper is based on Ardalan (2003, 2005a, 2005b) and it argues that most of the existing empirical work in the short-run framework has no discriminatory power (Ardalan, 2007, has made the same argument with respect to the long-run models). Theoretical models explicitly differentiate between the two types of adjustment mechanisms, but most short-run empirical models have no discriminatory power because they assume equilibrium in the money market.

The next section explores the existing empirical work on the short-run monetary approach to the balance of payments to see if it can discriminate between the differing views of Keynesian and monetarist economists.

QUESTION OF DISCRIMINATORY POWER

The main goal of this section is to show that existing empirical work on the short-run monetary approach to balance of payments does not discriminate between Keynesian and monetarist theories of the balance of payments. This is because the evidence is consistent with both Keynesian and monetarist models, as specified.

Ardalan (2003) noted that Prais (1977) proposed a test of the short-run monetary approach to the balance of payments. Ardalan (2003) also reviewed examples (They are: Khan, 1977, 1976; Rhomberg, 1977; and Schotta, 1966) of the numerous applications (See the list of references in Appendix 1) of that idea to various countries. The major conclusion of this line of research has been that the evidence strongly favors the monetary approach.

This section argues that most of the short-run evidence is unable to discriminate between the two theories. Monetarist short-run models consider the adjustment process to take place by excess money balances spilling over into commodity and financial markets. When this basic idea has been translated into empirical form, it has lost its discriminatory power because, with one notable exception (For an important exception see Jonson, 1976), the estimated equations do not explicitly recognize monetary disequilibrium. Therefore, the evidence has no discriminatory power because it is consistent with both Keynesian and monetarist models, as specified. In order to demonstrate this, first the theoretical monetarist model of Prais (1977) and the Keynesian model of Mundell (1963) are analyzed and compared, and then three empirical studies that are based on Prais' (1977) formulation are reviewed. These three consist of one by Rhomberg (1977) and two by Khan (1977, 1976). The examination of the short-run empirical formulations illustrates that the evidence is consistent with both models, as specified.

THEORETICAL MODELS

In this subsection the theoretical monetarist model of Prais (1977) and the Keynesian model of Mundell (1963) are analyzed and compared.

Prais' (1977) Model: Prais' (1977) model formulated the adjustment process in terms of continuous time, which allows precise specification of the relation between stock and flow variables. Prais (1977) 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 been widely used (See the list of references in Appendix 1) in the literature (Dornbush, 1976).

The model, which is in differential equation form, may be set out with a system of six equations given by equations (1) through (6):

$$LD = k.Y \quad (1)$$

$$dL/dt = X - IM \quad (2)$$

$$E = Y + a.(L - LD) \quad (3)$$

$$IM = b.Y \text{ or } IM = b.E \quad (4)$$

$$X = X(t) \quad (5)$$

$$Y = E + X - IM \quad (6)$$

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 (2) without altering the basic mathematics. Equation (3) indicates that domestic expenditure, E, equals income plus the excess of actual over desired liquidity. Imports, equation (4), 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 (5). Finally, national income, in equation (6), is defined as domestic expenditure plus exports less imports.

In this system, a disequilibrium – for example a deficit in the balance of payments due to an exogenous reduction in exports – is corrected by a fall in the money supply via (2), followed by a fall in domestic expenditure via (3), a fall in income via (6), and a fall in imports via (4). This process continues until the deficit in (2) is eliminated.

Mundell's (1963) Model: Mundell's (1963) model can be expressed in the following three equations:

$$I(i) + I^* - S(Y) + BT(Y) = 0 \quad (7)$$

$$M = L(Y, i) \quad (8)$$

$$M = D^* + R \quad (9)$$

Where:

I	=	investment
I*	=	autonomous investment
S	=	saving
BT	=	balance of trade
M	=	money supply
L	=	demand for money
D*	=	domestic assets of the central bank
R	=	foreign assets of the central bank

Government spending and taxes are included under "investment" and "saving" (a simplification which entails no significant loss).

