Pennsylvania Economic Association: 2009-2010

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Editor’s Introduction and Acknowledgements

Orhan Kara
Editor of Proceedings
2010 Annual Conference of the Pennsylvania Economic Association

The papers published in this volume were presented at the 2010 Annual Conference of the Pennsylvania Economic Association (PEA) held at Grove City College from June 3 to 5, 2010. The program lists all presenters, session chairs and discussants. Only the papers and comments submitted according to manuscript guidelines are included in the Proceedings.

The 2010 conference was a great success. Participants from across Pennsylvania and several other states, as well as, other countries gathered to share ideas. University faculty, research professionals, graduate students and undergraduate students presented papers and participated in discussions. In addition to the presentations in the concurrent sessions, the conference featured an excellent talk at Friday’s lunch and a panel discussion arranged by the Federal Reserve Bank of Cleveland.

The Pennsylvania Economic Association extends special thanks to Tracy Miller for his time and energy coordinating all local arrangements. The PEA thanks Dr. Richard K. Vedder, Senior Fellow at The Independent Institute and Edwin and Ruth Kennedy Distinguished Professor of Economics and Faculty Associate, Contemporary History Institute, Ohio University, for serving as our guest speaker. The PEA also thanks Grove City College President Richard G. Jewell and Provost William P. Anderson, Jr. for hosting the 2010 PEA Conference. We appreciate the assistance of Jeffrey M. Herbener, chairperson of the Economics Department, and the support of the Center for Vision and Values. Thanks also to the Federal Reserve Bank of Cleveland for hosting the Friday evening reception. Special thanks go to the entire PEA board for their work making the conference a success, and to all of the participants who made the conference an interesting, stimulating and friendly place to share ideas.
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Pennsylvania Economic Association

2010 CONFERENCE AGENDA

THURSDAY, June 3, 2010
(Location: Hall of Arts and Letters -HAL)

- 4:00 pm - 9:00 pm Registration (Atrium of the Hall of Arts and Letters)
- 5:00 pm - 7:00 pm Board of Director's Dinner/Meeting (Great Room of the Student Union)
- 7:00 pm - 10:00 pm Reception (Atrium of Hall of Arts and Letters)

FRIDAY, June 4, 2010
(Location: Hall of Arts and Letters)

- 8:00 am - 4:30 pm Registration (Atrium of the Hall of Arts and Letters)
- 8:30 am - 10:30am Coffee Break
- 9:00 am - 10:15 am Concurrent Sessions
- 10:15 am - 10:30 am Break
- 10:30 am - 11:45 pm Concurrent Sessions
- 12 noon - 1:15 pm Luncheon (Old MAP)
- 1:15 pm - 2:00 pm Lunch Speaker: Richard K. Vedder, The Independent Institute (Old MAP)
- 2:15 pm - 3:30 pm Concurrent Sessions
- 3:30 pm - 3:45 pm Coffee Break
- 3:45 pm - 4:45 pm Fed Panel Discussion (HAL 108)
- 4:45 pm - 5:45 pm Reception (hosted by the Federal Reserve: Atrium of the Hall of Arts and Letters)

SATURDAY, June 5, 2010
(Location: Hall of Arts and Letters)

- 8:00 am - 9:00 am Registration & Coffee (Atrium of the Hall of Arts and Letters)
- 9:00 am - 10:15 am Concurrent Sessions
- 10:30 am -11:00 am General Membership Meeting (HAL 110)
- 11:15 am Closing
FRIDAY, June 4, 2010  8:00 a.m. – 4:30 p.m.

Conference Registration
Atrium of the Hall of Arts and Letters

8:30 a.m. – 10:30 a.m. Coffee Break: (Atrium)

FRIDAY, June 4, 2010  9:00 a.m. – 10:15 a.m.

Session F1A: International Economics
Location: HAL 114
Chair: White, Roger, Franklin and Marshall College

Composition of Export and Economic Growth, Evidence from Ghana
Dramani, John-Bosco & Tandoh, Francis, Garden City University College

Impact of Imported Inputs on Technology Use and Skill Premium
Goel, Manisha, The Ohio State University

Discussants:
Sissoko, Yaya, Indiana University of Pennsylvania
White, Roger, Franklin and Marshall College

Session F1B: Student Session: Economic Development
Location: HAL 116
Organizer and Chair: Trejos, Sandra, Clarion University of Pennsylvania

Social Fractionalization and Economic Development in Ecuador
Cooper, Katie & Hughes, Dani, Clarion University of Pennsylvania

The Implications of the One-Child Policy on China's Economy
Baker, Kayla, Clarion University of Pennsylvania

Economic Growth and Deforestation in Brazil
Schill, Travis, Clarion University of Pennsylvania

Primary School Enrollment in Sub-Saharan Africa
Dechant, Joslyn, Clarion University of Pennsylvania

Discussants:
Pathan, Abdul, Pennsylvania College of Technology
Brewer, Stephanie, Indiana University of Pennsylvania
Trejos, Sandra, Clarion University of Pennsylvania
Renshaw, Robert H., Renshaw Enterprises
**Session F1C: Economic Development**

**Location:** HAL 214  
**Chair:** Smith, Kenneth, Millersville University

Productivity Scientists, the Impact on Economic Development, and the Keystone Innovation Starter Kits Initiative  
Armstrong, Thomas, Pennsylvania Department of Community & Economic Development

Regional income disparities in India and test for convergence - 1980 to 2006  
Agarwalla, Astha & Pangotra, Prem, Indian Institute of Management-Ahmedabad, India

**Discussants:**  
Dholakia, Ravindra H., Indian Institute of Management, Ahmedabad (India)  
Smith, Kenneth, Millersville University

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**Session F1D: Health Education and Welfare**

**Location:** HAL 216  
**Chair:** Balough, Robert S., Clarion University of Pennsylvania

Market Protection Strategies in the Orphan drug Industry  
Reaves, Natalie, Rowan University

Evaluating the Integrity of the Bayh-Dole Act: Are Patents necessary?  
Kong, Joseph, Pennsylvania State University

Education, Health and Economic Growth: A Panel Data Study of SAARC Countries  
Iqbal, Asim; Wasif Siddiqi Muhammad & Rehman, Jamshaid Ur, GC University, Lahore

**Discussants:**  
Balough, Robert S., Clarion University of Pennsylvania  
Halloran, Matthew, Penn State Worthington Scranton  
Keith, Kristen, University of Toledo

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**Session F1E: General Economics and Teaching**

**Location:** HAL 308  
**Chair:** Culp, David, Slippery Rock University

Toward a More Diverse & Globally Relevant Economics Education: Applications in the Principles of Microeconomics Course  
Hannan, Michael, Edinboro University of Pennsylvania

A Vocabulary Experiment in a Survey Economics Course  
Litzinger, Patrick, Robert Morris University

Student Research Revision as a Tool for Learning Statistics  
Sanders, William; Cotherman, Tyler; Dunkin, David; Larson, Nicholas; Lundgren, Christopher; Schmader, Jared & Stegman, Scott, Clarion University of Pennsylvania

**Discussants:**  
Culp, David, Slippery Rock University  
Ancil, Ralph E., Geneva College  
O’Roark, Brian, Robert Morris University
Session F1F: Urban, Rural & Regional Economics
Location: HAL 310
Chair: Smith, Lynn, Clarion University of Pennsylvania

Regional Differences in the Inner City Retail Gap
Bellinger, William & Wang, Jue, Dickinson College

The Effect of Race on Work Commuting Time in Pennsylvania Metropolitan Areas
Dunn, Robert & Williams, Johnathan, Washington & Jefferson College

Measuring Brain Drain and Brain Gain with College Data
Wagner, Derek & Kurre, James, Penn State - Erie

Discussants:
Dunn, Leslie, Washington & Jefferson College
Smith, Lynn, Clarion University of Pennsylvania
Mondal, Sunita, Slippery Rock University

FRIDAY, June 4, 2010  10:15 a.m. – 10:30 a.m.
Coffee Break:  Atrium
FRIDAY, June 4, 2010  10:30 a.m. – 11:45 a.m.

Session F2A: Economic Development
Location: HAL 114
Chair: Armstrong, Thomas, Pennsylvania Department of Community & Economic Development

Testing for Trickle-Down or Polarization – Evidence from India
Dholakia, Ravindra H., Indian Institute of Management, Ahmedabad (India)

The Impact of Political Dependence on Small Island Economies
Dunn, Leslie, Washington & Jefferson College

Institutions and Economic Growth: A Study in a Cross Section of Countries
Saribas, Hakan, Zonguldak Karaelmas University

Discussants:
Armstrong, Thomas, Pennsylvania Department of Community & Economic Development
Agarwalla, Astha, Indian Institute of Management-Ahmedabad, India
Onyeiwu, Stephen, Allegheny College

Session F2B: Microeconomics
Location: HAL 116
Chair: Tolin, Thomas, West Chester University

Dynamic Contributions to a Public Project with Increasing Per-Capita Returns
Halloran, Matthew, Penn State Worthington Scranton

The Effect of the Internet on Music Sales
Mondal, Sunita, Slippery Rock University

Discussants:
Tolin, Thomas, West Chester University
Litzinger, Patrick, Robert Morris University
Session F2C: Macroeconomics and Monetary Economics
Location: HAL 214
Chair: Kara, Orhan, West Chester University

A Note of the Role of Social Security Trust Fund Payments in the Great Recession
Dunn, James, Edinboro University of PA

The United States Liquidity Trap and The Federal Reserve Exit Dilemma
El Nasser, Marwan & Robinson, Richard, The State University of New York at Fredonia

The Relative City Prices Convergence in an emerging economy: Empirical Evidence from Spatial GLS
Mohsin, Hasan, Southern Illinois University Carbondale

Discussants:
Culp, David, Slippery Rock University
Dramani, John-Bosco, Garden City University College
Kara, Orhan, West Chester University

Session F2D: Labor and Demographic Economics
Location: HAL 216
Chair: Jozefowicz, James J., Indiana University of Pennsylvania

Race and Gender Effects of Early-Career Occupational Mobility
Keith, Kristen & Ajilore, Gbenga, University of Toledo

Smith, Lynn & Balough, Robert S., Clarion University of Pennsylvania

Discussants:
Dunn, Robert, Washington & Jefferson College
Reaves, Natalie, Rowan University
Jozefowicz, James J., Indiana University of Pennsylvania
Session F2E: Mathematical and Quantitative Models  
Location: HAL 308  
Chair: Walker, John, Kutztown University

A Dynamic Model of the Market for Housing  
Andelin, Steven, Pennsylvania State University

Current Account Sustainability in African Economic Communities: Are there Regional Differences?  
Sissoko, Yaya, Indiana University of Pennsylvania & Sobradji, Niloufer, Simmons College

Cox-Ingersoll-Ross Interest Rate Calibration and the Pricing of Residential Mortgages  
Mansour, Stephen; Dobric, Vladmir, Lehigh University; Hussain, Riaz, University of Scranton & Storer, Robert, Lehigh University

Discussants:  
Walker, John, Kutztown University  
Baird, Phil, Duquesne University  
Asarkaya, Yakup, University of Virginia

Session F2F: Financial Economics  
Location: HAL 310  
Chair: Bennett, Charles A., Gannon University

The Decision of Home Mortgage Term  
Baek, Chung & Bilbeisi, Khamis, Troy University

Using Averages and Break-Even Analysis to Find Optimal Solutions  
Ancil, Ralph E., Geneva College

Herd behaviour and trading of Dutch pension funds  
Rubbaniy, Ghulame, Erasmus University Rotterdam, Rotterdam, The Netherlands

Discussants:  
Bennett, Charles A., Gannon University  
Economopoulos, Andrew, Ursinus University  
Hannan, Michael, Edinboro University of Pennsylvania
LUNCHEON AND SPEAKER
12:00 Noon – 2:00 p.m.
Location: Old MAP

“How America Got Rich”

Friday Luncheon Speaker:

Richard K. Vedder, Ph.D.
The Independent Institute

Dr. Vedder is Senior Fellow at The Independent Institute and Edwin and Ruth Kennedy Distinguished Professor of Economics and Faculty Associate, Contemporary History Institute, Ohio University. Dr. Vedder is co-author (with Lowell Gallaway) of The Independent Institute book, Out of Work, the recipient of both the 1994 Sir Antony Fisher International Memorial Award and 1994 Mencken Award Finalist for Best Book, and the Institute monograph, Can Teachers Own Their Own Schools? Dr. Vedder received his Ph.D. in economics from the University of Illinois, and he has been Senior Economist at the U.S. Joint Economic Committee and Visiting Fellow at the Center for the Study of American Business, Washington University, and he has taught at the University of Colorado, Claremont Men’s College, and MARA Institute of Technology. His other books include Going Broke by Degree: Why College Costs Too Much, The American Economy in Historical Perspective; Poverty, Income Distribution, the Family and Public Policy (with L. Gallaway); Essays in Nineteenth Century Economic History; Essays in the Economy of the Old Northwest; Economic Impact of Government Spending; A Fifty State Analysis, and Variations in Business and Economic History. His hundreds of articles and reviews have appeared in numerous scholarly journals as well as such publications as the Wall Street Journal, Christian Science Monitor, National Review, Washington Times, and Investor’s Business Daily.
FRIDAY, June 4, 2010 2:15 p.m. – 3:30 p.m.

Session F3A: Financial Economics
Location: HAL 114
Chair: Andelin, Steven, Pennsylvania State University

Does the Internal Rate of Return Calculation Require a Reinvestment Rate Assumption?—There Is Still No Consensus
Walker, John, Kutztown University & Check, Henry, Penn State University

Evaluating the Target Pipeline in Pharmaceutical Acquisitions
Economopoulos, Andrew & Vass, Dan, Ursinus College

Home Bias and Dutch Pension Funds’ Investment behaviour
Rubbiani, Gholame; Van Lelyveld, L.P.P. & Verschoor, W. F.C., Erasmus University Rotterdam, Rotterdam, The Netherlands

Discussants:
Andelin, Steven, Pennsylvania State University
Baek, Chung, Troy University
Bennett, Charles A., Gannon University

Session F3B: Public Economics
Location: HAL 116
Chair: Linn, Johnnie, Concord University

Tax Invisibility and Government Size
Ovaska, Tomi, Youngstown State University

The Role of Ex-Ante Moral Hazard
Hartigan, Jason & Mehmeti, Artan, Bowling Green State University

Legislative Turnover, Fiscal Policy and Economic Growth: Evidence from US State Legislatures
Uppal, Yogesh, Youngstown State University

Discussants:
Linn, Johnnie, Concord University
Smith, Kenneth, Millersville University
El Nasser, Marwan, The State University of New York at Fredonia
Session F3C: Business Administration and Business Economics; Marketing; Accounting
Location: HAL 214
Chair: Hannan, Michael, Edinboro University of Pennsylvania

An Application of the Oversocialized Conception of People to Accountants' Ethics
Nugent, David, Slippery Rock University

Exploring Market Segmentation for Household Buyers of Accounting Services
Garland, Barbara; Green, Joseph; Kirkwood-Mazik, Heather & Ponsford, Brenda, Clarion University

Corporate Social Responsibility and Shareholder Wealth
Baird, Phil; Geylani, Pinar Celikkol & Roberts, Jeffrey A., Duquesne University

Discussants:
Hannan, Michael, Edinboro University of Pennsylvania
Lusher, Anna, Slippery Rock University
Mansour, Stephen, Lehigh University

Session F3D: Labor and Demographic Economics
Location: HAL 216
Chair: Benedict, Mary Ellen, Bowling Green State University

Is Education the Great Equalizer? An Examination of Race and Higher Education Attainment on Salary
Benedict, Mary Ellen, Bowling Green State University & McClough, David, Ohio Northern University

Substance Consumption Among Youth: A Dynamic Analysis of Cigarette, Alcohol and Marijuana Use
Asarkaya, Yakup, University of Virginia

Individual Attitudes on Immigration: A Multi-National Analysis
Smearcheck, William, Washington & Jefferson College

Discussants:
Tolin, Thomas, West Chester University
Benedict, Mary Ellen, Bowling Green State University
Bellinger, William, Dickinson College
Session F3E: Agricultural and Natural Resource Economics; Environmental and Ecological Economics & Industrial Organization
Location: HAL 308
Chair: Dunn, James, Edinboro University of PA

The Evolving Relationship between Natural Gas and Crude Oil Prices: Evidence from a Dynamic Cointegration Analysis
Ates, Aysegul, Akdeniz University & Huang, Jui-Chi, Penn State Berks

Generic and Brand Advertising in Markets with Product Differentiation
Isariyawongse, Kosin, Edinboro University & Tremblay, Victor J. and Kudo, Yasushi, Oregon State University

Determinants of Growth and Performance in the Tooling and Machining Industry of Northwestern Pennsylvania
Onyeiwu, Stephen, Allegheny College

Discussants:
Sissoko, Yaya, Indiana University of Pennsylvania
Jozefowicz, James J., Indiana University of Pennsylvania
Dunn, James, Edinboro University of PA

Session F3F: Miscellaneous Topics
Location: HAL 310
Chair: Kara, Orhan, West Chester University

Losing The World: Another Adam Smith Problem
Quinn, Kevin, Bowling Green State University

Trading on Education: How Economic Education Motivates Votes on Free Trade in Congress
O’Roark, Brian & Farone, Jason, Robert Morris University

The Baleen Whales’ Saving Grace: The Introduction of Petroleum Based Products in the Market and its Impact on the Whaling Industry
McColough, John, The Pennsylvania State University-Lehigh Valley & Check, Henry, Penn State University

Economics, Philosophy (Metaphysics), and Progress
Renshaw, Robert H., Renshaw Enterprises

Discussants:
Renshaw, Robert H., Renshaw Enterprises
McColough, John, The Pennsylvania State University-Lehigh Valley
Armstrong, Thomas, Pennsylvania Department of Community & Economic Development Quinn, Kevin, Bowling Green State University
Session F3G: Economic Education Panel
Location: HAL 110
Organizer and Moderator: Pathan, Abdul, Pennsylvania College of Technology

Successful Teaching of Economics Principles to Beginning Students
Pathan, Abdul, Pennsylvania College of Technology

Clicking on Immediate Learning/Teaching Assessment in the Principles of Economics Class
Trejos, Sandra, Clarion University

FRIDAY, June 4, 2010  3:30 p.m. – 3:45 p.m.
Coffee Break: Atrium

FRIDAY, June 4, 2010  3:45 p.m. – 4:45 p.m.

Federal Reserve Bank of Cleveland
Panel Discussion
The Hall of Arts and Letters (HAL): HAL 108

FRIDAY, June 4, 2010  4:45 p.m. – 5:45 p.m.

Reception
hosted by the Federal Reserve Bank of Cleveland
Atrium of The Hall of Arts and Letters
SATURDAY, June 5, 2010    8:00 a.m. – 9:00 a.m.

Conference Registration & Coffee
(Atrium)

SATURDAY, June 5, 2010    9:00 a.m. – 10:15 a.m.

Session S1A: International Economics
Location: HAL 114
Chair: Sissoko, Yaya, Indiana University of Pennsylvania

Simultaneous Quantile Regression and the Immigrant-Trade Link
White, Roger, Franklin and Marshall College & Tadesse, Bedassa, University of Minnesota - Duluth

Balance of Payments Constrained Growth Model: An Application to Cameroon
Sissoko, Yaya, Indiana University of Pennsylvania & Awung, Wilfred, University of Buea

FDI Inflows in Sub-Saharan Africa: Are Some Countries Preferred to Others?
Olabiyi, Olayemi, University of Texas at Dallas

Discussants:
Olabiyi, Olayemi, University of Texas at Dallas
White, Roger, Franklin and Marshall College
Sissoko, Yaya, Indiana University of Pennsylvania

Session S1B: Public Economics
Location: HAL 116
Chair: Baumgardner, Gerald, Penn College

Unleashing Leviathan: Public Goods under Involuntary Taxation
Linn, Johnnie, Concord University

Excise Taxes and the Demand for Beer: The Case of the Commonwealth of Pennsylvania
Dalecki, James, Indiana University of Pennsylvania

Discussants:
Baumgardner, Gerald, Penn College
Linn, Johnnie, Concord University
Session S1C: General Economics and Teaching
Location: HAL 214
Chair: Brewer, Stephanie, Indiana University of Pennsylvania

University Summer School Offerings and Revenue Generation
Culp, David, Slippery Rock University

Assessment Practices in Undergraduate Accounting Programs
Lusher, Anna, Slippery Rock University

Investing in Science and Technology education as a strategy to strengthen the US economy
Mehtabdin, Khalid & Hays, Gregory, The College of St Rose

Discussants:
Mehtabdin, Khalid, The College of St Rose
Garland, Barbara, Clarion University
Brewer, Stephanie, Indiana University of Pennsylvania

Session S1D: Miscellaneous Topics
Location: HAL 216
Chair: Sanders, William, Clarion University of Pennsylvania

Financing Roads and Highways in Pennsylvania in the 21st Century
Miller, Tracy, Grove City College

Regional Differences in the Economic Return to Investment in Human Capital
Kara, Orhan, West Chester University

Discussants:
Smith, Lynn, Clarion University of Pennsylvania
Sanders, William, Clarion University of Pennsylvania
SUNDAY, June 5, 2010  10:30 a.m. – 11:00 a.m.