Equation (7) specifies that the flow market for goods and services is in equilibrium. This condition ensures that the current supply of goods and services equals the current demand. Due to unemployed resources, output can change with no change in domestic prices. Like monetarists, Mundell (1963) assumes perfect capital mobility, i.e., domestic and foreign interest rates are equal. Autonomous investment, I*, is a parameter representing an autonomous element in the investment schedule, separated for purposes of analysis. It should be noted that: $dBT/dY<0$, $dS/dY>0$, $dI/di<0$, $I(i) + I^* - S(Y)$ is the balance on capital account, and $BT(Y)$ is the balance on current account. Equation (7), therefore, shows both the equilibrium in the commodity market, i.e., the IS curve, and the balance of payments equilibrium. The demand for money, L, is assumed to depend upon the interest rate and domestic income.

The money stock, described by equation (9), equals the assets of the central bank. Commercial banks are ignored. D* is taken as a policy-determined parameter. In effect, Mundell (1963) assumes the money multiplier is unity.

In this model an autonomous increase in exports has a multiplier effect on income, and increases savings, taxes, and imports. After the new equilibrium is established, both the goods and capital markets must be in balance. In the goods market, the budget surplus and excess of private saving over investment have their counterpart in the balance of trade surplus. In the capital market, the private and public sectors must be willing to accumulate foreign securities. Capital market equilibrium requires that the current account surplus be exactly balanced by a capital outflow, so that there is balance of payments equilibrium after all adjustments have taken place.

There will nevertheless be a change in foreign exchange reserves. Before the flow equilibrium is established the demand for money will increase at a constant rate in proportion to the increase in income. To acquire the needed liquidity the private sector sells securities and this puts upward pressure on the interest rate and attracts foreign capital. This improves the balance of payments temporarily, forcing the central bank to intervene by buying foreign reserves and increasing the money supply. The money supply is therefore increased directly through the back door of foreign exchange rate policy. Foreign exchange reserves accumulate by the full amount of the increased cash reserves needed by the banking system to supply the increased money demanded by the public as a consequence of the increase in income.

Comparison: When the adjustment processes in these short-run models are compared, the essential points are seen to be captured by the expenditure and import functions. Behavioral relations (equation 6) in Prais' (1977) model indicate that excess money balances spill over to the commodity market in general, and imports in particular, while the disequilibrium interpretation of Mundell's (1963) model suggests that the increase in money balances results in downward pressure on interest rates and, therefore, a capital outflow. These models reflect the theoretical difference that exists between Keynesian and monetarist views of the transmission mechanism and the international adjustment process. Monetarists tend to assume that some excess balances spill over directly in to commodity markets while Keneysians tend to assume that all excess balances spill over in to financial markets.

EMPIRICAL MODELS

In this subsection it is shown that existing short-run empirical models have no discriminatory power. In order to do this, first three typical empirical studies that are based on Prais' (1977) formulation are reviewed. These three consist of one by Rhomberg (1977) and two by Khan (1977, 1976). Then empirical forms of their expenditure and import functions are analyzed. This is because the role of excess money balances in these equations is crucial in discriminating between the theories.

Three Typical Empirical Models: Now three typical empirical studies that are based on Prais' (1977) formulation are reviewed (This part is taken from Ardalan, 2003). These three consist of one by Rhomberg (1977) and two by Khan (1977, 1976).

Rhomberg's (1977) Model: 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 (15) through (20):

$$LD(t) = k.Y(t) \quad (10)$$

$$E(t) = a_0 + a_1.Y(t) + a_2.Y(t-1) + a_3.\{[L(t-1)+L(t-2)]/2 - k.Y(t)\} \quad (11)$$

$$IM(t) = b_0 + b_1.E(t) \quad (12)$$

$$G(t) = g_0 + g_1.Y(t) \quad (13)$$

$$Y(t) = E(t) + G(t) + X(t) - IM(t) \quad (14)$$

$$L(t) = L(t\text{-}1) + X(t) + DK(t) - IM(t) + DD(t) \quad (15)$$

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 (11). 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 then reported.

Khan's (1977) Model: Like Prais (1977), 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.

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:

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

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:

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

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:

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

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

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

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:

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

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:

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

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:

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

Substituting (22) into (20):

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

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

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

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:

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

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:

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

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

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

this is the equation that is estimated.

Nominal Income: The ex-post nominal income identity is:

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

The Balance of Payments (BP): It is specified as:

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

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 and reports the results.

Khan's (1976) Model: 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.

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.

Real Imports: The real value of imports is specified as a linear function of the level 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:

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

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:

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

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

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

$$(1-a.a_4)>0,\ a.a_5<0,\ a>0 \tag{35}$$

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:

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

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:

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

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 (39), for i_{vz}:

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

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:

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

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:

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

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:

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

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

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

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:

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

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, represents monetary policy variables.

Expenditure and Import Functions: After reviewing the three typical empirical studies that are based on Prais' (1977) formulation, i.e., Rhomberg (1977) and Khan (1977, 1976), it is time to analyze the empirical forms of their expenditure and import functions. This is because the role of excess money balances in these equations is crucial in discriminating between the monetarist and Keynesian theories.

Expenditure Function: As noted previously, in the short-run monetary models, (real) expenditure is made a positive function of (real) money balances, (real) income, and the interest rate. Rohmberg's (1977) expenditure function (equation (11) from above) is:

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

Khan's (1977) expenditure equations in his first model (equations (25) and (27) from above) are:

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

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

Khan's (1976) expenditure equation in his second model (equation (35) from above) is:

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

$$(1 - a.a_4)>0,\ a.a_5<0,\ a>0$$

But, these empirical forms are also consistent with the Keynesian theory. To show this, each explanatory variable is considered in turn.

Real Income: Consider the effect of (real) income on (real) expenditure. According to the Keynesian theory, an increase in (real) income causes an increase in (real) consumption and (real) investment and therefore, in total (real) expenditure.

Real Money Balances: Consider the effect of (real) money balances on (real) expenditure. According to the Keynesian theory, an increase in (real) money balances causes a reduction in interest rate and results in an increase in (real) investment and therefore (real) expenditure. Moreover, the effect of (real) money balances on the level of consumption is also consistent with a Keynesian approach. So, as a result of the increase in (real) money balances, both investment and consumption can increase.

Interest Rates: The same negative relationship between interest rates and (real) expenditure is implied by the Keynesian theory. An increase in the interest rate causes (real) investment to decrease and, other things being equal, causes total (real) expenditure to decrease.

Import Function: Rhomberg's (1977) import equation (equation (12) from above) is:

$$IM(t) = b_0 + b_1.E(t)$$

Khan (1977), in his first model, specifies import function to be (equations (16) and (19) from above):

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

$$D[IM(t)] = A.a_0 + A.a_1.R(t) + A.a_2.E(t) - A.IM(t) + A.u_1(t)$$

In his second model, Khan (1976) uses the following equation as the import equation (equation (31) from above):

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

Again, these empirical forms are consistent with Keynesian theory. The effects of (real) income, reserves, and relative prices on imports are the same as implied by Keynesian theory.

(Real) Expenditure: According to Keynesian theory, imports, like other expenditures, are positively dependent on income. If variations in the trade balance are relatively small, income and expenditure are highly correlated through the income identity, i.e., Y = C + I + G + X – IM = E + X – IM. In this way, expenditure is a good proxy for income, and whether the import function includes income or expenditure as the explanatory variable, a positive relation is expected. Moreover, since expenditure, E, includes imports, regressing (real) imports on (real) expenditures, especially when the variance of expenditure on domestic goods is low relative to the variance of expenditure on foreign (imported) goods, yields biased estimates.

Reserves: The stock of reserves is used as an indicator of the extent of import controls. In the short-run context, this is consistent with both theories and does not involve any difference between the two.

Relative Prices: According to the Keynesian theory, an increase in the price of imports is, in effect, a deterioration in the terms of trade and results in reduced imports. That is, Keynesian theory implies the same negative relationship between import prices and (real) imports.