GENERAL MEMBERSHIP BUSINESS MEETING

The Hall of Arts and Letters (HAL): HAL 110

This Annual Business Meeting of the General Membership of the Pennsylvania Economic Association is open to the entire membership of the PEA, including all registrants at the conference. Please plan to attend as door prizes are available, which include handcrafted items from Wendell August Forge (https://www.wendellaugust.com/page/welcome).

SUNDAY, June 5, 2010  11:15 a.m. - Closing

There is no formal closing session, but conference participants are welcome, and encouraged, after the last set of paper sessions, to stay and chat as long as you wish and thank you for helping to make this year’s conference a success.
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USING AVERAGES AND BREAK-EVEN ANALYSIS TO FIND OPTIMAL SOLUTIONS

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ABSTRACT

This paper explores the use of averages and an extended form of break-even analysis to find optimal solutions. The usual approach in economics textbooks is to deny such an outcome is possible with such methods and to emphasize, instead, the nature and exclusive necessity of marginal analysis. This paper, however, demonstrates that such a result is possible by considering two main cases: (1) Boehm-Bawerk’s classic horse-trading example; and (2) three common total revenue/total cost functions of mainstream economic analysis. The conclusion is that strong statements about the inability of averages and break-even points to lead to optimal outcomes must be rejected and a more qualified and nuanced understanding of the optimum-finding techniques considered.

INTRODUCTION

Averages and totals have been de-emphasized, despite their use in business practice, or have been considered to be in opposition to marginal analysis, or to be ultimately disguised marginal analysis. The following will show that such views need to be significantly qualified, and that such practices as averaging and an extended break-even analysis are consistent with marginal analysis outcomes even though their pathway is different, a difference which perhaps unsettles some ideas about theory and business practice in the mainstream approach. We will look at Boehm-Bawerk’s famous horse-trading example and then at the standard economic models of costs and revenues.

BOEHM-BAWERK’S HORSE-TRADING EXAMPLE

In his The Positive Theory of Value, Eugen von Boehm-Bawerk was concerned to explain value in free markets and to rebut various ideas put forward by socialists and Marxists concerning price formation and exploitation. In the course of this treatment he became very intent to clearly identify how the line of demarcation separating those who are successful from those who are not, in any free market situation, is formed. It was important for him to stress the marginal nature of price formation in a free market system. His analysis was rooted in the view that price was formed by two marginal pairs: two potential buyers and two potential sellers, one pair of which would be successful, engaging in exchange, and the other pair unsuccessful, dropping out of the market. After a detailed analysis of two-sided competition in a horse market, he concludes with emphasis: “...we arrive at the following most simple formulation of the law of price. Market price is established at a point within a range which is limited and determined by the valuations by the two marginal pairs.” (1973, original emphasis). As a further gloss on this we may refer to Ekelund and Hebert (1983) in their book on the history of economic thought where they give a favorable exposition of Boehm-Bawerk’s treatment commenting: “…Boehm-Bawerk established that it is these marginal pairs of buyers and sellers – and these marginal pairs alone – that determine price.”

It is instructive to look at Boehm-Bawerk’s example and see not merely how he arrived at his conclusion but also whether the example can be understood in another way, in terms of averages, for instance. Boehm-Bawerk relied on the usual Austrian form of exposition where the quantities are fixed and not divisible; the calculus is not used, but marginal thinking is applied and indeed emphasized as the only way to understand price formation. His example involves two groups, buyers and sellers, in a horse-trading market. The data for these two groups are found in Table 1.

The data are displayed in a way which resembles supply and demand schedules though there is really no need to do so except with the intention of showing the intersection of the corresponding demand and supply curves, that is, to show that price is determined at the margin. The process of offering various bids eliminates seven of the eighteen original market participants leaving five sellers with six buyers. It is not a matter of matching all the different pairs of buyers and sellers but only of two critical pairs as Boehm-Bawerk emphasizes; the final market-clearing price must rest not merely between the one marginal pair of buyers offering $220 and $210 but also between the sellers offering $200 and $215. The result is that the final price must actually lie somewhere between $210 and $215, just enough to shut out the would-be buyer at $210 but not enough to bring into the market the would-be seller at $215; any price within this range will do. The market then clears at this price with five buyers and five sellers. The pairs here are marginal not only in the simple sense that they are additional pairs in the market but that they are the final, critical pairs necessary to clear it, defining that price which separates those market participants who remain from those who drop out. Any offers above or below this range will make no difference to the final result.

There are, however, some qualifications that must be made to his approach. One could, for example, envision the process of reaching a market-clearing price as a statistical one where
the bidding begins with the mean of the reservation prices of both buyers and sellers. The buyers' collective offer sums to $2210 and averages to $221 while the collective offer of the sellers sums to $1455 and averages to $182. The total, combined average is $204. With this last average used as an initial offer, we have the same results of Boehm-Bawerk, namely, that five sellers remain in the market, those ranging from $100 to $200. The would-be seller at $215, of course, finds this proposed price too little and so drops out as do all those who have a still higher reserve price for selling. On the buyers side, those buyers remain who have the higher reserve price, namely, from $300 down to $210. This leaves us with five sellers and six buyers, close but not quite clearing the market, the same position as Boehm-Bawerk comes to. The difficulty is the buyer at the level of $210. There is no horse for him. One could clear the market by raising the price but not so high as to entice the other seller to re-enter. One may think of the deciding price as the average price between these two coming to about $213. At this level there will be five sellers and five buyers. What, then, do we make of the "marginal" pair? It is just as fair to call them an "averaging" pair since it is their values that determine the boundary between those who stay and those who leave and thus determine the average price which clears the market. In this case, the margin is nothing more than an average.

Nor is it necessary that this particular pair remain, that they are somehow vitally necessary to the process. If we remove them from the data and recalculate the mean, the new average drops slightly from nearly $204 to about $203. At this new price, the market clears with the same players but because the difficult "marginal" pair (210/215) is absent, there is no further correction needed. In short, this pair serves no other function than to solve the problem their very presence produces. Together they produce that price which excludes the offspring drives out the parents. Any set of numbers whose average falls in the same range will give the same result; no particular pair is indispensable.

If we average the marginal pairs we also arrive at the same result. We have $220, $215, $210, and $200. These sum to $845 and average to $211.25 or about $211, also within the same range. The critical marginal pairs, or averaging pairs, are really the two pairs closest to what will turn out to be the intersection of the supply and demand schedules, one value above and below on each schedule. Actually, we need only find the one pair whose offers are closest and average them. In this case that would be $210 and $215 which averages out to about $213. (Boehm-Bawerk himself at times appears to change his mind and refers merely to this one pair as critical.) All other offers will respond to this price and the market will clear.

Another way to look at the matter is to think of the market as incomplete. There can be no clearing without completeness, that is, without an even number of buyers and sellers. What would the situation look like if we added two more sellers at the higher end of the range? Using linear regression we can estimate the next two to be offering $291 and $316. The average for the total now is $213, precisely the same as that between the supposed critical pair. If we leave out the original pair of $210/$215 we still arrive at the same average, market-clearing price. One could then with equal justification argue that it is this latter pair from (regression analysis) that is critical and decisive for by bringing them into the business, the necessary price is reached even though the offers of $215 and $210 are omitted. These two new entrants have the effect of teasing out more of the prices the buyers are truly willing to pay, moving them a bit closer to their reservation prices. To be exact it requires the buyers to pay each $9.00 more per horse, raising the price from $204 to $213, which is also consistent with the original case of eight sellers to ten buyers, a shortage that leads to competition among the buyers, thus raising price.¹

It is also possible to arrive at the solution without even knowing the individual bids but working merely with the totals and averages. In the latter case, the mean acceptance value for the sellers as indicated before is $182 and that of the buyers is $221. See the data in Table 2.

The critical decision rule here is based on the observation that dropping participants from the market in each group works until the differences between the group (total revenue) values is smaller than their means, at which point no further reductions are needed. If we were to begin with the original number of buyers and sellers we would work our way down the list as the differences were shrinking. As we come to the fifth participant we see the difference has now diminished to a value less than that of the buyers' mean value of $221 though still greater than that of the sellers' value. One may reason similarly from the lower end working up to the fifth participant. At that level the difference is $195, greater than the smaller mean price ($182) but less than the larger mean price ($221). At the next level, the difference $234 exceeds the value of the larger mean ($221) so that we cannot justify going that high. In other words, the difference of $195 is the only difference that falls between the two means, $182 and $221. The other differences are either all less than both means or are all more than both of them. This identifies the solution level of five participants of each group (buyers and sellers) or ten all together. The solution must obviously lie between $182 and $221. In Figure 1, we multiply the means out to their respective numbers (8 and 10) for totals of $1455 and $2210. The difference between these lines, which equals 195, occurs at five.

The gap of $755 ($2210 – $1455) must be eliminated entirely by the buyers. With this example, one can't add new participants nor change their reservation prices. Only the number of participants and their respective offers can be reduced.²
One way to think of this process is to reason that since there are ten buyers and eight sellers, the buyers must lose more than the sellers. (But also see the appendix.) If buyers are to fully account for the gap, then they must lose 3.42 participants \( \frac{755}{221} \). Working our way from the top downward, that leaves them with \( $1455 \)\( ($2210 - $755) \) -- the same collective value as the sellers. However, the number of participants do not yet match. Buyers now have 6.58 members and the sellers still have 8. Since both groups are now at \$1455\ and since they must both end up at \$1065\, the remaining (second) gap is \$390\ for each group or \$780\ collectively.

Looking at this from the 5th position (Table 2), that is, working our way from the bottom up or from left to right, buyers are at \$1105\ which leaves \$40\ dollars off \( ($1105 - $1065) \). Or from the other direction \$350\ ($1455 - $1105), also \$40\ ($390 - $350) short of where they should be. If we consider the difference in total value of the sellers and the value at the 5th position, we have \$545\ ($1455 - $910) which amounts to \$155\ more than is needed \( ($545 - $390)\). In other words, adding that amount onto the $910 would just give the right total value of $1065.

The method of apportioning the difference between the two groups is based on their original proportions. The proportions to reduce total market value to reach equilibrium for each group are determined by using the proportions they contribute to the total initial value:

\[
\text{Buyers: } \frac{$2210}{$3665}/2 = 1.206 \quad (1) \\
\text{Sellers: } \frac{$1455}{$3665}/2 = 0.794 \quad (2)
\]

Each group’s market value should equal one half of the total. These fractions show they do not. The buyers exceed their share by .206 and the sellers fall short by .206. For the sellers, the proportion is,

\[
\frac{$1455}{$3665} = .397. \quad (4)
\]

Applying this to the gap remaining to them gives,

\[
.397 ($390) = 154.83 \approx 155. \quad (5)
\]

And,

\[
155/195 = .795 = 2(.397). \quad (6)
\]

In rounder terms based on the means (Table 2), the buyers adjust this last difference of 195 by a reduction of about 20\% ($39) and the sellers by an increase of about 80\% ($156 added onto the $910) which also yields $195($156 + $39).

Another way to think of this is to note that,

\[
\frac{$545}{$390} = 1.3974. \quad (7)
\]

In other words, such a reduction overdoes it by .3974 which must be restored by an additional \$155\.

\[
.3974($390) = $155. \quad (8)
\]

Working this from the buyers’ side, we note that

\[
$1455 - $1105 = $350. \quad (9)
\]

As a proportion of \$390\ this is,

\[
$350/$390 = .8974. \quad (10)
\]

This leaves,

\[
(1 - .8974) $390 = (.1026) $390 = (.2052) $195 = $40. \quad (11)
\]

The small differences in the rounding cancel out, and we have:

\[
$156 + $39 = $155 + $40. \quad (12)
\]

It should be clear that the percentages likewise sum to unity \( (79\% +21\% = 80\% +20\%)\).

The whole process is succinctly pictured in Figure 1 with the line depicting the buyers’ data from Table 2 described as,

\[
y = 221x. \quad (13)
\]

The sellers’ data are defined by

\[
y = 182x. \quad (14)
\]

The average between these two, giving the market-clearing price, is defined by,

\[
y^* = $213x. \quad (15)
\]

The number of participants involved depends on the rounding, the direction of which depends on one’s position as either a buyer or a seller. After closing the gap the new lower value of $1455 is still too high for three buyers (3.42) who drop out, but not yet four, and so we round down. Removing the remaining gap of $390 is enough to drop two more rounding up from 1.76 ($390/$221). For the sellers, however, dropping $390 to $1065 involves 2.14 participants ($390/$182) is so low as to drop three, and we must round up. Thus, five buyers and three sellers drop out.
We note that at the equilibrium position of $1065, the respective number of participants using the original average is: $1065/221 = 4.82$ and $1065/182 = 5.85$. The average number of participants clearing the market is five for each group which also lies in between the 4.82 and the 5.85, the one rounding up and the other down.

We may find the collective market-clearing payment for each group, $P_c$, from the following equations:

\[
P_c = \frac{1105 - .206(195)}{5} \approx 1065, \text{ and}
\]

\[
P_c = \frac{910 + (1 - .206)195}{5} = \frac{1064.83}{5} \approx 1065.
\]

We may also look at the matter as a function of total sums spent on the trade. In Figure 2, we have the total possible sum that could be spent on the horse with ten potential buyers. We also have the sellers starting a total value of $1455 for eight sellers. We picture beginning at the full amounts and reducing the number of participants and the remaining sums until we arrive at the market-clearing level. As indicated above, that will be at five participants. To arrive at the final price we shift the buyer's line down until it intersects the x-axis at five and intercepts the y-axis at $1105. The slope which is the price is still the same at $221. We now pivot about the point five and lower the value on the y-axis by $40. This gives us a value of $1065. The market-clearing price of $213 is the slope of that line ($1065/5$) $213.

With this in mind, we can calculate the market-clearing price as follows:

\[
(3,665 - 755 - 780)/10 = 213 \tag{24}
\]

In allocating their proportions to the gap as explained above we have: $755 + 780 = 1535$. That amount as a fraction of the total is: $1535/3665 = .4188$, the proportion that must be eliminated to clear the market. The remaining amount is:

\[
(1 - .4188)3665 = 2130 \tag{25}
\]

The final market-clearing price is found by dividing this number by the number of market participants, which in turn is found by dividing $1535 by the collective mean:

\[
1535/204 = 7.52 \text{ or 8 participants} \tag{26}
\]

This leaves ten remaining so that dividing equation (25) by that amount gives the market-clearing price of $213.

In brief, Boehm-Bawerk’s example stressing the optimal outcome, an efficient, market-clearing price, through the reliance on marginal pairs can be understood as achievable in terms of total sums and averages without knowing the prices or values of particular participants or marginal pairs.

**STANDARD TOTAL REVENUE/ TOTAL COST FUNCTIONS**

The treatment of break-even analysis is usually displayed as a rough rule of thumb which has some validity in narrowly confined situations but which is not capable of delivering a precise, theoretically sound result, an optimal result, because the concept of diminishing returns is not considered. Consider, for example, Davies and Lam (2001) who compare the differences between standard economic theory and break-even analysis: “In the first place, the economic model is an optimising model, which identifies the profit- and
contribution-maximising level of output and price. The break-even model shows no optimum as the levels of profit and contribution simply increase with the level of output.” (emphasis added). In a similar vein, the authors Keat and Young (2009) summarize the limitations of break-even analysis, two of which are: “It assumes the existence of linear relationships, constant prices, and constant average variable costs. However, when the effects of relatively small changes in quantity are measured, linear revenues and variable costs are certainly good approximations of reality...The analysis does not result in identification of an optimal point; it focuses on evaluating the effect of changes in quantity on cost and profits.”

What these authors conclude is in fact correct for the usual break-even analysis considered. But if we extend the method, i.e., improve on it to account for the effect of diminishing returns, we will be able to find optimal solutions after all. The following cases illustrate the extended method.

**Example One**

A common instance of a total revenue function (TR) is given as:

\[
TR = 1 - (x-1)^2 \\
= 1 - x^2 + 2x - 1 \\
= 2x - x^2.
\]

A simple total cost curve (TC) is given as:

\[
TC = x.
\]

Figure 3 illustrates the combination of these two functions. Setting MR equal to MC and using the calculus to find the point of profit-maximizing output level (PMO) we have:

\[
2 - 2x = 1 \\
x = \frac{1}{2}.
\]

Setting total cost and total revenue equal to each other and solving to find the break-even points (BEPs), we obtain 0 and 1. Averaging them to get the profit-maximizing level of output (PMO), we have:

\[
PMO = \frac{0 + 1}{2} = \frac{1}{2}.
\]

The results from extended break-even analysis and marginal analysis are precisely the same.

**Example Two**

We can reverse this and use a quadratic function for total costs and a straight line function for total revenue (Fig. 4):

\[
TC = \frac{1}{4} + (x - 1/2)^2
\]

\[
TR = x.
\]

Using marginal cost equal to marginal revenue, we have:

\[
2x - 1 = 1 \\
x = 1.
\]

Using extended break-even analysis we have:

\[
\frac{1}{4} + (x - 1/2)^2 = x \\
x^2 - x + 1/2 = x.
\]

Completing the square and solving in the usual manner gives:

\[
(x - 1)^2 = \frac{1}{2} \\
x = 1 \pm \sqrt{2}.
\]

Averaging these we have:

\[
PMO = \frac{1 + \sqrt{2} + 1 - \sqrt{2}}{2} = \frac{2}{2} = 1.
\]

Again, the outcomes are precisely the same.

**Example Three**

We can combine the more typical cost and revenue functions and apply the same methods (Fig.5). Let the total cost function again be:

\[
TC = \frac{1}{4} + (x - 1/2)^2 \\
= x^2 - x + 1/2.
\]

With the total revenue function as before, we have:

\[
TR = 1 - (x - 1)^2
\]

Setting MR equal to MC to find the PMO, we have:

\[
2 - 2x = 2x - 1 \\
x = \frac{3}{4}.
\]

Using extended break-even analysis, we have:

\[
x^2 - x + 1/2 = 2x - x^2.
\]

Rearranging terms gives:

\[
x^2 - 3/2x + 1/4 = 0.
\]

After completing the square, we have:

\[
(x - 3/4)^2 = 5/16 \\
x = \frac{3}{4} \pm \sqrt{5}/4.
\]
Averaging these two numbers we have:

\[
\text{PMO} = \frac{3/4 + \sqrt{5}/4 + 3/4 - \sqrt{5}/4}{2}
\]
\[
= 1.5/2
\]
\[
= 3/4.
\]

Here, too, the result is exactly the same as with marginal analysis.

Since both functions are now quadratic equations, we can also work with the axes of symmetry. For these two parabolas they are at \(x = 1/2\) for the total cost function and \(x = 1\) for the total revenue function. Averaging these values also gives the PMO:

\[
(1 + ½)/ 2 = 3/4.
\]

We may also note that the sum of the BEPs equals the sum of the axes of symmetry. (See Fig. 5.)

Another method is based on the line connecting the BEPs, or Break-Even Line (BEL). We can think of this line as the average of two lines parallel to it but tangent to the TR and TC curves at the PMO solution. (See Fig. 6.)