CONCLUSION

Two major theories in the area of balance of payments are the Keynesian and monetarist theories. This paper argued that most short-run "tests" of the monetary approach to balance of payments have no discriminatory power. Short-run (disequilibrium) models specify a monetarist transmission mechanism, i.e., excess money balances spill over to commodity markets and increase expenditures on goods and services in general and imports in particular. This transmission mechanism, however, disappears from most of the empirical work, because actual money balances, not excess balances, appear as an explanatory variable. As a result, these short-run models are indistinguishable from equilibrium models and, therefore, cannot be used to identify the effects of excess money balances. In other words, most of the existing short-run empirical work on the monetary approach to the balance of payments has very little discriminatory power because it assumes equilibrium in the money market.

The need still exists to discriminate between Keynesian and monetarist theories of international economics (For a discussion of the ideas separating Keynesians and monetarists, see Mayor, 1978, Chapter 1, pp. 1-46). Most of the extant empirical work does not meet that objective because it cannot discriminate between monetarist and Keynesian models.

Keynesian and monetarist views about the transmission mechanism and the homeostatic mechanism are fundamentally different and provide bases for discriminatory tests. On the

transmission mechanism (which is a short-run phenomenon), the Keynesian view is that excess money balances spill over into the bond market only. In the monetarist view, excess money balances spill over into the bond and money markets. On the homeostatic mechanism (which is a long-run phenomenon), Keynesian theory holds that there is no, or only a very weak, homeostatic mechanism and, in the absence of government intervention, real income tends to remain below the level of full employment. In the monetary interpretation, the homeostatic mechanism is strong, and real income can be treated as though it were exogenous.

For further research in this area some directions may be outlined. One is to develop tests on the basis of differing views of Keynesians and monetarists with respect to the transmission mechanism. One, for example, may estimate Prais' (1977) short-run theoretical model, without assuming equilibrium in the money market, as most existing empirical work does. Given the rapid development of econometric procedures to estimate disequilibrium systems, an effective test based on this approach should be feasible in the near future. The other approach would be to develop tests on the basis of differing views of Keynesians and monetarists with respect to the homeostatic mechanism.

APPENDIX 1

Ardalan's (2003) Appendix 3 provides "… a comprehensive list of references which have estimated a short-run model in the tradition of the monetary approach to balance of payments." The list of the references is as follows: "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 (1973), 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)."

REFERENCES

Agenor, P.R. (1990). Government Deficits, Output and Inflation in a Monetary Model of the Balance of Payments: The Case of Haiti, 1970-83. *International Economic Journal*, Summer, 4(2), 59-73.

Aghevli, B.B. (1975). The Balance of Payments and Money Supply under the Gold Standard Regime: U.S. 1879-1914. *American Economic Review*, March, 65(1), 40-58.

Aghevli, B.B. (1977). Money, Prices and the Balance of Payments: Indonesia 1968-73. *Journal of Development Studies*, January, 13(2), 37-57. Reprinted in Ayre, P.C.I. ed. (1977). *Finance in Developing Countries*, London: Frank Case.

Aghevli, B.B. & M.S. Khan (1980). Credit Policy and the Balance of Payments in Developing Countries. In Coats, Warren L., Jr. and Khatkhate, Deena R., eds. (1980). *Money and Monetary Policy in Less Developed Countries: A Survey of Issues and Evidence.* Oxford: Pergamon Press.

Aghevli, B.B. & C. Sassanpour (1982). Prices, Output and the Trade Balance in Iran. *World Development*, September, 10(9), 791-800.

Akhtar, M.A. (1986). Some Common Misconceptions about the Monetary Approach to International Adjustment. In Putnam, Bluford H. and Wilford, D. Sykes, eds. (1986). *The Monetary Approach to International Adjustment.* Revised Edition, New York and London: Greenwood Press Inc., Praeger Publishers.