The top tangency line \(T_1\) is:

\[
y = 9/16 + x/2.
\]

The bottom tangency line \(T_2\) is:

\[
y = -1/16 + x/2.
\]

Averaging them gives:

\[
y = 4/16 + x/2.
\]

The last line is the Break-Even Line (BEL).

Using this last equation and the PMO of .75, we can solve for the maximum profit (Fig. 7):

\[
\text{Profit} = ¼ + .75/2
\]
\[
= .6250.
\]

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\]
\[
= .6250.
\]

The profit-maximizing total revenue, MTR, is found by taking the above result and multiplying it by the sum of the BEPs, 1.5:

\[
\text{MTR} = (1/4 + .75/2)(1.5)
\]
\[
= .9375.
\]

Checking this against the TR function at this point (.75), we get 15/16 = .9375. For TC we get 5/16 = .3125. Subtracting to get the maximum profit, we have: .9375 - .3125 = .6250.

The profit maximizing price, PMP, is:

\[
PMP = \frac{\text{MTR}}{Q}
\]
\[
= .9375/.75
\]
\[
= 1.25.
\]

If this last example is taken as the standard or general model, i.e., as most representative of the economic vision of costs and revenues from which marginal analysis proceeds, then this result shows significantly that the extended version of break-even analysis can achieve optimal outcomes.

SUMMARY AND CONCLUSION

The foregoing paper examines the contention that theoretical optimal economic outcomes must be understood in the mainstream sense of marginal analysis, not focusing on totals and averages or on break-even analysis. This view is shown to be deficient. To illustrate the matter, two examples were examined: Boehm-Bawerk’s famous horse-trading case stressing the unique role of marginal pairs, and conventional mainstream micro-theory rooted in quantitative, calculus-based marginal analysis. In both cases the use of averages and totals and an extended version of break-even analysis leads logically to the same optimal outcomes. The method was different though the outcome was the same. This result has bearing on how economists gloss the role of method with ideological overtones and on the -- perhaps -- greater realism of this alternative method, to wit; that when entrepreneurs use rules of thumb such as averages they may very well be using a method which has sound theoretical underpinnings and whose results are fully consistent with mainstream theory. Their execution may be flawed from the point of view of theory but the principle involved is valid. In any event for the cases discussed, the usual conclusions about these methods must be significantly qualified.
Table 1

<table>
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<tr>
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Table 2

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<td>10</td>
<td>(1638)*</td>
<td>(351)</td>
</tr>
</tbody>
</table>

*From regression analysis

FIGURE 1: BUYERS/SELLERS MEANS AND DIFFERENCES

AB = 195
BC = 155
AC = 40

$ y^* = 213x

y = 221x

y = 182x
FIGURE 2: TOTAL VALUES OF BUYERS/SELLERS

\[ y^* = 1065 - 213x \]
\[ y = 2210 - 221x \]
\[ y = 1455 - 182x \]
\[ y = 1105 - 221x \]
\[ y = 910 - 182x \]

FIGURE 3: TOTAL REVENUE WITH STRAIGHT LINE COSTS

\[ TR = 1 - (x - 1)^2 \]
\[ TC = x \]
FIGURE 4: TOTAL COST WITH STRAIGHT-LINE REVENUES

\[ \text{TR} = x \]
\[ \text{TC} = \frac{1}{4} + (x - \frac{1}{2})^2 \]

FIGURE 5: BASIC COST/REVENUE MODEL WITH BREAK-EVEN POINTS AND AXES OF SYMMETRY LINES

\[ \text{TC} = \frac{1}{4} + (x - \frac{1}{2})^2 \]
\[ \text{TR} = 1 - (x - 1)^2 \]
FIGURE 6: BASIC MODEL WITH TANGENT AND BREAK-EVEN LINES

FIGURE 7: BASIC MODEL WITH PROFIT MAXIMIZATION
We can arrive at the solution using these rates by noting:

\[
P_m = T_B(1 - r)/n = T_B(1 - r'')/n, \quad \text{and}
\]

\[
P_m = [T_B(r - r'') + T_S]/m = T_S(1 + r - r'')/m = T_S(1 + r)/m,
\]

where

\[
T_B = \text{sum of the buyers’ reservation prices}
\]

\[
T_S = \text{sum of the sellers’ reservation prices}
\]

\[
m = \text{number of sellers}
\]

\[
n = \text{number of buyers}.
\]

Placing these values in the formulas we have:

\[
P_m = \frac{\$2210(1 - .0424)}{10} = \$211.6 \approx \$212.
\]

And,

\[
P_m = \frac{\$1455(1.206 - .0424)}{8} = \frac{\$1455(1.1636)}{8} = \$211.6 \approx \$212.
\]

It is instructive to see the proportioning as one which increases the value to the sellers and decreases it to the buyers in this manner:

\[
\$1455(1+.206) = \$2210(1-.206) \approx \$1755.
\]

This can be understood as sharing some of the $755 gap: The sellers’ value increases by $300 which is their proportion of the gap (.397 x $755), while the buyers’ value decreases by $455(.603 x $755). We note that these proportions can be written as:

\[
.397 = \frac{1}{2} (1 - .206), \quad \text{and} \quad .603 = \frac{1}{2} (1 + .206).
\]

This result however, is not the solution. Instead, we must multiply both sides by 1.206 to get the answer:

\[
\$1455(1+.206)(1+206) = \$2210(1-.206)(1+.206)\]

\[
\$1455(1.206)^2 = \$2210(1 - .206^2)
\]

\[
\approx \$2116.
\]

Dividing by ten as shown above gives the market-clearing price of $211.6 or about $212.

Interestingly, the solution can be found using the interest rates exclusively without a knowledge of the number of participants in each group. If we focus, for example, just on the gap of $755 and apply a similar method as the one above, we have:

\[
\text{ENDNOTES}
\]

1 One could of course regress for the lower numbers and add them into the sellers, the effect of which would be to lower the average price still further, a perfectly reasonable market outcome; but I use the higher values to conform to Boehm-Bawerk’s example since my object is to show that his outcome can be reached as an average. One could also delete the lower offers among the sellers or make corresponding changes among the buyers.

2 The $755 gap assumes the original 18 participants. Recalling the pre-solution collective mean of $204, we have $755/$204 = 3.7 or requiring the dropping of 4 participants. Similarly, the figure $780/$204 = 3.8, also requires the dropping out of 4 participants, so that we are left with ten. To take it out of the sellers’ value reduces their collective market amount to less than the $1455 as well as reducing the number of participants that go along with this value. It also eats into their portion of the $780 gap (2 x $390) that must be accounted for separately.

\[
\text{APPENDIX}
\]

There are a number of variations on this theme showing that the collective or aggregate values, not merely the marginal ones, lead to the market-clearing price. Here are some other examples that basically involve two methods: using averages based on the number of participants with implicit interest rates in each group, and using the implicit interest rates alone for the two groups which does not require the use of the number of participants for each group.

Following through on the concept of interest rates as a method of solving for the market-clearing price, we can treat the $755 gap as one shared by both buyers and sellers; the question then is one of how much to allocate to each group. Since the original proportion as explained in the text is .206, dividing up that amount between the two groups amounts to taking a proportion of a proportion. For the sellers and the buyers we have, respectively:

\[
.794(.206) + .206(.206) = .206 \quad \text{(A-1)}
\]

\[
.1636 + .0424 = .206.
\]

These are the implicit interest rates for the two groups and clearly,

\[
r = r' + r'' \quad \text{(A-2)}
\]

And,

\[
.1636/.2060 + .0424/.2060 = .7942 + .2058 = 1.0000 \quad \text{(A-3)}
\]

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\[ P_m = \$755[(1 + r)/2 - r^2]/2 \]  
\[ = \$755[(1.206)/2 - .0424]/2 \]  
\[ = \$755(.603 - .0424)/2 \]  
\[ = \$211.63 \approx \$212. \]  

We can also use the other interest rates: .1636 for \$1455 to get \$238, and .0424 for \$2210 to get \$94. These sum to \$332, leaving \$423 to be evenly divided by the two:

\[ P_m = [\$755 - \text{r}'T_s - \text{r}''T_b]/2 \]  
\[ = [\$755 - .1636(\$1455) - .0424(\$2210)]/2 \]  
\[ = \$423.26/2 \]  
\[ = \$211.63 \approx \$212. \]  

The solution can also be found solely in terms of the sellers. (Compare A-5 and A-11). We have,

\[ P_m = T_s [(1+r)^2 - (1 + r - r^2)]/2 \]  
\[ = T_s (r + 2r^2)/2. \]  

Inserting the relevant values yields:

\[ P_m = \$1455 (.206 + 2(.0424))/2 \]  
\[ = \$1455(.2908)/2 \]  
\[ = \$423.114/2 \]  
\[ = \$211.56 \approx \$212. \]  

Essentially the same result can be achieved from the buyers’ side with appropriate modifications as follows:

\[ P_m = (T_b/2)[1 - [(1+r)^2 + (r - r^2 -1)]/2 \]  
This reduces to,

\[ P_m = (T_b/4)(1 - 3r). \]  

Inserting the values we have,

\[ P_m = ($2210/4)(1 - .618) \]  
\[ = \$552.5(382) \]  
\[ = \$211.06 \approx \$211. \]  

Finally, we can expand on the information indicated in Figure 2. Here we start with the postulated equilibrium lines of \$1455 and \$2210 each with a slope of one. They are in equilibrium with themselves, not with each other. We alter these lines in proportion to their share of the interest rate of .206. From the previous discussion for the sellers we have:

\[ \$1455(1.1636) = \$1693. \]  
Since there are eight sellers, we get,

\[ .1693/8 = 211.6 \approx 212. \]  

At the other end, for the buyers, we have,

\[ \$2210 (1 - .0424) = \$2116. \]  
Dividing by their number of initial participants, 10, we also get 211.6 or about 212.

Again, the market-clearing price can be found without knowing the number of participants by simply averaging the difference from these two final numbers:

\[ (\$2116 - \$ 1693)/2 = \$423/2 \]  
\[ = \$211.5 \approx \$212. \]  

This can also be understood as an average collective value:

\[ (\$2116 + $1693)/2 = $1904.5, \]  
so that the profit-maximizing total value is this average collective value plus or minus the market-clearing price: \$1905 +/- $212.

The number of final market participants can be deduced by dividing the price into the two alternatives:

\[ \$1693/212 \approx 8 \text{ and } \$2116/212 \approx 10 \]  
The formula thus gives two possible outcomes with an average number of participants of nine.

REFERENCES


EVALUATING THE TARGET PIPELINE IN A PHARMACEUTICAL ACQUISITION

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ABSTRACT

Many firms in the pharmaceutical industry turn to acquisitions when faced with gaps in their drug development pipelines and patent expirations as an alternative to making long-term investments in internal research and development. It is expected that the characteristics of a successful acquisition are related to the target firm’s pipeline. Specifically, higher quantities of late-stage drugs in the target’s pipeline as well as a focus on developing biotechnology drugs are expected to lead to superior returns for the acquiring firm’s investors. Evidence from forty-three mergers suggest that pipeline does have a significant impact on abnormal returns to shareholders, while mergers with biotech firms appear to yield long-term benefits to the acquirers.

INTRODUCTION

Meeting the goal of maximizing shareholder returns in the pharmaceutical industry is predicated on the firm’s ability to sustain a pipeline of new and innovative products. In attempting to strengthen their product pipelines, pharmaceutical firms can essentially pursue two distinct strategies. The first potential course of action involves making long-term investments in internal research and development. The second strategy is to strengthen the pipeline by engaging in mergers and acquisitions in order to acquire another firm’s pipeline of drugs. While the focus of this paper is the merger and acquisition strategy, it is helpful to begin with a discussion and analysis of some of the major problems associated with the process of maintaining a strong pipeline through internal drug development.

THE CHALLENGES OF INTERNAL GROWTH

Investing in internal research and development presents many challenges with no guarantees of developing a successful new drug. The process of bringing a new drug to the market is a long and expensive one, and the risk of failure is present at every stage of this process. The heavy financial commitment that research and development demands also prevents resources from being devoted to other means of growing the company and increasing shareholder value that could have more of an immediate impact, such as additional expenditures on advertising the company’s drugs currently on the market or increasing the dividends paid out to shareholders. Despite these drawbacks, pharmaceutical companies are constantly striving to develop the next blockbuster drug through organic research and development.

Regulatory Process

When a pharmaceutical company decides to make a major investment in hopes of developing a new drug, there is always a great risk that the drug may fail to gain the approval of the Food and Drug Administration (FDA) and thus potentially become nothing more than a major sunk cost. The FDA is an agency that is part of the United States Department of Health and Human Services, and it is charged with protecting the health of the American public. One of the major responsibilities this entails is determining if and when a new drug is safe to be marketed and sold to the public. The FDA has received some scathing criticism for over-regulating from economists such as the great Milton Friedman, who said that “The FDA has done enormous harm to the health of the American public by greatly increasing the costs of pharmaceutical research, thereby reducing the supply of new and effective drugs, and by delaying the approval of such drugs as survive the tortuous FDA process” (Klein 2000). Despite criticisms such as these, the FDA does play an important role in bringing a new drug to market and they will continue to intensely scrutinize any drug before it reaches the public. This inevitably results in a long and costly process.

There are seven stages involved in bringing a new drug to market (Kellog and Charnes 2000). The first stage is discovery, where researchers identify promising new molecular entities (NMEs). If the compound has promise it then enters the regulatory process. The process of gaining FDA approval starts with pre-clinical trials. In stage two of the process the compound is closely scrutinized and tested in vitro, which literally translates to “in the glass.” At this stage additional tests are done, generally in test tubes or petri dishes. If this part of the pre-clinical trial goes well, they enter stage three where animal testing will begin to determine if the drug is safe to proceed to the clinical trial stage (stage four). Less than 1% of the compounds that enter the pre-clinical trials make it to the human testing that takes place in the clinical stage (Grabowski 2002).

For those drugs that do manage to survive these pre-clinical trials, there is an even more intense process ahead in the stage three clinical trials. There are three phases in the
clinical trial process. Phase I of the clinical trials entails giving a small dose of the compound being tested to a very small sample size of humans. Generally, the sample size in Phase I consists of healthy adults, and the purpose is to determine the appropriate dose that should be given as the effects the drug has on the body. If the Phase I tests do not raise any red flags, the compound proceeds to Phase II. Phase II is where the majority of failures occur, as it is the first time that the full dose is given to humans, and the sample size is again increased. The sample in this phase usually consists of adults who have the condition the drug is intended to treat. For those compounds that do survive Phase II, Phase III is the most expensive stage, a result of the length and intensity of the trials in the phase. The sample size is enlarged in an attempt to increase the chances that the benefits will be determined to be statistically significant. If all goes well in Phase III, the company submits a New Drug Application (NDA) to the FDA, who will inform the developing company if they may begin to market the drug to the public. This clinical trial process is both expensive and time consuming, and only 22% of the compounds that enter this process ultimately succeed in gaining the FDA’s approval (Grabowski 2002). Once the drug can finally be marketed, the company enters the final post-approval stage, where they continue to monitor and research the newly approved drug.

This demonstrates that researching and developing a new drug and successfully bringing it to market is extremely difficult, and in this process the stakes are high. It is because developing a new drug is an extremely costly endeavor. Joseph DiMasi, Ronald Hansen and Henry Grabowski (2003) found that the average out-of-pocket cost of developing a new drug is $403 million (DiMasi et al. 2003). This figure is before expenditures for marketing and other costs associated with finally bringing a new drug to the market, assuming it is one of the fortunate few that ever make it that far. For those select drugs that are eventually marketed and distributed to the public, the total cost is, on average, in excess of $800 million.

For those new drugs that do succeed in gaining the FDA’s approval and make it to market, there is a limited window in which these drugs can really produce strong revenues for the developing firm. This is because on average these new drugs only enjoy an eight year effective patent life in which to recoup the costs of development and make the firm profitable. A drug’s effective patent law life is the time that drug is under patent protection after reaching the market. Although patents for new pharmaceuticals generally last for twenty years, the time that it takes to test and develop those drugs counts against the patent’s life. Since it takes on average twelve years to bring a drug to market, that drug is only on the market and enjoying patent protection for eight years before generic competition is allowed to enter the market. This generic competition forces the developing firm to drastically reduce their prices, since once other firms can just copy the compound it is extremely cheap to manufacture the drugs.

Decision for Internal Development

As the FDA approval process suggests, the decisions facing a pharmaceutical firm present a complex capital budgeting problem. Kellogg and Charnes (2000) developed a model that can help value drug development projects. They calculated that the expected net present value (ENPV) of a drug is

\[
ENPV = \sum_{i=1}^{7} \rho_i \sum_{t=1}^{T} \frac{DCF_{i,t}}{(1 + r_d)^t} + \sum_{j=1}^{5} \sum_{t=1}^{T} \frac{CCF_{j,t}}{(1 + r_e)^t} \tag{1}
\]

The NPV estimation has two distinct cash flows: the first is where the pharmaceutical is making cash outlays during the development stage (DCF) of the drug and the second is where the pharmaceutical is receiving cash inflows from commercial success (CCF). At each stage, where i is an index of the seven stages of drug development, there is the conditional probability \( \rho_i \) that the drug will succeed at the end stage for a drug that is in stage \( i \). \( q_i \) is the probability of success once the drug makes it to market. Kellogg and Charnes divided the degrees of success into five categories ranging from “dog” to “breakthrough.” \( T \) is when all future cash flows falls to zero. In the DCF this happens when the drug reaches the next stage, while in the CCF this occurs at the expiration of the patent. Each period has its own discount rate. \( r_d \) is the discount rate for development cash flows while \( r_e \) is the discount rate for commercialized cash flows. Kellogg and Charnes used six and nine percent for the discount rate for the development and commercialized stages, respectively. As Kellogg and Charnes discuss, this model can be used to value each of the projects in a potential target’s pipeline, which can then lead to a valuation of the firm as a whole.

For the purposes of this paper, it will be helpful to modify the equation presented by Kellogg and Charnes. This modification will allow us to analyze a project in a firm’s pipeline during the patent stage and during the post-patent stage separately. This will take into account that just because a drug loses its patent protection, the revenues a firm derives from that drug do not fall to zero. Prices often are dramatically slashed, but the firm will often to continue to produce that drug and sell it under the same name, albeit at a great discount. The second term of equation 1 above is modified and presented below.

\[
ENPV = \rho_T \sum_{i=1}^{T} q_i \left( \sum_{t=T+1}^{T} \frac{CCF_i}{(1 + r_d)^t} \right) + \left( \sum_{g=T+1}^{N} \frac{CCF_g}{(1 + r_e)^g} \right) \tag{2}
\]
where $CCF_p$ is the cash flow during the patent life and $CCF_G$ is the cash flow during the generic period.

As a drug in the pipeline completes a stage of development, it becomes more valuable, as the probability of it ultimately reaching the market increases. This has the effect of enhancing the overall value of the firm, as the value of a pharmaceutical company is ultimately derived from the value of its future drugs. Through valuing an entire firm’s pipeline, it is possible to attempt to value the entire firm. This helps offer the firm some guidance and certainty when trying to determine how much they should be willing to pay to make a potential deal worthwhile for their investors.

Clearly, for pharmaceutical companies looking for future sources of revenue, investing in research and development in hopes of bolstering the firm’s own pipeline is not always a reliable strategy. The process of developing new compounds and getting them approved can take fourteen years or longer and is extremely expensive. Further, failures, particularly in the later stages, can lead to gaps in the pipeline which will disrupt a firm’s revenue stream as other drugs come off patent. These factors make growing revenues at a consistent rate and increasing shareholder value extremely difficult.

Given the many problems associated with investments in research and development, it is not surprising that pharmaceutical companies have often looked for other ways to compensate for gaps in the pipeline and to help maintain their expected revenues. All indications are that mergers and acquisitions will remain a key strategy in the pharmaceutical sector for the foreseeable future.

MERGERS AND ACQUISITIONS IN THE PHARMACEUTICAL INDUSTRY

The pharmaceutical industry is an ideal industry in which to study mergers and acquisitions. This is because it is an important international industry comprised of many firms engaged in fierce competition, and they develop extremely important products with the potential to save and improve countless lives. There is also great diversity with regard to the size of these firms, as sizes range from some extremely small firms which operate mostly locally and are privately held to enormous international firms such as Pfizer, Inc., which has global revenues of nearly $50B. Most importantly for the purposes of this paper, these firms constantly face pressure to innovate and bring new drugs to the market. One of the results of this pressure is that firms of all sizes in the pharmaceutical industry have frequently engaged in mergers and acquisitions as a way to maintain their revenue streams and increase shareholder value.

The pharmaceutical industry is also an extremely complex sector that is constantly faced with both short-term and long-term challenges and uncertainties. The expiration of a key patent on a blockbuster drug and the subsequent generic competition can devastate a firm’s previously most reliable source of revenue. Maintaining a pipeline of drugs that will drive revenues in the future is far from guaranteed. As discussed previously, new drugs are costly and time-consuming to develop, and the vast majority of potential new drugs fail to gain the Food and Drug Administration’s approval and thus never reach the market. From the start of the development process it takes a new drug over ten years to reach the market, and less than one out of every hundred compounds that are studied in the preclinical stage ever make it to human testing. Further, only one in five of the drugs that do make it to human testing succeed in gaining FDA approval (Grabowski 2002). A failed drug leaves the firm with nothing to show for their time and resources invested in the project.

The industry also experiences seemingly endless political uncertainty, as “big pharma” and their allegedly outrageous profits is always an easy target for grandstanding politicians. These political attacks increase the uncertainty regarding the potential for future drugs currently being researched and developed to provide strong revenues if and when they ultimately reach the market. The current healthcare reform debate is merely the latest in a long line of government attempts to get more involved in the healthcare system to the detriment of pharmaceutical companies. These debates always increase the doubt about whether the drugs currently in a firm’s pipeline will be adequate to meet analysts’ and investors’ expectations even if there are no unexpected failures. This added uncertainty further pressures pharmaceutical companies to have a strong pipeline of drugs that will reach the market and succeed.

Acquisition Theories

There is a great deal of literature that discusses the motivations for acquisitions in the pharmaceutical industry and offers various explanations for why there are so many pharmaceutical mergers and acquisitions. Some of this literature argues that the synergies that can be created from bringing two firms together are a driver of merger activity. For example, William Pursche, an advisor to companies in a variety of sectors and a veteran of over three hundred mergers and acquisitions, argues that in the pharmaceutical industry, “for companies that can capture cost synergies through acquisitions there are considerable opportunities to create value” (Pursche 1996). This can indeed be the case, although most of the benefits that come with synergies are recognized in the short term. However, there can also be some serious inefficiencies when the two firms first come together that can have the effect of offsetting some of the benefits from shorter term synergies.

There is some management literature that argues that manager’s egos can be a reason for all the mergers. The argument is that top executives want to run the largest and
most powerful company possible. This desire can cloud a manager’s judgment and lead them to believe that they will be able to succeed where many merging pharmaceutical firms before them have failed. In criticizing the merger talks between GlaxoWellcome and SmithKline Beecham that would ultimately create GlaxoSmithKline, Fortune ran an article in which Glaxo COO Sean Lance criticized the process, declaring that “megalomaniac seems to be the driving force of these mergers. Egos are taking precedence over future strategies” (Chiang 1998). Given this, it is not surprising that the GlaxoWellcome and SmithKline Beecham merger has been roundly criticized for creating a larger but less successful company which has failed to produce higher shareholder returns (Heracleous and Murray 2001).

Other scholars believe that firms in this industry merge to diversify the drugs which are providing the bulk of their revenue. Pfizer Chief Executive Officer Jeff Kindler explained his company’s $68B acquisition of Wyeth by saying that, “this deal is about transforming our company into a more diversified business, and to providing [sic] real focus and accountability across those businesses” (Chiang 2009). Mergers can be a valuable way to prevent a firm from becoming overly dependent on one blockbuster drug, and therefore the firm will be in a position to better handle the inevitable patent expiration and subsequent generic competition that one key drug will eventually face. Further, Vasudevan Ramanujam and P. Varadarajan explain that “the rising cost of internal development… has rendered acquisition-based diversification increasingly attractive to firms” (Ramanujam and Varadarajan 1989).

While all these theories seem to make some sense, the one key motivation for mergers and acquisitions in the pharmaceutical industry are pipeline related. In this industry, a firm’s pipeline is absolutely critical. The pipeline receives intense scrutiny from analysts and rating agencies, because the quality of the pipeline is extremely significant in knowing if the company will be able to pay back its debts and grow their revenue in the future when their key current drugs come off patent. Therefore, firms in this industry turn to mergers and acquisitions when there are gaps in their pipeline due to late-stage and unexpected failures. As Simon Frantz explained, pharmaceutical mergers are “driven by losing major patents and not having enough drugs in their pipelines to fill the gaps” (Frantz 2006).

**Biotechnology Firms and Acquisition Value**

While many studies have examined mergers and acquisitions in the pharmaceutical industry, this study will be examining the characteristics of drugs in the target firm’s pipeline. Specifically, the effect of biotechnology drugs in the target’s pipeline will be closely scrutinized. Biotech drugs, unlike traditional pharmaceuticals, are produced from living organisms, and thus are more expensive to manufacture and distribute than traditional pharmaceuticals. The biotech field is currently the fastest growing and most promising area of pharmaceutical research. Biotech drugs are a relatively new area of pharmaceutical discovery, and as Henry Grabowski (2002) explains, they may in the near future be able to reach the market faster and achieve higher success rates. This fact, coupled with biotech’s potential to effectively treat a wide range of serious conditions, has led to heavy investments in the development of biotech drugs. However, Grabowski concedes that presently, the costs of development are no lower and sometimes even higher, and the likelihood of a drug reaching the market are no better for biotech drugs than for traditional drugs (Grabowski 2002). This is possibly why we do not presently see an ever greater percentage of biotech drugs in pharmaceutical pipelines.

The production of these biotech drugs can be extremely complicated. Although the process by which these drugs come to the market after being scrutinized by the FDA does not differ materially from the process traditional pharmaceuticals undergo, the actual production and manufacturing of these drugs is much different. One scholarly article concluded that the result of the complexity of manufacturing biotech drugs is higher barriers to entry, which will help reduce the competition once the drug loses patent protection (Grabowski et al. 2006). This would make biotech drugs in a target firm’s pipeline extremely attractive to pharmaceutical companies looking to make an acquisition, as their traditional drugs are constantly threatened by generic competition.

The biotech field is an area that holds immense promise and is getting significant attention. Due to the incredible potential biotechnology drugs have to treat a host of ailments from Alzheimer’s to diabetes, there is a belief that these drugs will be major revenue drivers in the future. As it was reported in *BusinessWeek* in 2005, it seems that “Biotechnology has finally come of age.” Pharmaceutical firms are making heavy bets that this will indeed be the case, and that biotechnology is the future of the industry. This is reflected in the fact that “Biotech increasingly dominates the pipeline (44% of all discovery stage candidates) and has a growing share of drug applications (about one in ten of filings)” (Lawrence 2005). Indeed, numerous small firms, and even some very large firms such as Amgen (the largest player with revenues in excess of $14.7B), have been started that focus solely on the development of biotech drugs (Mulligan 2001). These firms, with promising biotech drugs in their pipelines, are increasingly becoming attractive targets for pharmaceutical companies looking to merge, and pharmaceutical companies are increasingly willing to pay a high price for these biotech companies. Indeed, pharmaceutical companies “paying a large premium is fast becoming the industry standard and again reflecting the high demand for biotech companies” (Malik 2009).
Hypothoses and Relevance for Investors

If biotech firms do command a premium, investors will want to anticipate the merger prior to the announcement when abnormal returns appear to occur. A positive market reaction would result in investors in the acquiring firm achieving superior returns around the time of the announcement. Previous research has not examined the pipeline composition, and it is expected that a close analysis of the target pipeline could also help predict the likelihood that the acquisition will be well received by market.

Higher numbers of drugs in the later stages of development in a target firm’s pipeline would also be expected to increase the returns of the acquiring firm’s investors because these drugs are close to reaching the market and generating revenue for the acquirer. It is true that there is still no guarantee of a drug in later stages reaching the market and ultimately being successful. However, there is much less uncertainty regarding potential to reach the public for a drug that has already been tested on humans and achieved some good results than there would be with a drug still in the pre-clinical stage. Those drugs that are in the early stages of the process are longer duration projects, and as Bradford Cornell explains, “longer duration projects are ‘riskier,’ by the sheer fact of their longer duration and, therefore, should be discounted at higher rates” (Cornell 1999). This fact makes those drugs in the later stages much more valuable than those in the beginning stages of gaining FDA approval.

Potentially even more significant than late stage drugs in the target firm’s pipeline for predicting the likelihood of success in a pharmaceutical merger is a biotechnology focus in a target, resulting in biotech drugs in the target firm’s pipeline. As discussed above, there is incredible potential for major profits would come with the development of a new biotechnology drug. Given this, it would be expected that a biotech focus in a target firm would lead the market to respond positively to a biotech acquisition announcement and thus increase the returns realized by the acquiring firm’s investors.

Finally, some financial data will also be included to see if this information can help predict the market’s reaction to an acquisition. The target’s research and development expenditures for the year prior to the acquisition will be recorded and compared to the firm’s total assets. Dividing the research and development costs by the total assets will reveal how focused on organic pipeline development the target firm was. Firms value research and development expenditures because it shows a commitment to the development of successful new drugs and lays the foundation for future revenues. It is believed that targets that put proportionately more of their resources into development will be more favorably received by the market.

EMPIRICAL METHODOLOGY AND ANALYSIS

In order to test if a biotechnology focus, late stage drugs in the target firm’s pipeline and strong investments in research and development will indeed lead to higher returns for the acquiring firm’s investors, a two step empirical methodology will be used. The first step is known as an event study, a study where the market’s response in the trading days surrounding a major event is studied. The second step is analyzing the residuals from the event study to see if it can be determined what is driving the residuals. The following sections will discuss in detail the various tests run and will analyze the results.

Step One: Event Study

Testing the hypotheses put forth in this paper required performing an event study, which is any study that measures the impact of a specific event on the valuation of a company. There are numerous possibilities for events to be studied. The possibilities include earnings announcements, the sale of new stock or changes in management. In this study, the event will be the official announcement of the acquisition. Event studies are helpful, because “given rationality in the marketplace, the effect of an event will be reflected immediately in asset prices. Thus the event’s economic impact can be measured using asset prices observed over a relatively short period of time” (Campbell, Lo and MacKinlay 1997).

The actual event in this study will be the day the acquisition was officially announced. An event window to be examined must also be defined, since rumors of the acquisition could potentially cause abnormal price returns in the trading days leading up to the announcement, and there could be post-announcement drift that results in abnormal returns in the days immediately following the announcement. This window should be adequate to capture all the price action that would be a result of the acquisition. In this study the event window will start at the eighteenth trading day prior to the acquisition announcement and end at the close of the twentieth trading day after the announcement.

Prior to the event window the movement of an acquirer’s stock price is assumed to follow the general trend of the industry. A 100 day estimation period was used to capture the relationship between the target firm and the industry. This is a variant of the market model:

\[
R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}
\]

\[
E[\varepsilon_{it}] = 0
\]

\[
Var[\varepsilon_{it}] = \sigma^2_{it}
\]

\(R_{it}\) is the return of acquirer \(i\) at time period \(t\), and \(R_{mt}\) is the industry return for the same period. \(\varepsilon_{it}\) represents the zero mean disturbance term, and \(\alpha_i\), \(\beta_i\), and \(\sigma^2_{it}\) are the model’s parameters. This model shows the expected linear
relationship between the individual acquirer’s performance and the broader performance of the pharmaceutical industry (Campbell, Lo and MacKinlay 1997).

Given this “normal” relationship, the model is used to estimate the expected return during the thirty-eight day event period. The excess (or “abnormal”) returns of the acquirer’s stock during event period T is measured

\[ E_{IT}^* = R_{IT} - E(R_{IT}|X_T) \]

Where \( E_{IT}^* \), \( R_{IT} \) and \( E(R_{IT}) \) are the abnormal, actual and normal (expected) returns, respectively for the event time period T. \( X_T \) is the conditioning information for the normal performance model. Excess residuals for each firm are average for each day during the event period:

\[ \sum_{i=0}^{n} E_{IT}^* x_\tau \frac{1}{n} = E_T \]

Average residuals are summed over time and denoted as the cumulative average residuals (CARs).

\[ \sum_{T=-18}^{T=20} E_T = CAR_T \]

Step Two: Residual Analysis

Once the CARs are gathered, regression analysis can be utilized to assess the impact of pipeline composition and maturity on CARs. It is expected that the CARs are a function of characteristics of the target firm. The model that will be used is presented below.

\[ CAR_i = \beta_0 + \beta_1 Preclinical_i + \beta_2 PhaseI_i + \beta_3 PhaseII_i + \beta_4 PhaseIII_i + \beta_s Approved_i + \beta_6 Biotech_i + \beta_7 \frac{R&D}{Total Assets_i} + \mu_i \]

For this study it will be important to control for the type of target and the pipeline composition. Also included in the model is the target’s investment in research and development.

Data

To test the hypotheses, a list of potential acquisitions was generated with the help of the Mergent Database, which identifies firms which are no longer actively traded. Because of the need for transparency in creating the data set, all targets were publicly traded at the time of the announcement, as was the acquiring firm. All of the acquisitions had occurred fairly recently, as no acquisition on the list had been announced farther back than 1999. Like Golec and Vernon (2009) the target in each acquisition was classified as either a traditional pharmaceutical firm or a biotechnology firm based on the company’s SIC code. This process produced 23 traditional pharmaceutical targets, representing 56% of the sample and 18 biotech targets, representing 44% of the sample.

Once the list of targets was created and each firm was classified as either a traditional pharmaceutical or a biotech, the pipelines of the targets had to be analyzed. To accomplish this, the Mergent Database was again used, this time to obtain each target’s annual report for the full year prior to the year the merger was announced. These annual reports provided pipeline information, and the number of approved drugs as well as the number of drugs in development was recorded as well as the stage of development for each drug in the pipeline.

Some relevant financial data for each firm was also recorded. Specifically, the target’s research and development expenditures for the year prior to the announcement were recorded to see if firms who had made a heavy commitment to research received any premium. To put the research costs in the proper perspective, the target’s total assets were also recorded. This allowed a variable to be created that would take into consideration the different sizes of the targets when determining how significant the investments in research were.

Stock price information for the acquirer as well as for a pharmaceutical index was collected. The index chosen is the AMEX Pharmaceutical Index, which trades under the ticker symbol DRG. This index is designed to mirror the equity performance of the pharmaceutical sector. In collecting stock price data, for both each acquiring firm and the index close prices were recorded for each of the eighteen trading days prior to the announcement of the acquisition, the close price on the day the acquisition was announced and the close price for each of the twenty days after the announcement.

The logarithms for the recorded closing prices for both the acquiring firms and the index were then calculated, as these are proxies for asset returns.

Descriptive Statistics

The mean for drugs in the pipeline in the preclinical stage of development was slightly over three, while the average number of approved drugs was under two. It is also interesting to note the wide range in research and development expenditures and total assets observed in the sample. The ratio of research and development to total assets also speaks to the wide variation in the size of the targets. The target with the highest ratio spent a staggering 32 times more on research and development than the firm had in total assets. This reflects the fact that the sample captured firms of greatly different sizes. For further details about the data, see the descriptive table for the variables in Table-1.
EMPIRICAL RESULTS

Calculating CAR

To determine how the market is responding to acquisitions in the pharmaceutical industry, the returns in each acquisition had to be compared to the returns observed in the broad pharmaceutical index. This process had several steps. First, the industry index performance was used to predict the performance of each individual acquirer’s stock. The deviation in the acquirer’s actual performance, called the residual, was then calculated for each day observed. The observations for the acquirers of traditional pharmaceutical targets were then separated from the information on the acquirers of biotech firms. For both of these groups the residuals could then be accumulated so that the net abnormal returns could be analyzed. This was accomplished by simply summing the individual residuals for every day preceding the day being analyzed. These net abnormal returns are known as the cumulative average residuals.

Once the cumulative average residuals were calculated, the average cumulative average residuals for each day could be calculated for both the traditional and biotech targets. This was accomplished by averaging the cumulative average residuals for each acquiring firm across each day. It is expected that the CARs will be near zero for the days leading up to the event, that is that investors will on average over time will not receive a return other than what is the normal market return. However, these residuals could differ after the announcement depending on the reactions of the market to the information in the announcement. Any significant CARs in the time leading up to the announcement could indicate that investors are trading on rumors of the announcement. It is also expected that the CARs will be higher for firms acquiring biotechs that for those acquiring traditional pharmaceutical firms, since there may be cash flow advantages in the biotech generic market. The comparison will allow us to evaluate how the market is responding to biotech targets as compared to their traditional counterparts. The results are presented in Figure-1.

Interestingly, the graph shows that the CARs begin to trend higher for the firms acquiring traditional targets right away. This suggests that buying on rumors is occurring. There is less of a move before the announcement for the biotech acquirers, perhaps because with some of the smaller biotech firms there is less media scrutiny and fewer rumors are leaked. The strong performance of the traditional acquirers refutes the notion that the market has become generally negative on pharmaceutical acquisitions and will thus knock the stock of the acquiring firm down. However, in the days following the announcement, the performance of acquirers of traditional pharmaceutical firms begins to level off, whereas the biotech acquirers really begin to see positive abnormal returns. By the twentieth day following the announcement, the abnormal returns for each type of acquirer is similar, suggesting that the acquirers of biotech firms are not seeing higher returns than the acquirers of traditional targets.

The next step in the process was to determine if the results were statistically significant. To determine significance, the available data was used to calculate the standard error. From this the $J_1$ statistic, used to determine statistical significance, was calculated by dividing the average cumulative average residual by the standard error. The results for the acquirers of traditional firms reveal that the results are statistically significant at the 99% confidence interval for the entire event window. For the biotech acquirers, the results are statistically significant at the 99% confidence interval for the first five days of the event window, then lose their statistical significance until the third day before the announcement. The results then remain significant at the 99% confidence interval for the duration of the event window.

These results are the opposite of what was found by Hassan et al (2007), and Heracleous and Murray (2001). Hassan found that “despite the attractiveness of mergers in the pharmaceutical industry, [they found] no abnormal returns from mergers for acquiring companies” while H&M state that “there is a general background of evidence to show that mergers frequently destroy shareholder values. The pharmaceutical sector is no exception” (Heracleous Murray 2001).

Pipeline’s Impact on CARs

Four regression models were run in order to see if it could be determined what factors the market values in a target firm when pricing the acquirer. The first of these regressions was for the eighteenth trading day prior to the announcement of the acquisition. The second was the day of the announcement and the third was for the twentieth day after the announcement. The fourth model took the firms’ average CARs for the five days immediately after the acquisition was announced. The results are in Table-2 below.

The first column for each day shows the variable’s coefficient while the second column shows its t-value. The results reveal that for the eighteenth trading day before the announcement of the acquisition the model can explain less than 40% of the observed variation. However, the day of the announcement the model’s ability to explain the variation jumps to slightly over 56%. The average of the five days after the announcement is the strongest model, predicting just over 57% of the variation. By the twentieth day after the announcement, the model’s ability to explain the observed CARs is back below 50%.

In looking at the individual variables, the market seems to value the Phase III drugs, while not valuing projects in the
earlier stage of development. The value of the coefficient on the Phase III drugs also continuously rises as it gets later in the event window. This is not surprising, given that Phase III drugs are close to reaching the market and thus face less uncertainty than the drugs in the earlier stages of development. It is interesting that the market seems to even value Phase III drugs more than drugs already approved, perhaps because the patent on those drugs has already began to run out, while Phase III drugs will enjoy a longer period of protection. Although drugs in the earlier stages of development are not statistically significant, it is interesting to note that the coefficients do grow for each stage of development as the drug gets closer to the market. The coefficients for drugs in the preclinical stage are particularly small, not surprising given the tremendous rate of failure at that stage.