Ardalan, K. (2003). The Monetary Approach to Balance of Payments: A Review of Seminal Short-Run Empirical Research. *Journal of Economics and Economic Education Research*, 4(3), 61-113.

Ardalan, K. (2005a). The Monetary Approach to Balance of Payments: A Review of Seminal Long-Run Empirical Research. *Journal of Economics and Economic Education Research*, 6(1), 37-73.

Ardalan, K. (2005b). The Monetary Approach to Balance of Payments: A Taxonomy with a Comprehensive Reference to the Literature. *Journal of Economics and Economic Education Research*, 6(3), 39-61.

Ardalan, K. (2007). The Keynesian-Monetarist Controversy in International Economics: Discriminatory Power of Long-Run Empirical Tests. *Journal of Economics and Economic Education Research*, 8(3), 33-48.

Ardito Barletta, N., M. Blejer & L. Landau (1983). *Economic Liberalization and Stabilization Policies in Argentina, Chile, and Uruguay: Applications of the Monetary Approach to the Balance of Payments.* Washington, DC: World Bank.

Argy, V. (1969). Monetary Variables and the Balance of Payments. *International Monetary Fund Staff Papers*, July, 16, 267-286. Reprinted in International Monetary Fund. (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington, DC: International Monetary Fund.

Baker, A.B. & F. Falero, Jr. (1971). Money, Exports, Government Spending, and Income in Peru 1951-1966. *Journal of Development Studies*, July, 7(4), 353-364.

Bergstrom, A.R. & C.R. Wymer (1976). A Model of Disequilibrium Neoclassical Growth and its Application to the United Kingdom. In Bergstrom, A.R., ed. (1976). *Statistical Inference in Continuous Time Economic Models.* Amsterdam: North-Holland Publishing Company.

Blejer, M.I. (1977). The Short-Run Dynamics of Prices and the Balance of Payments. *American Economic Review*, June, 67(3), 419-428.

Blejer, M.I. (1983). Recent Economic Policies of the Southern Cone Countries and the Monetary Approach to the Balance of Payments. In Ardito Barletta, N., M. I. Blejer & L. Landau eds. (1983). *Economic Liberalization and Stabilization Policies in Argentina, Chile, and Uruguay: Applications of the Monetary Approach to the Balance of Payments.* Washington, DC: The World Bank.

Blejer, M.I. & R.B. Fernandez (1975). On the Trade-Off between Output, Inflation and the Balance of Payments. Working Paper, International Trade Workshop, University of Chicago, Chicago, Illinois.

Blejer, M.I. & R.B. Fernandez (1978). On the Output-Inflation Trade-Off in an Open Economy: A Short-Run Monetary Approach. *Manchester School of Economic and Social Studies*, July, 46(2), 123-138.

Blejer, M.I. & R.B. Fernandez (1980). The Effects of Unanticipated Money Growth on Prices and on Output and Its Composition in a Fixed-Exchange-Rate Open Economy. *Canadian Journal of Economics*, 13, 82-95.

Blejer, M.I., M.S. Khan, & P.R. Masson (1995). Early Contributions of *Staff Papers* to International Economics. *International Monetary Fund Staff Papers*, December, 42(4), 707-733.

Blejer, M.I. & L. Leiderman (1981). A Monetary Approach to the Crawling Peg System: Theory and Evidence. *Journal of Political Economy*, February, 89(1), 132-151.

Bonitsis, T.H. & J. Malindretos (2000). The Keynesian and Monetary Approaches to International Accounts Adjustment: Some Heuristics for Germany. In Arize, A.C., T.H. Bonitsis, I.N. Kallianiotis, K.M. Kasibhatla, & J. Malindretos eds. (2000). *Balance of Payments Adjustment: Macro Facets of International Finance Revisited*, Westport, Connecticut: Greenwood Press.

Borts, G.H. & J.A. Hanson (1977). The Monetary Approach to the Balance of Payments. Unpublished Manuscript, Brown University, Providence, R.I.

Brissimis, S.N. & J.A. Leventakis (1984). An Empirical Inquiry into the Short-Run Dynamics of Output, Prices and Exchange Market Pressure. *Journal of International Money and Finance*, April, 3(1), 75-89.