The ratio comparing the target’s research and development expenditures to total assets does not have much of an impact on how the market values the acquirer. This does make sense, because the market will value the successes of the research based on the projects, particularly the later stage projects, in the pipeline. The market is not rewarding a commitment to high expenditures on research.

Consistent with the results found in Graph-1, the model shows that the market is not giving a premium for biotech acquisitions. This could possibly be a result of the high price acquirers of biotech firms have to pay since, as discussed above, biotech firms often sell for a premium. This could weigh down the acquirer’s performance in the wake of the acquisition announcement.

**CONCLUSION**

There is a great deal of room for additional research on this subject. Future studies may want to examine whether the market values acquisitions between two firms who have collaborated on the development of a drug in the past. The market may value this past collaboration since the firm’s are already familiar with each other and have worked successfully in the past, creating a familiarity that may ease the transition that is sometimes difficult.

Future research may also want to consider using a longer time horizon when analyzing an acquirer’s performance. The relatively short time horizon utilized in this study was appropriate for an event study, but it would be interesting to see if the pipeline information would have an effect over the longer term performance of the acquirer. Testing this could be made more difficult by firms that frequently make acquisitions. One other possible avenue for future research could be to analyze the therapeutic class of the drugs in development. This would reveal whether the market values firms that focus on developing drugs that treat conditions that tend to be very profitable.

In a fiercely competitive industry such as the pharmaceutical industry, acquisitions will likely remain a key strategy for firms looking to maintain their revenues for the foreseeable future. Given this, it would benefit investors to have more information about what characteristics the market values in a target firm so that they can invest their capital wisely. Hopefully future research will be able to shed additional light on this question.
**Table 1**

Descriptive Statistics

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<th>Variable</th>
<th>Mean</th>
<th>Minimum</th>
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<tr>
<td>Pre Clinical</td>
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<td>Phase 1</td>
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<td>R&amp;D (millions)</td>
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<td>7.57</td>
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<td>TA (millions)</td>
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<td>RD/TA</td>
<td>1.134</td>
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**Table 2**

Impact of Firm’s Pipeline on CARs for Particular Days during Event Window

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<th>Variable</th>
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<th>-18*</th>
<th>0</th>
<th>0*</th>
<th>20</th>
<th>20*</th>
<th>5 day aver.</th>
<th>5 day aver.*</th>
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<td>0.50</td>
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<td>0.568</td>
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<td>Adj. R-sq</td>
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*t-statistics
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TESTING FOR TRICKLE-DOWN OR POLARIZATION – EVIDENCE FROM INDIA

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ABSTRACT

Current methods of testing the nature of economic growth are erroneous and could misguide policies. The correct method would be to consider incomes of the rich and the poor over time and test for the direction of Granger causality for the level as well as change in income. Both trickling down and polarizing growth fundamentally depend on uni-directional Granger causation such that the income (or growth in income) of the rich is the cause and the same of the poor the effect. Positive sign of the slope gives trickling down and negative sign shows polarizing growth. Indian regional data provides substantiation.

INTRODUCTION

Rapid growth in developing world subsequent to market oriented economic policy reforms in developing world over the last two- three decades has raised concerns about the nature of the growth. Do benefits of the rapid growth trickle down to the bottom or the poor? Alternatively, does the growth lead to polarization bypassing the poor? These questions have serious policy implications because if the growth were polarizing type, governments in the rapidly growing developing world would arguably be required to pursue direct interventionist policies to take special care of the poor sections of the society. On the other hand, if the growth has considerable trickle down effects, these governments may not have to divert to follow direct interventionist policies as the poor do benefit substantially from the growth.

These questions about the nature of the economic growth lead economists to examine them generally by considering changes in income distribution over time. Since reliable and comparable data on personal income distribution over time are almost completely absent in the developing countries (World Bank, 2006) because of insurmountable difficulties in getting reliable and accurate information (see, Rangarajan et al., 2009), countries are compelled to use proxies for personal income distribution. A popular substitute is private household consumption expenditures, but they have several conceptual and practical problems to serve the purpose satisfactorily. The other one and contextually less objectionable substitute of the personal income distribution is the regional (geographical) income distribution for testing about the nature of the growth. Conclusions about trickling down or polarizing effects of economic growth, then, depend on the behavior of measures of income inequality. Based on such conclusions, in the case of India, important policy decisions are taken to benefit the poor directly by intervening in market processes in terms of special programs (basically, direct and indirect subsidies) on employment, housing, healthcare, education, food, fertilizers and petroleum products. All such important policy decisions depend on the empirical issue -- whether the rapid economic growth leads to trickle down or polarization.

The next section reviews briefly some important contributions to the original hypotheses about the trickling down or polarizing growth. The third section, then, discusses currently popular regional inequality measures with Indian regional data. The fourth section argues about the causality test for deciding about the nature of economic growth in the country again with Indian regional data. The fifth and final section presents concluding remarks.

NATURE OF ECONOMIC GROWTH -- ALTERNATIVE HYPOTHESES

Problem of regional disparities in the level of economic development is almost universal. Its extent may differ in different economies. Nevertheless, its existence is certain in any nation of respectable size. The causes and behavior of such inequalities have attracted the attention of economists relatively very late. The seriousness of the socio-political implications of such inequalities prompts any national government to take action in terms of specific economic policies to tackle this problem eventually in the course of the development of the national economy. The foremost analytical and policy question that an economist should answer is — whether any conscious and deliberate additional interference with the normal functioning of the system by the government is required or the problem can be resolved by the normal functioning of the system without additional interference from the government. Consequently, the hypothesis of ultimate convergence in the levels of regional development emerged with the alternative hypothesis of ultimate non-convergence. Moreover, this hypothesis has explicitly links with the level of national development and implicitly with time.
The best way to study the level of economic development over a period is to analyze economic growth. It is natural, therefore, to find the analysis of regional economic growth to be the most popular field in the regional economics. Various theories in general and models in particular, devised in the last 50 years, provide insights into the answer of the above-mentioned question. However, this question characteristically like many other similar questions in the economic science remains unsettled, though it has secured a larger proportion of area of agreement among the scholars in the field. Most experts, for instance, generally agree that inherent tendencies for increasing regional disparities exist in the early stages of national economic development. Sharp differences of opinions and judgments, however, exist on the prediction of ultimate convergence as the nation reaches matured stages of development, and on the basic determinants of regional growth differentials.

Myrdal (1957) and Kaldor (1970) feel that the basic forces at work are disequilibrating in nature. In other words, once the divergence from the equity occurs, the force at work would be such that there is further divergence. Although Myrdal (1957) recognizes that the spread effects usually become stronger as a nation develops, he believes that the backwash effects are on an average more powerful than the spread effects. Hirschman (1959) also feels that the polarization effects are stronger than the trickling-down effects in the earlier stages of development of a nation. He is, however, more optimistic than Myrdal. As Hirschman (1959) points out, Myrdal is preoccupied with the doctrine of cumulative causation and hence ignores the emergence of the strong forces making for a turning point. Myrdal (1957) shows awareness about the lower extent of regional disparities in highly developed western economies, but makes no formal attempt to explain it within the framework of his doctrine of cumulative causation. According to Hirschman, this is the major limitation of his doctrine. Kaldor's model (1970) formalized by Richardson (1973) predicts divergence. Nevertheless, the reformulation of the same model by Richardson (1978) later showed that it is equally consistent with convergence. Hirschman's formulation of these arguments clearly gives rise to a hypothesis of an inverted U-shape curve between the extent of regional disparity and the level of national development.

The hypothesis of an inverted U-shaped curve gets support from empirical statements by Kuznets (1958) and Williamson (1965). Williamson (1965) explains this type of the shape of a regional inequality curve mainly with the help of four factors, viz., labor migration, capital migration, interregional linkages, and central government policy. The essence of the basic argument is that because of selective migration of labor, worker rate tends to rise in the rich regions and fall in the poor regions. Further, there also occurs qualitative deterioration in the working force of the poor regions. Therefore, the internal labor migration, in all probability, tends to increase regional income inequalities at least in the initial stages of national development. Moreover, the agglomeration economies, which consist of external economies and other benefits of clustering capital projects in the relatively rich regions, attract capital from the poor to the rich regions. This can further accelerate interregional inequality. Similarly, there is likely to be a lack of interregional linkages especially in the early stages of national development, with the result that the spread effect of technical change, social change, and income multipliers would be minimal. Even the Central Government's policy is likely to work in favor of the rich regions and against the poor regions, if the national objective is to attain maximum growth in the economy in the short run. In the allocation of investment, the rich regions with more social capital and hence a higher rate of return on private capital, may get priority; the licensing policy and national tariff policy may also favor the rich as compared to the poor regions. These are exactly the backwash or polarizing effects of economic growth in a region. Williamson (1965) finds USA and Italy as the examples of this type of growth taking place in the early stages of development.

Williamson (1965) also argues that the process of regional convergence or trickling down is likely to be cumulative once it starts after the nation reaches a threshold level of development. Easterlin (1957) feels that convergence is not inevitable since factors working against it are generally dynamic ones. Based on the historical evidence in the case of several developed nations, Williamson (1965), however, expects an automatic reversal in the earlier trend of increasing regional inequality again through the working of the same four factors.

There are, however, differences of opinion on the basic determinants of regional growth differentials. Isard and Reiner (1961) feel that the polarization of the economic growth in a nation may largely be due to (i) the unevenly distributed natural resources among regions, (ii) necessarily unequal access to major markets including foreign markets, and (iii) unequal distribution of inherited know-how and labor skills among regions. The export-base theories developed by Innis and Mac-Intosh also support the contention that regional differences in incomes, wages, and growth rates must be dependent on regional differences in natural resource endowments. Capithorne (1977, 1978), however, shows with the help of neoclassical trade and growth models that natural resource endowments alone can hardly be considered a decisive factor for the persistence of regional disparities in development. He emphasizes the role of the migration or growth of labor and capital as more important than the natural resources in causing regional disparities in economic growth. Richardson (1973), trying
to synthesize location theory and neoclassical growth theory by introducing a couple of location-specific variables, adds technical progress as an important causal factor. He postulates regional technical progress as dependent inter-alia on agglomeration economies. Boventer (1975) also emphasizes more or less the same set of factors although he explicitly considers regional industrial structure and changes therein as important factors. Mera (1975), on the other hand, contends that although mobility of labor and capital can check the inequality from widening, these factors, by themselves, are not powerful enough as compared to the technological factors. He emphasizes the social capital and changes in the degree of urbanization as basic determinants of the rate of technical progress in a region. Isard and Reiner (1961) argue that regional inequality in inherited know-how and labor skills is more subject to change.

Thus, the expectation about the ultimate convergence or divergence depends on what sets of factors are identified as the basic determinants of the regional growth differentials. However, this brief review of the contributions to the original hypotheses about the nature of the economic growth – polarizing or trickling down – points to a definite direction of causal effects, besides clearly stating that the growth path followed in the leading and the lagging regions would be necessarily different. Almost all scholars are tracing the effect of the growth in the rich region on the poor region rather than vice versa. Moreover, the final effect of the growth on regional inequality could be in either direction depending on the exact dynamics operating in the system. Like many other similar questions in the economic science, this issue also becomes an empirical issue that one requires to settle only within the given empirical setting of a study.

REGIONAL CONVERGENCE AND DIVERGENCE

The empirical measure used to be popular up to 1970s for describing the trend in regional inequality was to consider the weighted or un-weighted coefficient of variation (c.v.) of per capita Gross State Domestic Product (GSDP) originating within the geographical boundaries of the states. Contrast of such c.v.s over time would indicate the trend in regional disparity in a country. This was too crude a measure since it only captured dispersion of regional per capita incomes and trends therein. However, it is easy to calculate and simple to interpret. As a result, several policy makers use it even today in developing countries. Another (and perhaps more sophisticated) measure is the Gini coefficient of inequality. Some policy makers prefer using this measure (see, Ahluwalia, 2002) because it has a visual counter part in the Lorenz Curve and if carefully measured and interpreted can provide useful insights into the dynamics of distributional changes over time. However, policy makers ignore finer aspects more often than not, and emphasize only broad trends for drawing conclusions.

Table 1 presents the Gini Coefficient of inequality in India among states since 1980-81. The table shows that, in terms of the magnitude of the Gini coefficient, regional inequality has risen over time in India. The traditional conclusion, therefore, would be that Indian regional data support the polarization hypothesis against the spread effect of regional growth. There can be several objections to such a conclusion. It is not possible to establish conclusively whether the inequality has increased or not only by looking at the magnitude of the Gini coefficient. If the underlying Lorenz Curves are intersecting, such a conclusion may not hold. Moreover, one should not use such crude tests based on inequality measures to verify hypotheses about the nature of growth that essentially describe processes and casual effects as discussed in previous section.

Another popular analytical tool used for addressing the question of regional convergence or divergence is the one proposed by Barro and Sala-i-Martin (1995). The measure is regression based that considers per capita growth rate over a long period as the dependent variable and the logarithm of real per capita income in the base year as the independent variable in a cross section of regions. If one considers more independent variables, the same method would provide conclusion about “conditional” convergence or divergence. Although this method has a sound theoretical base, it essentially measures the impact of regional growth on regional inequality based on the premise that growth experience in the rich and the poor regions are similar. As the brief review of the original hypothesis in the previous section clearly points out, the growth experience in the rich and the poor regions are not likely to be similar within a country.

Studies on regional disparities in India have applied all these popular measures on regional income data and arrived at sharply different conclusions. Nair (1971) for the period 1950-60 and Choudhary (1974) for the period 1950-70 found no reduction in regional disparity in India. Majumdar and Kapoor (1980) found continuously rising regional income differentials during 1962-76, while Gupta (1973) and Sarkar (1994) found evidence for reducing regional disparities. Dholakia (1994) and Cashin and Sahay (1996) considering 20 state economies in the country showed evidence for regional convergence over 1960-90, but Rao et al.(1999), Kurian (2000), Ahluwalia (2002), Sachs et al.(2002), Dasgupta and Singh (2005) found increasing disparities or regional divergence in India even after policy reforms in 1991. However, Singh et al.(2003) and Dholakia (2003) considering several measures of well-being found no evidence of absolute worsening of regional disparity during the 1990s.
In short, empirical evidence on regional inequality in India is not conclusive. Conclusions differ because of use of different data sets, different time periods considered, different numbers of state economies included in the sample and different measures used for regional inequality. However, all these studies suffer from a common limitation when it comes to interpreting their findings for concluding about the nature of growth in the system. All of them ignore the basic issue of sequencing, precedence, or causality involved in the original hypothesis about trickling down or polarizing growth.

CAUSALITY TEST FOR TRICKLING DOWN GROWTH

The brief review of the original hypothesis about polarizing or trickling down growth in the second section above clearly reveals that it considers dynamic processes involving cause-effect relationship between the growth impulses in the rich region and those in the poor region of the country. Hence, there is a need to test this hypothesis directly by considering two regions, a better-off region (B) consisting of all better off states and a worse off region (W) consisting of the rest of the states in the country. Then, one has to carry out the Granger causality test for the level of the income and the rate of change in the income in the two regions.

The hypothesis of the spread or trickling down effects would hold if the income and growth of the better-off region Granger-causes the income and growth of the worse-off region with positive coefficients. The same direction of causality with negative coefficient would support the polarization or backwash hypothesis. However, if the causality turns out to be from the worse-off region to the better-off region, or if there is bi-directional causality, then the empirical evidence would be inconclusive about this hypothesis. This is because the literature on such reverse effects of growth in the poor region on the growth in the rich region is silent in terms of the polarizing or trickling down nature of the growth. As such, if the growth in the poor region causes the growth in the rich region, it would largely be in terms of expanding the markets for the products of the rich region, which is neither trickling down nor polarizing growth. If the Granger test shows a two-way causality between the rich and the poor regions, again the growth dynamics cannot reflect meaningfully either polarizing type or trickling down type of growth. Thus, bi-directional causality case or the reverse causality case between the rich and the poor regions would not qualify as either polarizing or trickling down growth. In such cases, however, the regional inequality indexes would show some trend — either rising or falling. Linking the trends in the regional inequality indexes with polarizing or trickling down nature of growth is, thus, theoretically unjustified if not totally incorrect.

In order to test this hypothesis, the exercise carried out here considers data on GSDP at constant (1999-2000) prices from all 25 states of India for the period 1980-81 to 2006-07 after making necessary adjustments for base year changes. Among the better-off states (B), Andhra Pradesh, Goa, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab and Tamil Nadu are included. These 9 states have their per capita GSDP higher than the all India average. The remaining 16 states having below average per capita GSDP are included among worse-off states (W). The GSDP of these two categories, B and W represent addition of the real GSDP of states belonging to the respective groups. The basic data on GSDP for all states are from the standard CMIE-CSO source.

The Granger-Causality test is performed by VAR modeling where the selection of lags is through Akaike Information Criterion (AIC) because the Wald Test is sensitive to the lag selection. Table 2 presents the results of the Granger-Causality test. The table clearly shows that both the VAR model and the Wald test for Granger-Causality confirm only uni-directional causality of level as well as rate of change in GSDP from B-group of states to W-group of states. It is, therefore, possible to test meaningfully the hypothesis about the nature of growth being polarizing or trickling down. Moreover, the coefficients in both the cases are positive indicating that an increase in the level (and the rate of change) of GSDP of the better-off states would lead to (or cause) an increase in the level (and the rate of change) of GSDP of the worse-off states in India. Thus, the Indian regional data over the last 27 years clearly support the hypothesis of spread or trickledown effect rather than the backwash or polarization effect. This is an important finding for the Indian policy makers, particularly, the Planning Commission and the Finance Commissions whose main concerns so far have been regional disparities and inequalities while allocating and devolving resources among states from the Union or the Central Government. Findings based on measures of regional inequality in India and other countries though not conclusive about increasing or decreasing trend over time have been often misinterpreted to imply polarizing nature of growth in the country. Findings of this paper, on the contrary, reveal that economic growth in India has been of trickling down type.

CONCLUDING REMARKS

Economic growth in better-off states does spur growth in the worse-off states not only through temporary migration of labor and capital but also through the forward and backward linkages of economic activities. The more
integrated is the national economy geographically, the higher are the benefits of the spread and the trickle down effects of growth in the leading regions to the lagging regions. Since increased globalization has reduced constraints on effective demand and thereby on the extent of specialization in regional economies, it has paved the way for increased spread and trickle down effects through greater regional integration in the domestic economy. The backwash and polarization effects become relevant more in an overall static framework where the size of the cake for sharing among regions remains more or less constant. Increased globalization, on the contrary, has enabled rapid expansion of production possibility frontier not only through reduced barriers to trade enabling greater flow of goods and services across borders, but also through increased factor mobility across nations. Rapid liberalization of domestic economic policies to ensure fuller economic integration of all state economies could be the most effective alternative to achieve further efficiency and acceleration in the growth rate. Concerns about regional equity and disparities in a domestically such a well integrated economy operating in an increasingly globalized environment through the so-called “inclusive growth” concerns and special subsidy oriented programs need not distract the efforts particularly in the light of the empirical findings of the present study.

Table 1 : Trends in Interstate Inequality, 1980-81 to 2006-07

<table>
<thead>
<tr>
<th>Year</th>
<th>Gini Coefficient</th>
<th>Year</th>
<th>Gini Coefficient</th>
<th>Year</th>
<th>Gini Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-81</td>
<td>0.115</td>
<td>1989-90</td>
<td>0.133</td>
<td>1998-99</td>
<td>0.159</td>
</tr>
<tr>
<td>1981-82</td>
<td>0.121</td>
<td>1990-91</td>
<td>0.166</td>
<td>1999-00</td>
<td>0.164</td>
</tr>
<tr>
<td>1982-83</td>
<td>0.113</td>
<td>1991-92</td>
<td>0.134</td>
<td>2000-01</td>
<td>0.164</td>
</tr>
<tr>
<td>1983-84</td>
<td>0.113</td>
<td>1992-93</td>
<td>0.148</td>
<td>2001-02</td>
<td>0.207</td>
</tr>
<tr>
<td>1984-85</td>
<td>0.112</td>
<td>1993-94</td>
<td>0.151</td>
<td>2002-03</td>
<td>0.204</td>
</tr>
<tr>
<td>1985-86</td>
<td>0.114</td>
<td>1994-95</td>
<td>0.158</td>
<td>2003-04</td>
<td>0.209</td>
</tr>
<tr>
<td>1986-87</td>
<td>0.111</td>
<td>1995-96</td>
<td>0.174</td>
<td>2004-05</td>
<td>0.205</td>
</tr>
<tr>
<td>1987-88</td>
<td>0.122</td>
<td>1996-97</td>
<td>0.164</td>
<td>2005-06</td>
<td>0.208</td>
</tr>
<tr>
<td>1988-89</td>
<td>0.119</td>
<td>1997-98</td>
<td>0.160</td>
<td>2006-07</td>
<td>0.206</td>
</tr>
</tbody>
</table>

Note: Gini Coefficients here are calculated on the basis of 14 major states in India
Source: Centre for Monitoring Indian Economy for the basic data.

Table 2 : Granger-Causality – Results of VAR Model and Wald Test

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
<th>P-Value</th>
<th>Wald Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. On GSDP levels with lag = 2 based on minimum AIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. GSDP-B</td>
<td>Constant</td>
<td>-63493</td>
<td>45120</td>
<td>0.1747</td>
<td>Chi-Square = 2.07 with 2 degrees of freedom and significant only at 35.47% level</td>
</tr>
<tr>
<td></td>
<td>GSDP-B(t-1)</td>
<td>1.378</td>
<td>0.284</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSDP-W(t-1)</td>
<td>0.067</td>
<td>0.379</td>
<td>0.8621</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSDP-B(t-2)</td>
<td>-0.692</td>
<td>0.311</td>
<td>0.0378</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSDP-W(t-2)</td>
<td>0.470</td>
<td>0.382</td>
<td>0.2321</td>
<td></td>
</tr>
<tr>
<td>2. GSDP-W</td>
<td>Constant</td>
<td>33967</td>
<td>34702</td>
<td>0.3394</td>
<td>Chi-square = 8.02 with DF=2 and significant @ 1.81% level</td>
</tr>
<tr>
<td></td>
<td>GSDP-B(t-1)</td>
<td>0.618</td>
<td>0.218</td>
<td>0.0103</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSDP-W(t-1)</td>
<td>0.185</td>
<td>0.291</td>
<td>0.5318</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSDP-B(t-2)</td>
<td>-0.380</td>
<td>0.239</td>
<td>0.1283</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GSDP-W(t-2)</td>
<td>0.519</td>
<td>0.294</td>
<td>0.0926</td>
<td></td>
</tr>
<tr>
<td>II. On ∆ GSDP with lag=1 based on minimum AIC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. ∆ GSDP-B</td>
<td>Constant</td>
<td>9687</td>
<td>6903</td>
<td>0.1745</td>
<td>Chi-Square = 0.16 with DF=1 and significant @ 68.81% level</td>
</tr>
<tr>
<td></td>
<td>∆ GSDP-B(t-1)</td>
<td>0.928</td>
<td>0.242</td>
<td>0.0009</td>
<td></td>
</tr>
<tr>
<td></td>
<td>∆ GSDP-W(t-1)</td>
<td>-0.147</td>
<td>0.365</td>
<td>0.6920</td>
<td></td>
</tr>
<tr>
<td>2. ∆ GSDP-W</td>
<td>Constant</td>
<td>13507</td>
<td>5158</td>
<td>0.0157</td>
<td>Chi-Square = 20.29 with DF=1 and significant @ 1.81% level</td>
</tr>
<tr>
<td></td>
<td>∆ GSDP-B(t-1)</td>
<td>0.815</td>
<td>0.181</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>∆ GSDP-W(t-1)</td>
<td>-0.631</td>
<td>0.273</td>
<td>0.0305</td>
<td></td>
</tr>
</tbody>
</table>
Note: Both the tests are consistent in their conclusions.

ENDNOTES

1. Computational assistance provided by Mr. Apoorva Adhvaryu and Mr. Brajesh Kumar is gratefully acknowledged.

2. It is important to note the distinction between the free operation of market forces and the ‘normal functioning’ of the system as used in the text. The former would imply no interference of any type from the government. The latter, on the other hand, recognizes the existence of some regular and given types of government interventions not originally intended to tackle the regional problem.

3. Non-convergence would include diversion or increasing inequality as well as persistence or constancy of the inequality.

4. It is interesting to note that during the “Take-off” stage, as Rostow (1956) and Kravis (1963) point out, personal income inequalities, too, tend to increase.

5. This argument is by Myrdal. As against this, Okum and Richardson (1961) argue that in the underdeveloped economies, marginal product of labour might be zero, hence out-migration helps improving per capita income. Moreover, because of the out-migration, the capital intensity in the region increases. On the other hand, the receiving region may face the migrants with very poor quality and again in the childbearing age group. Therefore, no general proposition on the effect of internal migration on regional income inequality is possible on a priori grounds.

6. Mera (1975) estimates that the short-run cost of achieving equity in the regional incomes in Japan are almost 30% in terms of aggregate efficiency in the system. He, however, also points out a possibility to achieve greater equity without losing aggregate efficiency. This possibility for a system of isolated regions exists if regions have a positive growth rate of capital in the optimal growth path.

7. The state per capita incomes are used to calculate coefficient of variation (c.v.) in cross section data. The c.v. calculated with the corresponding population weights is called weighted c.v. and the one without any weights is called un-weighted c.v.

REFERENCES


TOWARD A MORE DIVERSE & GLOBALLY RELEVANT ECONOMICS EDUCATION: APPLICATIONS IN THE PRINCIPLES OF MICROECONOMICS COURSE

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ABSTRACT

Curricular globalization and the introduction of multicultural perspectives have taken on increasing importance over the last two decades across college campuses. This has been driven in part by the need to prepare graduates for the realities of working and succeeding in a globally-competitive and culturally diverse economy, and supported by calls for such emphasis by regional and programmatic accrediting bodies. This paper begins by defining globalization and multiculturalism in the context of their relevance for economic decision-making and discusses the benefits of enhancing an understanding of economics and its underlying assumptions beyond the traditional Western perspective typically taught at American universities. The present study extends the existing literature by providing specific examples of ways in which the principles of microeconomics course may be enhanced to broaden student perspectives to help achieve university or programmatic learning objectives with respect to diversity understanding.

INTRODUCTION

Within the last several decades the world has become smaller in terms of the global spread of ideas and commerce. This has been fueled by many factors including increases in international trade, the development of international supply-channels, the rise of economic powers in Asia and Latin America, and the explosive growth of the Internet. At the same time, differences remain across regions and nations in terms culture, values, expectations, and behaviors. As educators, particularly in the fields of business or economics, it is critical that we prepare students for success in a global economy, where Western (or U.S.) thought, culture and norms cannot be assumed in all contexts. In addition, students need to develop an understanding of how cultural differences will affect economic behavior and their response to it.

The present study will focus on the teaching of microeconomic principles as an example of where the curriculum may be broadened to encompass multicultural perspectives. The typical pedagogy for principles of economics instruction emphasizes lecture of frequently unquestioned neo-classical theory without separate consideration of gender, race, or cultural differences (see Laskey Aerni, et al., 1999). This sentiment is similarly expressed by Mitry (2008), who champions the need for cultural integration in economics coursework to provide students with a fuller understanding of underlying economic assumptions. In addition, Mitry notes that traditional economic education is not effective in providing students with the cultural background and understanding necessary to effectively work with the many emerging and developing economies.

From a more practical perspective, the need for a more global and multicultural education of business students, in particular, has come the major accrediting bodies of such programs. For example, in the Preamble to its standards for business education, AACSB (The Association to Advance Collegiate Schools of Business) notes that some of the challenges facing organizations and managers stem from ―differences in organizational and cultural values‖ and ―cultural diversity among employees and customers‖ (AACSB, 2010, p.3). In this same document, it is noted that business programs must minimally prepare students for careers in a global context. This is emphasized further in its standard for curriculum management (Standard 15) where the program is expected to prepare students to interact with individuals from other cultures and to be able to manage in circumstances where ―business practices and social conventions are different than the graduate's native country‖ (p.71). Specific examples of global, cultural, and diversity curriculum topics are also provided. The importance of a global business education is likewise emphasized by ACBSP (Association of Collegiate Business Schools and Programs). Its standards for business accreditation emphasize the need for a curriculum that prepares graduates for the global work place and the global dimensions of business (ACBSP, 2009). For both organizations, the offering of a curriculum addressing global understanding is not optional for accreditation success.
Related to accreditation, requirements for student learning assessment have led to the development of learning goals and objectives for most academic programs in order to meet programmatic or regional accreditation requirements. Certainly in the case of business programs, particularly those maintaining or pursuing accreditation from AACSB or ACBSP, having learning goals or objectives related to multiculturalism or global understanding should be commonplace. While programs have latitude in where such learning occurs and where it is measured, the present study provides an example of such application in the microeconomics principles course.

We begin by determining what is meant by multiculturalism and globalization, followed by a discussion of the “measurement” of cultural difference across regions and nations. Clearly an understanding of cultural differences may most effectively be developed in our students through multiple applications throughout the curriculum. In this study, we will focus on how such augmentation may be done in a traditional principles of microeconomics course as an illustration and reasons for selecting this course will be discussed. Research is limited in this area apart from a notable study by Mitry (2008). The present study will provide specific examples of discussion topics that may be incorporated into the principles course with the goal of increasing students’ understanding of economics concepts and broadening their exposure to cultural differences likely to be faced in their professional careers.

CULTURE, MULTICULTURALISM, GLOBALIZATION, AND INTERNATIONALIZATION

What is culture and multiculturalism? While there are hundreds of definitions for culture (see Olie, 1995), these generally center on the fact that a culture is something acquired through experience and is frequently associated with the society of a nation or sub-region. According to Jones and Alony (2007), a society’s culture will include values based on dominant beliefs and attitudes; the partaking of rituals or collective activities; role modeling; and a common understanding of symbols that may be expressed in terms of myths and legends, dress, jargon, among others. Mehta, et al. (2010, p. 99) cites multiple reference to models of culture and indicates that, in general, people from a given culture exhibit similar norms and values, which they have learned and shared. Hofstede (2007) in a study on researcher ethnocentrism states that culture is a programming of the mind that is a collective attribute (not individual) that is manifested in behaviors that are common to some, but not all people.

Cultures have developed differently over time based on historical events and environmental factors and continue to differ among and within nations. An understanding of these differences is important for success in the conduct of international business and an understanding of socio-economic events around the world. Culture does not remain fixed over time and multiple factors in recent decades have helped expose individuals to other norms, ideas and social systems. Some of these blending influences include the rise in global trade, the World Wide Web, immigration, and cross-national and cross-cultural marriages (Jenner, et al., 2008). Jenner et al. refer to this process as crossvergence, such that a culture may retain certain core elements while also adapting components from other cultures with which it interacts. Hofstede (1980) in his major study on cultural measurement indicated that cultural positions across nations, particularly with regard to uncertainty avoidance (discussed in detail below), would change within a 20 to 40 year period (as cited in Jenner, et al., 2008). Despite the effect of global influences, difference in culture remain as noted in multiple cross-cultural studies (see e.g., Eva, 2000; Jenner, et al., 2008; Reisinger, et al., 2009; Hofstede, 2007).

What should be expected of students, particularly in business and economics, in terms of their understanding of multiculturalism and global environments? A multicultural education would tend to emphasize the need for understanding and acceptance of cultural differences in order to broaden our understanding of socio-political and economic events and behaviors. Students of business and economics should understand how values and norms differ across regions so that management and marketing practices will complement these differences and emphasize business performance. In addition, such exposure may develop the students’ understanding of the assumptions inherent in behavioral economic models as they relate to cultural differences, and help them to recognize and appreciate diversity of thinking and ways of life. This is not meant to imply that all components of a given culture must be accepted and respected by the student. For example, the oppression of women or authoritarian rule may be components of a given culture, should be recognized and understood by the student, but not necessarily embraced as values to be universally accepted. The student should recognize that differences exist and consider how they potentially affect the application of business or economic concepts within a given cultural perspective; broader social thought and action may be an outgrowth of such exposure. Particularly in the West, individuals (students) seem reluctant to adopt other ways of thinking, working under the assumption that their way is the best (Eva, 2000). This finding seems also relevant when considering both the teaching and learning of business and economic principles – both teacher and student should be cognizant of their own ways of thinking and recognize that assumptions and practices may be different for other cultures.
As a final note, multicultural and global economics education in the context of this study differs from what is commonly referred to as international economics. International economics generally refers to topics of trade and related issues such as balance of payments, exchange rate determination, international monetary policy, trade policy, etc. Indeed the term globalization has been used to generally characterize the effects of world trade, outsourcing, and related issues on workers, poverty, relative economic development and growth. Thus, globalization characterizes more the interconnectedness and interdependence of local, national and regional economies (Goldstein, 2004; Cheung and Chan, 2010). While these are critically important topics for understanding by any student of business and economics, they may be generally understood, at least in part, separate from an understanding of cultural differences. Instead, we wish to examine economics (in particular concepts within microeconomics) in terms of how cultural differences may affect how economic questions are answered and the universality of underlying assumptions to our economic models.

MEASURING CULTURE

An analysis of cultural differences in the classroom may be performed using case studies of given nations or regions exhibiting certain cultural traits. Especially if the cultures differ greatly from that of the student, it can be instructive to compare how economic decisions may differ between peoples of the two areas. However, such an approach can be difficult especially if the instructor is not natively familiar with the alternate culture. In addition, it is difficult to identify relevant cultural characteristics without presenting an incomplete or distorted view of the countries norms, traditions, and values.

The measurement of cultural differences in a more systematic manner was undertaken in a major study by Hofstede (1980) with an expansion of the analysis in 1988. In this work, Hofstede identified key dimensions of cultural differences by country and region, and his results have been used in multiple analyses and applications since their development as key measures of cultural diversity. Hofstede’s 1980 study was conducted through the surveying of 116,000 IBM employees working in 40 different countries. The survey attempted to measure work-related values across these countries resulting in the identification, through factor analysis, of four primary dimensions of cultural values, with the relative position of countries on these dimensions represented on an approximate 0 to 100 scale. This original analysis allowed for the calculation of cultural dimension scores for 79 countries and regions. A fifth dimension was later added measuring short and long-term orientation for 39 countries and regions (Hofstede and Bond, 1988; Hofstede, 2001; Hofstede and Hofstede, 2005). It should be noted that survey participants did not represent all countries and regions reported in the results and that scores for some countries were estimated based on a replication process (see discussion in Hofstede and Hofstede, 2005).

While there have been criticisms of the approach (see e.g., Dorfman and Howe, 1988; Jones and Alony, 2007; McSweeney, 2002; Nasif, et al., 1991; Schwartz, 1990, 1999), the results continue to be used as the most comprehensive measures available of cultural diversity at the country level. Certainly, they are useful for providing students a foundational understanding of the major dimensions and differences in cultural values, with the qualification that culture is dynamic and more complex than can be summarized through aggregated indexes.

Hofstede’s five cultural dimensions are briefly defined and discussed below, although it is noteworthy that only the first four dimensions (emanating from the 1980 study) are most frequently analyzed in applied work. This may be due in part to the fact that the fifth dimension was developed for a smaller set of countries and regions than was done in the original study. These five dimensions include Uncertainty Avoidance, Power Distance, Individualism versus Collectivism, Masculine versus Feminine, and Long-term versus Short-term Orientation. For each dimension, a comparison of selected characteristics of high and low scoring countries is presented, as derived from Hofstede and Hofstede (2005). Additional observations from other authors that have applied this framework in their own work are also presented as appropriate. In practice, it is less important how accurately these measures represent cultural diversity in various countries or regions, especially recognizing that such diversity is dynamic, but more important that they demonstrate the existence of relative differences (Mitry, 2008).

Uncertainty Avoidance (UA)

This dimension measures the extent to which people in a given society feel threatened by a lack of structure or uncertainty (Jones and Alony, 2007). A high score for this dimension means that individuals in this society desire certainty and low risk in decision-making. These societies develop formal rules for conduct, and deviation from such rules is not tolerated (Mehta, et al., 2010) Therefore, in a business and economic context, individuals in these societies would prefer to avoid uncertain, ambiguous or risky decisions and actions (Mitry, 2008). In the workplace, clear instructions are expected from the supervisor. Alternatively, in weaker avoidance societies, rules continue to exist but may be challenged, while a more friendly and comfortable work environment is desired (Mehta, et al. 2010); individuals may be more open to change and perceive such changes as positive opportunities (Cheung and Chan, 2010). From a
marketing perspective, Jenner et al. (2008) point out that in high UA countries, consumers may need more adaptation time to accept and purchase new technology that has an unfamiliar track record. Citing Hofstede (1980), Jenner et al. also indicate that in high UA countries, where rules are very important, vague rules or procedures may lead to greater overall anxiety and an enhanced work ethic. From a consumer behavior perspective, Reisinger et al. (2009) cite work by Tai and Chan (2001) indicating that people from high UA cultures generally require more information in making buying decisions in order to protect group interests and minimize uncertainty. Other observations based on the work of Hofstede and Hofstede (2005) are summarized below.

### High UA Countries
- High stress and anxiety
- Acceptance of familiar risks but fear of ambiguous situations and unfamiliar risks
- Hesitance toward new products and technologies
- Conservative investments
- Appeal of expertise in advertising (e.g., physician spokesperson)
- Fewer changes of employment and longer service to an employer
- Emotional need to be busy and inner urge to work hard
- Top managers concerned with daily operations
- Intrapreneurs constrained by existing rules
- Worse at invention; better at implementation

### Low UA Countries
- Low stress and anxiety
- Comfortable with ambiguous situations and unfamiliar risks
- Fast acceptance of new products and technologies
- Riskier investments
- Appeal of humor in advertising
- More changes of employment and shorter service to an employer
- Hard-working only when needed
- Top managers concerned with strategy
- Intrapreneurs are relatively free from rules
- Better at invention; worse at implementation

A sample of high and low scoring countries/regions on this dimension is as follows, with the U.S. ranked 62nd out of 72 countries/regions.

- **High UA countries/regions:** Greece, Portugal, Guatemala, Uruguay, Belgium (Flemish)
- **Low UA countries/regions:** Singapore, Jamaica, Denmark, Sweden, Hong Kong

### Power Distance (PD)

This dimension measures the extent to which an unequal distribution of power is acceptable with the society (Mitry, 2008). Inequalities in power would be acceptable in high PD cultures and there would be greater importance attached to proper social relationships for fear of losing respect (Reisinger, et al. 2009). In a business context, Mehta et al. (2010) suggest that a high score on this dimension would indicate a more paternalistic relationship between management and subordinate in the workplace, whereas there would be more interdependence and trust between these groups in societies and workplaces with lower scores on this dimension. This interpretation is echoed by Jenner et al. (2008) and Jones and Alony (2007), who indicate that a higher score on this dimension would imply a greater acceptance of inequality in social relationships such that a more centralized command structure would be expected in business organizations; in low scoring PD countries one would expect a more ready flow of ideas across different levels of the organization. Additional characteristics of countries scoring high and low on this dimension follow (Hofstede and Hofstede, 2005).

### High PD Countries
- Centralization of power is popular
- There are more supervisory personnel
- Wide salary range between top and bottom of organization
- Privileges and status symbols are normal
- Contact between superiors and subordinates is initiated by superiors
- Mostly poorer countries with small middle classes

### Low PD Countries
- Decentralization of power is popular
- There are fewer supervisory personnel
- Narrow salary range between top and bottom of organization
- Privileges and status symbols are frowned upon
- Superiors are accessible to subordinates
- Mostly wealthier countries with larger middle classes

A sample of high and low PD countries/regions is shown below, with the U.S. tied for the ranking of 57th-59th among 74 countries/regions.