Cheng, H.S. & N.P. Sargen (1975). Central-Bank Policy towards Inflation. *Federal Reserve Bank of San Francisco Business Review*, Spring, 31-40.

De Silva, K.E.A. (1977). Money Supply, Inflation and the Balance of Payments in Sri Lanka (1959-74). *Journal of Development Studies*, January, 13(2), 22-36.

Dornbusch, R. (1973 & 1976). Devaluation, Money and Non-Traded Goods. *American Economic Review*, December, 63(5), 871-883. Reprinted in Frenkel, J.A. & H.G. Johnson, eds. (1976). *The Monetary Approach to the Balance of Payments.* London: George Allen and Unwin; Toronto: University of Toronto Press.

Fleming, J.M. & L. Boissonneault (1961). Money Supply and Imports. *International Monetary Fund Staff Papers*, 8, 227-240. Reprinted in International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund.

Franco, G.R. (1979). Domestic Credit and the Balance of Payments in Ghana. *Journal of Development Studies*, 15(2), 202-215.

Guitian, M. (1973). Credit Versus Money as an Instrument of Control. *International Monetary Fund Staff Papers*, November, 20, 785-800. Reprinted in International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund.

Horne, J. (1979). The Effect of Devaluation on the Balance of Payments and the Labour Market: United Kingdom, 1967. *Economica*, February, 46(181), 11-25.

Horne, J. (1981). Beggar-My-Neighbour Devaluation: The Case of Ireland, 1967. *European Economic Review*, March, 15(3), 327-338.

International Monetary Fund (IMF) (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington, DC: International Monetary Fund.

International Monetary Fund (IMF) (1987). Theoretical Aspects of the Design of Fund-Suported Adjustment Programs. *IMF Occasional Paper*, No. 55. Washington, DC: International Monetary Fund.

International Monetary Fund (IMF) (1996). *Financial Programming and Policy: The Case of Sri Lanka.* Washington, DC: International Monetary Fund

Johnson, H.G. (1972). The Monetary Approach to Balance of Payments Theory. *Journal of Financial and Quantitative Analysis*, Papers and Proceedings, March, 7, 1555-1572. Reprinted in Johnson, H.G., ed. (1973). *Further Essays in Monetary Theory.* London: George Allen & Unwin, 1972. Reprinted in Connolly, M. & A. Swoboda, eds. (1973). *International Trade and Money*, London: Allen and Unwin. Reprinted in Frenkel, J.A. & H.G. Johnson, eds. (1976). *The Monetary Approach to the Balance of Payments.* London: George Allen and Unwin; Toronto: University of Toronto Press.

Jonson, P.D. (1976). Money and Economic Activity in the Open Economy: The United Kingdom, 1880-1970. *Journal of Political Economy*, October, 84(5), 979-1012.

Jonson, P.D. & H.I. Kierzkowski (1975). The Balance of Payments: An Analytical Exercise. *Manchester School of Economics and Social Studies*, 43, 105-133.

Kanesathasan, S. (1961). Government Imports and Import Taxes in Monetary Analysis of Income and Imports. *International Monetary Fund Staff Papers*, December, 8, 412-426.

Khan, M.S. (1974). Experiments with a Monetary Model for the Venezuelan Economy. *International Monetary Fund Staff Papers*, July, 21(2), 389-413.

Khan, M.S. (1976). A Monetary Model of Balance of Payments: The Case of Venezuela. *Journal of Monetary Economics*, 2, 311-332.

Khan, M.S. (1977). The Determination of the Balance of Payments and Income in Developing Countries. In International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund.

Khan, M.S. & M.D. Knight (1981). Stabilization Programs in Developing Countries: A Formal Framework. *International Monetary Fund Staff Papers*, March, 1-53.

Kieran, M. (1970). Monetary Policy and the Business Cycle in Postwar Japan. In Meiselman, D., ed. (1970). *Varieties of Monetary Experience.* Chicago: University of Chicago Press.

Knight, M.D. & D.J. Mathieson (1979). Model of an Industrial Country under Fixed and Flexible Exchange Rates. In Martin, J. & A. Smith, eds. (1979). *Trade and Payments Adjustment under Flexible Exchange Rates*, Macmillan.

Knight, M.D. & D.J. Mathieson (1983). Economic Change and Policy Response in Canada under Fixed and Flexible Exchange Rates. In Bhandari, J.S. & B.H. Putnam, eds. (1983). *Economic Interdependence and Flexible Exchange Rates.* Cambridge, Massachusetts: MIT Press.

Knight, M.D. & C.R. Wymer (1976). A Monetary Model of an Open Economy with Particular Reference to the United Kingdom. In Artis, M.J. & A.R. Nobay, eds. (1976). *Essays in Economic Analysis: The Proceedings of the Association of University Teachers of Economics, Shefield 1975.* Cambridge: Cambridge University Press.

Knight, M.D. & C.R. Wymer (1978). A Macroeconomic Model of the United Kingdom. *International Monetary Fund Staff Papers*, December, 25(4), 742-778,

Knoester, A. & J. Van Sinderen (1985). Money, the Balance of Payments and Economic Policy. *Applied Economics*, 17, 215-240.

Lachman, D. (1975). A Monetary Approach to the South African Balance of Payments. *South African Journal of Economics*, September, 43(3), 271-283.

Laidler, D.E.W. (1975). Price and Output Fluctuations in an Open Economy. In Laidler, D.E.W., Ed. (1975). *Essays on Money and Inflation.* Manchester: University of Manchester Press, Chicago: University of Chicago Press.

Laidler, D., B. Bentley, D. Johnson, & S.T. Johnson (1981). A Small Macroeconomic Model of an Open Economy: The Case of Canada. Research Report 8110, University of Western Ontario, July.

Laidler, D. & P. O'Shea (1980). An Empirical Macro-Model of an Open Economy under Fixed Exchange Rates: The United Kingdom, 1954-1970. *Economica*, March/May, 47, 141-158.

Leon, H. & H. Molana (1987). Testing the Monetary Approach to Balance of Payments in Developing Countries. In Chrystal, K.A. & R. Sedgwick, eds. (1987). *Exchange Rates and the Open Economy.* New York: St. Martin's Press, Brighton; U.K.: Harvester Press, Wheatsheaf Books.

Levantakis, J.A. (1984). Stabilization Policies in the Greek Economy: Will They Work? *Journal of Policy Modeling*, June, 7(3), 441-455.

Levy, V. (1981). Oil Prices, Relative Prices, and Balance-of-Payments Adjustment: the Turkish Experience. *European Economic Review*, 15, 357-372.

Mayer, T. (1978). The Structure of Monetarism. *Kredit und Kapital*, 8(2&3), 191-218 and 293-316. Reprinted in Mayer, T. *The Structure of Monetarism.* New York: W.W. Norton & Company.

Miller, N.C. (1980). Offset and Growth Coefficients for Five Industrial Countries: 1960-1970. *Review of Economics and Statistics*, August, 62(3).

Miller, N.C. & S.S. Askin (1976). Monetary Policy and the Balance of Payments in Brazil and Chile. *Journal of Money, Credit, and Banking*, May, 8(2), 227-238.

Mundell, R.A. (1963). Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates. *Canadian Journal of Economics and Political Science*, November, 29(4), 475-485.

Mussa, M. (1974). A Monetary Approach to Balance-of-Payments Analysis. *Journal of Money, Credit, and Banking*, August, 6(3), 333-351.

Myhrman, J. (1976). Balance-of-Payments Adjustments and Portfolio Theory: A Survey. In Classen, E.M. & P. Salin, eds. (1976). *Recent Issues in International Monetary Economics.* New York: North-Holand.

Otani, I. & Y.C. Park (1976). A Monetary Model of the Korean Economy. *International Monetary Fund Staff Papers*, March, 23(1), 165-199.