- **High PD countries/regions:** Malaysia, Slovakia, Guatemala, Panama, Philippines
- **Low PD countries/regions:** Austria, Israel, Denmark, New Zealand, Switzerland (German)

### Individualism versus Collectivism (IND)
This dimension measures the degree to which individual interests are valued relative to those of the collective group. A high score for this dimension means that individualism and individual interests are valued in society relative to more collective needs. In a high IND country, individuals would focus on their own self-interests and expect acknowledgement of achievements; the broader group is assumed to benefit from each individual acting in his/her own self interest (Mehta, et al., 2010). This is echoed by Jones and Alony (2007) who note that people from individualistic societies may prefer to work alone rather than in groups; likewise these cultures would be more geared toward competitiveness (Cheung and Chan, 2010). The opposite is true for collectivist societies where the achievement of the group and loyalty to the group are most valued. In the context of economic behavior, a low score for IND in a given society may imply that material rewards common in Western cultures for inducing productivity may be less effective (Mitry, 2008). Additional relevant characteristics based on Hofstede and Hofstede (2005) follow.

### High IND Countries
- Adults look after themselves and their immediate (nuclear) family
- Children think in terms of “I”
- Individual ownership of resources
- Consumption patterns show self-supporting lifestyles
- Media is the primary source of information
- Occupational mobility is high
- Every customer should get the same treatment
- Companies are typically owned by individual investors
- Economic theory is based on individual self-interest

### Low IND Countries
- People are born into extended families and protect them in exchange for loyalty
- Children think in terms of “we”
- Resources are shared with relatives
- Consumption patterns show dependence on others
- Social networks are the primary source of information
- Occupational mobility is low
- In-group customers should get better treatment
- Companies are typically owned by families and collectives
- Imported economic theories are not able to deal with collective interests

A sample of high and low scoring countries/regions on this dimension follows, with the U.S. ranked 1st among 74 countries/regions (Hofstede and Hofstede, 2005).

#### High IND countries/regions:
- United States, Australia, Great Britain, Canada (Total), Hungary

#### Low IND countries/regions:
- Guatemala, Ecuador, Panama, Venezuela, Columbia

### Masculine versus Feminine (MAS)

This dimension measures the degree to which value is placed on assertiveness (Mitry, 2008). In more “masculine” societies, men are expected to be more assertive and focused on material success, while women are expected to be more modest and concerned with the quality of life; in “feminine” societies both men and women favor modesty and show concern for quality of life issues (Hofstede and Hofstede, 2005). More generally, in “masculine” cultures characteristics such as authority, performance and success are dominant relative to more “feminine” traits emphasizing the importance of relationships, quality of life, and service (Jones and Alony, 2007). Thus, in a business context, higher scores (indicating masculinity) would imply that gender roles are clearly delineated, whereas there would be an expectation of more flexible gender roles in a lower scoring society (Mehta, et al., 2010). Below are some additional characteristics on this dimension based on Hofstede and Hofstede (2005).

#### High MAS Countries
- Challenge, earnings, recognition and advancement are important
- Aggression is accepted
- Job choice is based on career opportunities
- More status products are sold
- Management is decisive and aggressive
- Conflicts are resolved by letting the strongest win
- Preference for larger organizations
- More money is preferred over more leisure time

#### Low MAS Countries
- Relationships and quality of life are important
- Children are socialized to be non-aggressive
- Job choice is based on intrinsic interest
- More products for the home are sold
- Management is performed by intuition and consensus
- Conflicts are resolved by compromise and negotiation
- Preference for smaller organizations
- More leisure time is preferred over more money

A sample of high and low scoring countries/regions on the MAS dimension are as follows (Hofstede and Hofstede, 2005), with the U.S. ranked 19th among 74 countries/regions.

#### High MAS countries/regions:
- Slovakia, Japan, Hungary, Austria, Venezuela

#### Low MAS countries/regions:
- Sweden, Norway, Netherlands, Denmark, Slovenia
Long-term versus Short-term Orientation (LTO)

This dimension measures the value placed on time (Mitry, 2008). People from high LTO cultures are generally more concerned with long-term commitments, planning, work ethic and patience, and are more risk-averse than people from low LTO cultures (Reisinger et al., 2009). Hofstede and Hofstede (2005) identify the following additional characteristics.

**High LTO Countries**
- Perseverance and sustained efforts toward slow results
- Thrift – sparing use of resources
- Willingness to subordinate oneself for a purpose
- Humility for men and women
- Work values include honesty, adaptiveness, accountability, and self-discipline
- Leisure time is not important
- Importance of profit 10 years from now
- Large savings – funds available for investment

**Low LTO Countries**
- Efforts are to produce quick results
- Social pressure toward spending
- Concern with social and status obligations
- Humility for women only
- Work values include freedom, rights, achievement, and thinking for oneself
- Leisure time is important
- Importance of this year’s profit
- Smaller savings and little available for investment

A sample of high and low LTO countries/regions follow, with the U.S. ranked 29th among 39 countries/regions.

- High LTO countries/regions: China, Hong Kong, Taiwan, Japan, Vietnam
- Low LTO countries/regions: Pakistan, Czech Republic, Nigeria, Spain, Philippines

Relative scores from the Hofstede studies are shown in Table 1. Of course, a society or culture is not defined by a single one of these dimensions, but by their combination. It is also important to remember that the scores do not represent absolute levels of a given characteristic, but the nature of that dimension of culture relative to the other countries and regions.

For example, in comparing cultural differences on these dimensions between the United States and Brazil, one would find that relative to the U.S., Brazilian peoples have greater uncertainty avoidance, desiring more formal rules, less uncertainty, and lower risk in decision-making than would be true for people from the U.S. (Brazil=76, U.S.=46). In the area of power distance (PD), the two countries are both in the medium range for all countries (Brazil=69, U.S.=40), but the relative difference indicates that people from Brazil would be more acceptable of inequality in social and work relationships and would likely be more comfortable with a more centralized command structure in the work environment than in the U.S. For example, it may be more likely for subordinates to address managers by their first names in the U.S., while this may be less likely in Brazil. There is a greater difference with regard to the individualism-collectivism cultural dimension, where the U.S. score of 91 is much higher than Brazil’s score of 38. Thus, we would expect a greater emphasis on individual and independent decision-making and competitiveness in the U.S., whereas in Brazil one would expect more teamwork and decision-making based on group interests. In terms of the masculine-feminine dimension, the U.S. ranked somewhat more highly relative to Brazil (Brazil=49, U.S.=62) with the results indicating a leaning toward more masculine behaviors in the U.S. Traits like assertiveness and material success would be relatively more prevalent in the American culture. Lastly, in terms of long-term outlook Brazil ranks much more highly relative to the U.S. (Brazil=65, U.S.=29). Thus, we would expect that Brazilians would have a greater emphasis on long-term planning and show greater risk-aversion compared to those in the U.S., where there would be more emphasis on short-term gains and quick results.

As discussed above, Hofstede’s analysis reports results by country and for some regions. Some of these regions are sub-areas within countries where cultural differences may be expected (e.g., French and German Switzerland), so such disaggregation is reasonable and justified by the findings. Similarities among countries in certain regions have also led to generalizations about regional characteristics. For instance, one may be tempted to consider broader regions such as “Asia” or “Western Europe” with the assumption that countries within these regions are sufficiently similar to warrant aggregation. Hofstede (2007) cautions against assuming that countries within a certain geographic area can be aggregated as culturally similar, citing differences between China and Japan. This concern is apparent from a review of index score results from a subset of Asian countries shown below. While Japan and South Korea show high uncertainty avoidance, China and Hong Kong rank very low in this dimension. Likewise, China is stronger in the power distance dimension relative to the other countries, but relatively low compared to Japan in the independence and masculinity dimensions.

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Index Scores</th>
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<tbody>
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<td></td>
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</table>

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Lastly, while Hofstede’s work is most frequently cited in studies of multicultural applications (particularly those requiring measurement), in should be noted that other quantitative measures exist and have contributed to the validation and expansion of Hofstede’s original work. Examples include Bond’s Chinese Value Survey (Bond, 1988) and the Rokeach Value Survey (Rokeach, 1972; Thompson, 1982). The Chinese Value Survey (CVS) was designed with a Chinese culture bias, rather than a Western culture bias as in the cases of the Hofstede 1980 study and the Rokeach Value Survey (Hofstede, 2007). The results from the CVS showed four cultural dimensions, three of which were correlated with Hofstede’s 1980 results, the exception being the UA dimension which did not appear to have an equivalent in the CVS. The CVS results identified a new dimension, which we now refer to as the LTO, which has been adopted as a fifth dimension of cultural values (Hofstede and Bond, 1988).

**APPLICATIONS IN MICROECONOMIC PRINCIPLES**

While multicultural understanding can be incorporated in various areas of a business or economics curriculum, the principles of microeconomics course seems to be a particularly appropriate home for at least partial exposure. Some reasons for selection of this course include the fact that it is required in such programs, and is typically taught within the first two years of these programs, thus providing an appropriate venue to lay a foundation for further thought development in multicultural issues and applications. The content of the typical principles course in microeconomics is also well-suited to multicultural integration. Traditional topics include demand and supply models and their determinants, consumer behavior and elasticity concepts (consumer responsiveness), market structure analysis (including competitiveness, product differentiation, production costs), and resource markets (in particular an introduction to labor economics). Thus, consumer and firm decision-making comprise much of this course and how such decisions/choices are made may certainly be subject to cultural differences.

Since much of traditional economic theory and models have been developed based on Western thought, the presentation of this theory is consistent with the culture, traditions and thoughts of Western (e.g., U.S.) students. With a lack of exposure to cultural diversity, students will frequently not recognize that people may think differently than they do and make choices different than those portrayed in the text. They have limited understanding that people think and interpret incentives differently in other parts of the world or even within sub-regions of their own country.

Certainly exposure to cultural diversity in and of itself is beneficial for the students, but more memorable understanding may result from the application of cultural diversity concepts to core material of study. Students must first have an understanding of the existence and dimensions of cultural diversity before they can begin to apply such understanding to economic decision-making. The Hofstede framework presented above provides one approach to introducing key dimensions of multiculturalism and a way to examine relative cultural differences. A key study by Mitry (2008) has shown this to be an effective approach to incorporating cultural diversity into the teaching of introductory economics. His goal was to demonstrate that exposure to the existence of cultural diversity, and requiring students to consider economic questions cognizant of cultural differences, would improve understanding of economics concepts. His approach involved exposing students to the basic cultural values measures developed by Hofstede and focusing on relative cultural differences between the U.S. and a small group of Eastern European countries. In a controlled experiment, he found that students in classes where cultural diversity was introduced in this manner performed significantly better on average on standard economics exams, a conclusion further affirmed through follow-up testing weeks later that showed significantly greater retention of economics material. While Mitry provides some examples of economic concepts relevant to the Hofstede dimensions, he did not provide much detail in terms of specific questions for discussion or assignments where multiculturalism may be directly applied. The present study builds on Mitry’s work by providing a fuller discussion of Hofstede’s cultural dimensions and specific examples of discussion topics and assignments relevant to the principles of microeconomics course.

**Using Hofstede’s Framework and Results**

Hofstede’s five cultural dimensions provide an accessible approach to introducing students to cultural differences. They are quantified and thus allow the student to examine relative differences in cultural values across many countries and regions. While there is a large literature (some of which has been cited above) on Hofstede’s methodology and the dynamic nature of relative cultural values, it is not necessary to spend class time on these details. The focus of discussion should be on the existence of the cultural dimensions and relative differences that exist across countries. Students interested in methodological details may be directed to relevant sources. It would be useful to spend some class time early in the semester defining the dimensions and presenting data similar to that in Table 1. Working through an

<table>
<thead>
<tr>
<th>China</th>
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<td>39</td>
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</table>
interpretational example, like that comparing the U.S. and Brazil above, may also help students to more fully understand the dimension definitions. For instance, students may be placed in small groups and assigned a country for cultural comparison to the U.S. based on each dimension. The U.S. results would provide a useful benchmark for comparison to another country since the students would be most familiar with their own culture (assuming application at a U.S. college or university).

Given the large number of countries and regions for which data are available, the instructor may wish to select a subset of countries for comparison to the U.S. during the semester, since the comparative process may otherwise be overwhelming. For example in the Mitry (1988) study, relative cultural comparisons were limited to the U.S. and three Eastern European countries where some differences among the dimensions were readily identifiable. Another option may be to consider relative differences among NAFTA partners (U.S., Canada, Mexico, and maybe Chile), other major trading partners (e.g., China, Japan), or a subset of emerging economies (e.g., Brazil, China, India). The instructor may have a personal interest or experience in some regions and may wish to identify countries for comparison on that basis, or the school may have exchange or partnership relationships with schools from certain foreign countries that may serve as a basis for cultural comparison (this may be especially helpful if some students participate in study abroad in the future). As mentioned above, the important point is that the students are comparing other cultures to their own culture (U.S.) so that they have a foundation and motivation for comparison. This also helps reinforce the point that their own cultural values are not universal.

For class demonstration and discussion purposes the five dimensions can be analyzed singly or in combinations depending on the nature of the discussion, available time, and desired depth of inquiry. While culture is multidimensional, there may be some applications where a particular dimension (e.g., Uncertainty Avoidance) may be especially relevant in affecting economic behavior irrespective of the other dimensions.

**Examples for Incorporating Cultural Diversity in the Microeconomics Course**

Below we present some examples of how the instructor can use information on relative cultural differences in the principles of microeconomics course. Topics and questions for consideration are first presented and followed by some direction for the instructor to facilitate student thinking. To assist in illustrating how the cultural dimension scores may be integrated into the class, we will use an abbreviated table of Hofstede’s measures for the U.S., South Korea, Singapore, and Thailand, as shown below. It should be noted that the examples that follow may be used in a variety of ways: in-class faculty-led discussion, small group discussions with reporting out, homework assignments, or examination/assessment questions.

<table>
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<tr>
<th>Country/Region</th>
<th>UA</th>
<th>PD</th>
<th>IND</th>
<th>MAS</th>
<th>LTO</th>
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<td>Korea (South)</td>
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<td>Thailand</td>
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</table>

- **Demand for New Products.** The non-price determinants of demand include tastes and preferences and number of buyers, among others. How would initial demand for a new product (e.g., a new format for digital music) be affected by a country’s culture?
  - In a high UA culture there is a need for greater certainty and low-risk in decision-making. Thus, the introduction of a new and innovative product would likely be better received in a relatively low UA country (such as in the U.S. or Singapore). In countries with relatively higher UA scores there will likely be greater adaptation time to the new product until a track record of success begins to develop (Jenner, et al., 2008). Depending on the nature of the new product, demand may also be influenced by the IND and MAS dimensions. If the new product is geared toward individual satisfaction or is a “status” product, its demand may be higher in countries that rank highly on the IND and MAS dimensions.

- **Advertising.** Advertising and its effectiveness arise in the discussion of tastes and preferences as a determinant of demand and especially in coverage of monopolistic competition (and to some degree oligopoly). How would the design of the advertising message differ based on culture and which dimensions may be relevant?
  - While advertising and message design topics are principally covered in marketing courses, the principles of microeconomics course lays the foundation for the advertising topic. Clearly consumer tastes and preferences for a product are influenced in part by advertising, which is also a primary mechanism for a monopolistically competitive firm to differentiate its product. A number of cultural
dimensions may be relevant. For instance, Jenner et al. (2008) cite multiple studies showing the importance of the IND dimension for understanding consumer behavior. Some of the findings cited indicate that in more collectivist countries, effective advertisements are designed with a larger number or collective set of main characters, to emphasize conformity rather than uniqueness, focus on group rather than individual benefits, and appeal to consumer desires to assimilate rather differentiate themselves from others. Jenner et al. also note that advertisements in more individualistic countries focus more on ego emotions (such as pride and happiness) and on buying decisions made by the individual buyer. Therefore, based on the above sample of countries, one would expect a more collective approach to advertisement design to appeal more in the Asian countries than in the U.S. This exercise helps students to recognize that an increase in advertising spending will not necessarily have a like effect on consumer tastes and preferences unless such advertising is culturally sensitive. The MAS dimension may also be relevant. In relatively lower-scored MAS countries modesty and broader concern with quality of life issues are more prevalent than in higher MAS countries. Thus advertisements should be designed to address these differences based on the culture of the target market; for instance, South Korea and Thailand consumers would be more receptive to advertising emphasizing modesty and home products, whereas in the U.S. more specific gender roles may be exemplified and status products popular (see Hofstede and Hofstede, 2005).

- **Utility Theory & Rational Self Interests.** Utility theory is the foundation for understanding consumer choice and the law of demand. Traditional Western economic thought posits the economic man as a self-interested individual seeking to maximize his/her own utility. Is this a reasonable assumption across cultures? How would cultural differences affect utility determination and the demand for goods and services?

  - In a high IND society, the belief in such decision-making would appear to be quite rational. Individuals in such societies focus on individual interests and acknowledgement of individual achievements. Thus, the utility function for individuals in these cultures will likely comprise elements that provide individual happiness. In the table above, the U.S. ranks very high on this dimension, as do a number of other Western countries from which much of economic theory has emanated. However, in more collective societies (low IND) this assumption would not necessarily be valid as the interests of the group (e.g., family, society) may supersede those of the individual. Thus, individual utility functions may be defined more broadly to incorporate group happiness and satisfaction as part of one’s own utility function. As shown in the example data above, the three Asian countries rank much lower on the IND dimension. This does not mean that the economic man across any culture doesn’t wish to maximize his/her own utility, but that in low IND countries those utility functions are likely to be defined quite differently and capture more familial or societal needs in the generation of utility. Thus, the utility derived from consuming a given product or service may be larger or smaller for the typical individual depending on the culture (i.e., depending on whether such consumption favors individual or collective happiness); likewise, culture would have an impact on marginal utility and therefore demand determination. For example, in a high IND or MAS culture one would expect that status products would derive higher utility compared with that generated in low IND countries, with correspondingly lower demand for such products in the low IND countries.

- **Price Elasticity of Demand.** The price elasticity of demand measures the responsiveness of quantity demanded to a given percentage change in the good’s (service’s) price. Would one expect the elasticity for a given good or service to vary across countries due to cultural differences?

  - Some of the determinants of the price elasticity of demand include availability of substitutes, the percent of the consumer’s income going toward the good, the degree to which the good is a necessity, consumer loyalty to brand, and amount of time for adjustment to a price change. In this case, there are a few options to note possible cultural effects. In terms of the availability of
substitutes, countries with high UA scores may be less likely to consider substitutes for certain goods. By definition, individuals in these countries prefer to avoid uncertain or ambiguous situations. Thus it may be argued that such consumers may be less willing to switch products due to an increase in price (less elastic demand) compared to consumers in low UA countries (more elastic demand). The IND dimension may also be relevant. Hofstede and Hofstede (2005) notes that low-scoring IND countries (more collectivist) demonstrate consumption patterns reflecting dependence on others (rather than making purchases to suit a more individualistic lifestyle). Consequently, in lower IND countries we may expect less elastic demands for some good (compared to higher IND countries) as responsiveness to price changes will not always be an individual decision, but collective. Referring to the sample of country scores above, we may expect more elastic demands in the U.S. relative to the other Asian countries included in the table. In general, the student should recognize that price elasticity of demand figures calculated in one country may not be relevant in another.

- New Product Development. New product development is important especially in monopolistically competitive and in certain oligopolistic industries for firm success. In which types of countries/societies would we expect greater success in such development and which cultural dimensions might be most relevant?

  - In high PD societies there tend to be more structured manager-to-subordinate relationships in the workplace, compared to low PD societies where there is a more ready flow of ideas among workers. Therefore, companies in low PD countries should excel in the initial stages of the development of new products due to the relatively more free flow of ideas, whereas the actual implementation stage may be more amenable to companies located in higher PD countries (Jenner, et al., 2008). Likewise, the level of uncertainty avoidance (UA) may also affect new product development since one would expect greater entrepreneurial behavior in countries with low UA scores. Using the above scores as an example, we would expect more new product development initiation in the U.S. relative to a country like South Korea; the U.S. PD score is relatively smaller and there is less risk aversion (per the lower UA score). On the other hand, the implementation stage of new product development may be more successful in the three Asian countries given their higher PD scores.

- Optimality of Competitive Markets. Traditional economic theory emphasizes the value of competitive markets and the entrepreneur as an engine of growth and innovation. Is this emphasis on competitiveness and risk-taking universal or does it differ by culture? What cultural dimensions may be relevant?