Parikh, A. (1993). Monetary Policy in Bangladesh, 1973-85. In Page, Sheila, ed. (1993). *Monetary Policy in Developing Countries*, London: Routledge.

Parkin, M. (1974a). Inflation, the Balance of Payments, Domestic Credit Expansion, and Exchange Rate Adjustments. In Aliber, R.Z., ed. (1974). *National Monetary Policies and the International Financial System.* Chicago: University of Chicago Press.

Parkin, M. (1974b). World Inflation, International Relative Prices and Monetary Equilibrium under Fixed Exchange Rates. Paper presented to second Racine Conference, Racine, Wisconsin, July.

Polak, J.J. (1957). Monetary Analysis of Income Formation and Payments Problems. *International Monetary Fund Staff Papers*, November, 6, 1-50. Reprinted in International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund.

Polak, J.J. (1998). The IMF Monetary Model at 40. *Economic Modelling*, 15(3), July, 395-410.

Polak, J.J. & V. Argy (1971). Credit Policy and the Balance of Payments. *International Monetary Fund Staff Papers*, March, 18, 1-24. Reprinted in International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund.

Polak, J.J. & L. Boinssonneault (1960). Monetary Analysis of Income and Imports and Its Statistical Application. *International Monetary Fund Staff Papers*, April, 7, 349-415. Reprinted in International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund.

Prais, S.J. (1961 & 1977). Some Mathematical Notes on the Quantity Theory of Money in an Open Economy. *International Monetary Fund Staff Papers*, May, 8(2), 212-226. Reprinted in International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund.

Rhomberg, R.R. (1977). Money, Income, and the Foreign Balance. In International Monetary Fund (1977). *The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund.* Washington: International Monetary Fund. Reprinted from Jackson, E.F., ed. (1965). *Economic Development in Africa*, Oxford, England.

Rodriguez, C.A. (1976). Money and Wealth in an Open Economy Income-Expenditure Model. In Frenkel, J.A. & H.G. Johnson, eds. (1976). *The Monetary Approach to the Balance of Payments.* London: George Allen and Unwin; Toronto: University of Toronto Press. (1976).

Sassanpour, C. & J. Sheen (1984). An Empirical Analysis of the Effects of Monetary Disequilibria in Open Economies. *Journal of Monetary Economics*, January, 13, 127-163.

Schotta, C. (1966). The Money Supply, Exports, and Income in an Open Economy: Mexico 1939-63. *Economic Development and Cultural Change*, July, 14(4), 458-470.

Spinelli, F. (1983). Fixed Exchange Rates and Adaptive Expectations Monetarism: The Italian Case. *Review of Economic Conditions in Italy*, February, 0(1), 97-124.

Taylor, L. (1972). Money, the Balance of Payments and Income Determination in Jamaica (1950-1970). *Social and Economic Studies*, June, 21(2), 171-183.

Taylor, M.P. (1986). A Varying-Parameter Empirical Model of Balance of Payments Determination under Fixed Exchange Rates: Results from UK and West Germany. *Applied Economics*, 18, 567-582.

Teal, F. & Y.M. Giwa (1985). Domestic Credit and the Balance of Payments in Ghana: A Comment. *Journal of Development Studies*, July, 21(4), 548-561.

Vaez-Zadeh, R. (1989). Oil Wealth and Economic Behavior: The Case of Venezuela, 1965-81. *International Monetary Fund Staff Papers*, June, 36(2), 343-384.

Wallich, H.C. (1950). *Monetary Problems of an Export Economy.* Cambridge: Harvard University Press.

Wilford, D.S. (1977). *Monetary Policy and the Open Economy: Mexico' Experience.* New York: Praeger Publishers.

Yusoff, M. (1988). Money, Prices, and Balance of Payments in Malaysia. *Indian Economic Journal*, July/September, 36(1), 33-47.

Zecher, R. (1976). Monetary Approach and International Reserve Flows in Australia. In *The Monetary Approach to the Balance of Payments*, edited by Frenkel and Johnson.