  - One would assume that high IND and low UA cultures would best fit this model of economic behavior. These characteristics of U.S. culture fit this model, as is also true of a number of other Western-oriented countries (e.g., Australia, Canada, and Great Britain). However the natural tendency toward competitiveness would be less prevalent in low IND countries as exemplified among the Asian countries in our sample above. Countries with high UA values possess cultures that are more risk-averse, which would tend to limit entrepreneurial behavior. Likewise, one would expect more competitive attitudes and behaviors in countries with high MAS scores compared to low MAS countries. From the table above, we again find the U.S. to be relatively high in this area relative to the other countries. From the students’ perspective the analysis should not be interpreted to mean that the competitive model is right or wrong, but rather what we assume to be seemingly natural beliefs or inclinations toward competitiveness, self-interest, and risk-taking may not be universal.

- Production Processes and Cost. The analysis of firm and industry production decisions is a major topic within microeconomics. How will cultural differences affect the organization of production and costs?

  - A number of cultural dimensions may affect the organization of production regardless of market structure. For example, in high UA countries rules and procedures are very important which may stifle creativity and
eventually lead to higher costs. More important is the PD dimension which defines acceptable inequality of power within the workplace. In higher PD countries (e.g., Singapore) one would expect a strong command structure in the workplace where decisions would be made by upper management and channeled down to subordinates. In lower PD countries (e.g., U.S.) a more ready flow of ideas across the organization is more acceptable and may enhance innovation. The IND cultural dimension may also be relevant. In higher IND cultures one would find more independent work by employees, a greater sense of competitiveness, and possibly more frequent job changes (e.g., U.S.). In lower IND countries we would find the opposite, where the value for the organization may supersede individual needs and where loyalty to group (organization) is more common. Lastly, in terms of the LTO dimension, one may expect companies located in high LTO countries to value long-term investment and planning for future achievement (e.g., South Korea and Thailand) versus performance in low LTO countries where the focus is more on short-term results (U.S.). The student should glean from these examples how cultural differences may affect cost curves for firms or industries, recognizing that there are multiple ways of organizing production (including services) some of which are influenced by cultural values.

- **Labor Supply Function.** Labor supply measures the number (or hours) of labor available at given wages. How would cultural differences potentially affect the shape of the labor supply curve?

- We would expect than that in countries that rank relatively low in the IND and MAS dimensions, it would be more common among individuals for less independent action and assertiveness and a diminished focus on material success. An example might be a comparison of the U.S. (IND=91, MAS=62) and South Korea (IND=18, MAS=39). How would labor supply in the U.S. differ from that in South Korea based on these differences? It is possible that the responsiveness of South Korean workers to material rewards (wages) may be weaker than in the U.S. This would then imply the labor supply curve in certain South Korean labor markets may be less elastic than in U.S. labor markets. Thus, larger wages (or other material rewards) may be needed to incentivize South Korean laborers relative to those in the U.S. (see Mitry (1988) for a related discussion). A key lesson for students is that workers respond differently to wage and other incentives depending on the country’s culture.

Additional examples to improve multicultural understanding may also be employed, with or without the use of Hofstede’s cultural dimensions. For example, the instructor may invite one or more international faculty or students to the class to discuss cultural values and practices in their home country. If students are already somewhat familiar with Hofstede’s dimensions, they could query the guest(s) regarding the characteristics inherent in the dimensions to gain a better understanding of differences and how they affect answers to economic questions. The discussion could also include common business practices, the effect of religious obligations on the scheduling of work and work processes, and attitudes toward consumption, among others.

An additional approach would involve having students locate articles in the popular press (newspaper or magazines) discussing how firms have responded to the growing market for halal goods (goods permissible according to Islamic law) in both the U.S. and abroad. In this case, the culture of a specific ethnic group may be analyzed in the context of microeconomic theory and practice. Similar analyses could be performed for other ethnic populations (e.g., Hispanics in the U.S.) and sub-regions (e.g., Quebec versus the rest of Canada).

**CONCLUSION**

Recognition of cultural diversity is critical for the preparation of students for success as managers in a global economy. The desire for such an education should be naturally driven by the globalization of the world economy during the last decades and the recognition that beliefs, customs, and traditions differ and should be recognized across countries. Accrediting bodies for business education also emphasize the importance of a multicultural education and serve to motivate business programs to incorporate such training within their curricula.

This study has demonstrated how exposure to cultural diversity may be incorporated into the principles of microeconomics course. This course was chosen because of its emphasis on consumer and producer decision-making, which are sensitive to cultural differences, and because it is required early in the course of study when it is appropriate to...
lay the foundation for multicultural and global understanding. As found by Mitry (2008), by forcing students to think about economic concepts in light of cultures other than their own, they should not only gain greater understanding of cultural differences but also have improved understanding of their core material.

The original work by Hofstede in 1980, and later expanded upon, provides a good framework for identifying key dimensions of cultural values that allows students to examine the relative position of one country versus others on each dimension. The framework directly identifies for the student key aspects that define cultural differences and provides guidance as to how such differences may be analyzed in an economic context. The present study extends the current literature in this area by providing specific questions and methods for incorporating the recognition of cultural diversity into the teaching of microeconomic principles. The need for greater multicultural understanding by students is clear, but will first require that faculty understand this diversity and provide this knowledge in a context that is meaningful and memorable for the student.

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<tr>
<th>Country/Region</th>
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Sources: Hofstede and Hofstede (2005) and Cheung and Chan (2010).
Notes: Data for South Africa are for Whites only; data for Nigeria and Zimbabwe are available for the LTO dimension only.
PRODUCTIVE SCIENTISTS, THE IMPACT ON ECONOMIC DEVELOPMENT, AND THE KEYSTONE INNOVATION STARTER KITS INITIATIVE

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ABSTRACT

The Pennsylvania Keystone Innovation Starter Kits (KISK) initiative provides additional financial resources to Pennsylvania academic medical centers, non-profit research institutions, and Keystone Innovation Zone–partnering Institutions of Higher Education to recruit highly productive or star research faculty. The additional resources provide funding for these researchers to “build out” labs and staff, equipment, acquisition and to leverage funding of their research. The location of these scientists within the Commonwealth tends to be an important determinant for close proximity of new firm location or existing firm investments so as to further develop the scientist’s intellectual property for market commercialization by firms. Local and state economic development is advanced, where KISK is a key component for Pennsylvania’s technology-based economic development strategy.

INTRODUCTION

Technology-based economic development (TBED) strategies have become a greater priority among states so as to enhance state and regional economic development (Armstrong, 2009; Douglass, 2006; Geiger and Sa’, 2005). One of the key pathways along any TBED continuum from research to intellectual property (IP) generation to licensing to new startups or existing firms (Pennsylvania Department of Community and Economic Development, 2005) is the role of highly productive scientists or star scientists and their impact upon regional economic development.¹ Star scientists tend to have a substantial positive impact on firm entry, firms success and, importantly, on early stage production of innovations near the research location of star scientist as a founder of a start-up firm or near the research team (Armstrong, 2009; Zucker and Darby, April 2006; November 1996).

Productive faculty tend to play a vital role for nearby firms not only for consulting expertise, but a new technology could not be fully commercialized without the active involvement and investment of the discovering scientists. Natural excludability of certain IP, due to the high degree of a scientist’s embedded knowledge of the IP, requires firms to gain access to scientists’ research teams or laboratories for further development (Zucker, Darby, and Armstrong, December 1994). Zucker and Darby (February 2002) report that lab bench activity is the main conduit through which joint research between an Institution of Higher Education (IHE) and firm scientists to transmit transformational tacit knowledge. Faculty active involvement is needed to commercialize IP from concept or prototype to market where the requirement of close proximity of scientists and firms creates increased localized economic development (Zucker and Darby, February 2002).

This localized economic development is the result of research teams with productive faculty producing transferable IP that allows businesses to enhance characteristics of existing products or hedonics demanded by consumers. The transfer of technology with continual key involvement of faculty provides attributes between a given quantity of a product and its enhanced technical characteristics where individuals possess preferences for collections of these characteristics (Armstrong, Spring 2008; Triplett, 2004; Eastwood, Brooker, and Terry, December 1986). The result is product preferences are valued because they provide the characteristics sought by consumers. Firms pursue greater production of those products with the valued characteristics to satisfy consumer demand; thereby, advancing local economic development surrounding the IHE, faculty and industry research team, and the localized firm.²

In addition, a TBED strategy of targeting highly productive scientists provides benefits to IHEs such as generating potential revenue for an academic institution, building relationships with external stakeholders, increasing additional sponsored research, and hiring more graduate students and post-doctoral fellows (Phan and Siegel, 2006; Link, Siegel and Bozeman, May 2006).³

Productive or star scientists play a key role in regional and state economic growth for science-based technologies where knowledge is tacit and requires hands on experience (Zucker and Darby, November 1996). Location of
productive scientists tend to be an important determinant of location of new firms created or existing firm’s investments transformed by use of IP to be further developed by scientists and firms for commercialization. Zucker and Darby (November 1996) also mention that once the technology has been commercialized in specific locations, agglomeration economies will tend to keep the firm there with respect to new biotechnology enterprises.

Section II of this paper provides greater detail on the role of productive or star scientists and their impact on local economic development where companies, existing firms licensing a technology or a new university start-up, require close proximity to productivity scientists to further develop their technology for commercialization. Afterwards, the paper discusses the Pennsylvania Keystone Innovation Starter Kit (KISK) initiative. KISK grants provide funds to Pennsylvania academic medical centers, non-profit research institutions and Keystone Innovation Zone (KIZ)-participating IHEs for recruitment of top faculty researchers. The KISK program provides funding for these researchers to “build out” labs and staff, equipment, acquisition and to leverage their research.

Early evidence from KISK IHE recipients suggests greater IP and commercialization possibilities. Lastly, the conclusion links greater resources through the KISK initiative to a greater potential for commercialized products resulting in greater local and state economic development.

**PRODUCTIVE SCIENTISTS AND THEIR IMPACT ON ECONOMIC DEVELOPMENT**

The transfer of technology though commercialization is just one of three mechanisms where IHE’s transfer knowledge to the private sector (CEO Council for Growth, October 2007; Varga, August 2002). The first mechanism is the use of an IHE’s physical facilities where knowledge transfers occur through the presence and use of laboratories, libraries, computers, incubators and research parks. The second mechanism is the formalized knowledge transfer via a technology transfer office or technology transfer resource network (Armstrong, 2009).

The third mechanism is a mixture of formal and informal networks. The formal networks consist of academic and industry professionals transferring knowledge through collaboratives such as research partnerships, workforce development initiatives, faculty consulting, and skilled student human capital hiring. The informal networks transfer technical knowledge through communication by faculty through seminars, student internships, professional associations, and continuing education (Link, Siegel, and Bozeman, May 2006). The third mechanism, which is the focus of this paper, is the collaborative research involving both the firm employees and productive research faculty or star scientists to transfer new knowledge to industries tends to be followed by localized growth of firms and economic development (Zucker and Darby, February 2002).

Research faculty and staff at IHEs apply for billions in research support annually from government, industry (sponsored research) and private funding agencies. Of interest is the economic development implication of university research. Mansfield (1991, 1995) surveys of industrial researchers found that spatial proximity between universities and innovating firms is more important for applied R&D than for basic research. For particular industries, he found that knowledge flows are geographically local in the information processing and drugs industry. Firms tend to collaborate with local IHEs for applied research; while for basic research, firms can collaborate with IHEs over longer distances (Acs, et. al., 2002).

Varga (August 2002) in the review of literature suggests significant local academic technology transfer impacts on non-routine functions such as R&D, prototype manufacturing, or small volume production of firms as contrasted to the relatively insignificant impacts upon routine production activities. Small firm impacts as researched by Acs, et. al. (1994a,c) show that knowledge spillovers as measured by product innovations from IHEs have a more decisive role in innovation activity of small firms relative to large firms.

For firms to take advantage of scientific breakthroughs at IHEs, Zucker and Darby (March 2005) and Zucker, Darby, and Armstrong (December 1994) report that access to knowledge, primarily retained by discovering scientists or excludable knowledge, is needed. Natural excludability requires firm scientists to gain access to the faculty, research team, or laboratory, generally through contractual arrangement, where IP is embodied within the discovering scientist. Continual development of the IP leading to possible commercialization requires a local nexus between the firm and scientist.

Top scientists become the human capital resource where new firms are built or existing firms are transformed. Zucker, Darby, and Brewer (1994) report that where productive faculty or star scientists are publishing are important determinants of where firms are created to make use of the excludable IP. The location of a productive scientist embodying natural excludable IP is an important determinant of the geographic distribution of a new science-based industry (Zucker and Darby, November 1996). Due to the high cost of transferring tacit knowledge and complexity of IP, IP can effectively be used by a commercial firm employing those productive scientists,
thus proximity of firms and scientists become important. Furthermore as scientists increase their collaboration with industry researchers, there is a strong positive effect on a company’s success.  

In the biotechnology and semiconductor industries, actual work at the bench level between star and firm scientists have a positive impact on firm performance measures (Zucker, Darby, and Armstrong, 2002; Zucker and Darby, January 2001; Torero, 1998). From an average firm in biotechnology, five articles coauthored by an academic star and the firm’s scientists result in five more products in development, three and a half more products on the market, and 860 more employees (Zucker and Darby, November 1996).

University licensed inventions tend not to be ready for commercialization and require further development. Jensen and Thursby (2001) report that about 75 percent of university patents are for such novel inventions that they cannot be licensed unless the inventor agrees to participate in further development for commercialization application. In the same report when considering those inventions that are licensed, a mid-1990s survey of major universities suggests that 48 percent of licensed inventions were simply a proof-of-concept and 29 percent were only a lab scale prototype. In addition, Jensen and Thursby (August 1998) report only 12 percent of inventions were at the stage for close-to-practical-use.

Now, economic development is enhanced due to close contact university-industrial relationships which leverage scientific breakthroughs by star scientists that would less likely occur without the close contact relationships. The result is commercialization of many innovations will tend to be local, especially in early stage production of innovations because of the necessary relationships needed for implementing the technology with either the faculty developers of the founding company or research team. AUTM (2008) reports that out of the 555 new start-up companies in 2007 based on university technologies, 402 or 72% of new start-ups were in the licensing institutions’ home state.

Scientific breakthroughs have regional and state economic development implications. The challenges facing economic development within Pennsylvania is to provide additional resources permitting IHEs to hire productive faculty for continuing product development with primarily localized university start-ups or existing firms that have licensed the innovation. The KISK initiative was first funded in FY2005-06 with four additional fiscal years of funding providing supplemental financial resources to Pennsylvania’s IHEs so as to enhance commercialization of innovation for the Pennsylvania Department of Community and Economic Development’s (DCED’s) goal of greater regional and state economic development.

**Pennsylvania’s Keystone Innovation Starter Kits Initiative**

The KISK initiative was created as a result of the Governor’s 2004 Stimulus Package and is a companion program to the KIZ program (Armstrong and Yazdi, 2004) statutorily authorized under Act 2004-12. In April 2004 the Commonwealth set out to catalyze IHEs and industry collaborations by creating the KIZ program. The KIZ program focuses Pennsylvania’s commitment to creating new technologies and entrepreneurs – using Pennsylvania’s IHEs to deliver economic development opportunities throughout the Commonwealth.

KISK, as a companion program, provides funds to recruit top-level, productive faculty to Pennsylvania academic medical centers, non-profit research institutions, and those KIZ-partnering IHEs to accelerate the development of a cluster of companies and employees in emerging and growing technology areas. Geiger and Sa’ (2008) report that clusters tend to form and grow around academic leaders and, in particular, in the biotechnology area. The KISK initiative provides funding for these researchers to “build out” labs and staff, equipment, acquisition and to leverage their research.

The Technology Investment Office (TIO) within DCED oversees the KISK program which aligns with the other entrepreneurial, workforce and technology development programs administered within TIO, including the Ben Franklin Technology Development Authority, and other state government programs. The mission of TIO is to serve as a catalyst for growth and competitiveness for Pennsylvania companies and universities through TBED initiatives including funding, partnerships and support services.

KISK funding provides additional financial resources in designing recruitment packages to attract the valued faculty member to an IHE, academic medical center, or non-profit research institution. Early stage research through productive faculty coupled with Pennsylvania’s supportive TBED infrastructure for protection and licensing of intellectual property and enhanced product development of the promising research will increase the likelihood of firm commercialization success and regional economic development (Armstrong, 2009). KISK is used for the following purposes within one year after the award of the Grant (Pennsylvania Department of Community and Economic Development, October 2008):

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1. Provide funding for recruitment of new research faculty members that contribute directly to the enhancement of targeted industries by:
   a) Developing and/or teaching courses that are directly related to the targeted industry areas.
   b) Advising undergraduate students in their relevant course of study.
   c) Supervising thesis work of M.S. students.
   d) Serving as dissertation advisor to Ph.D. students conducting research in targeted industry areas.
   e) Patenting and licensing of intellectual property.
   f) Assisting early stage companies for commercialization of intellectual property.

2. KISK funds may also be used for one or more of the following purposes as part of a package to recruit new faculty members in a targeted technology area:
   a) Purchase of design, development and testing equipment (e.g., workstations, peripherals, electronic test and prototyping equipment), as designated by the newly recruited research faculty member.
   b) Tuition and/or stipends for M.S. and/or Ph.D. students directly supervised by the newly recruited research faculty member.
   c) Renovation of research laboratories and related facilities, as designated by the newly recruited research faculty member.
   d) Licensing of key technologies for design, development verification, testing and related activities.

3. KISK funds may not be used to:
   a) Fund the payment of academic year based salaries.
   b) Fund travel outside of the country.
   c) Fund indirect costs or general administrative overhead at participating IHEs, academic medical centers, and non-profit research institutions.
   d) Planned long-term (beyond grant-year) support of staff salaries.

The Appendix provides a list and description of 64 KISK awards totaling over $11.4 million for the past four fiscal years, FY2005-2006 to FY2008-2009. Each KISK may not exceed $250,000 per award for the three fiscal years, FY2005-2006 to FY2007-2008 and $200,000 per award for FY 2008-2009. Table 1 provides a breakout of the KISK awards by industry. The percentage and dollar amount of KISK awards is dominated by biosciences at 60% (38) and 65% ($7,445,523) respectively. The second largest percentage is energy industry at 17% for the number of KISK awards (11) and 17% for the dollar amount of KISK awards ($1,932,300). The third largest percentage is nanotechnology and other at 6% (4) for the number of KISK awards and 7% ($780,000) is in the nanotechnology industry for the dollar amount of KISK awards.

Table 1: KISK Awards by Industry

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KISK awards are helping to enhance financial recruitment packages to hire star or talented faculty to IHEs in economically relevant fields (Geiger and Sa’, 2008). As summarized in Table 1 and reported in the Appendix, competitive KISK grants have been awarded in the six industry sectors: biosciences, energy, nanotechnology,
telecommunication/IT, manufacturing and other. A sample of the industry areas are illustrated below by the KISK recipients for FY2008-09:

Industry--Biosciences--Fox Chase Cancer Center, Philadelphia (Southeast).
- Funds from the DCED KISK grant will be used to develop high-throughput small hairpin RNA libraries and screening technologies that will ultimately enhance Fox Chase’s ability to diagnose and treat cancer. The new faculty hire, Dr. Biao Lu, Director of the Institute for Personalized Medicine and Research Assistant Professor in the Cancer Genetics and Signaling Program will build on Fox Chase’s emerging screening facility to create a truly state of the art center which will support large-scale, high throughput genetic screens. This capability will increase academic technology transfers, enhance collaborations with biotechnology companies and pharmaceutical firms in Pennsylvania, and could lead to establishing start-up companies.

Industry--Energy--Pennsylvania State University, Main Campus, State College (Central).
- The rural economic development and renewable energy goals of the Commonwealth require a dramatic transformation of agriculture. Hundreds of millions of tons of cellulosic biomass will be needed in the next decade to support a growing cellulosic biofuels industry. The new tenure-track faculty position, developed by the Penn State Institutes of Energy and the Environment, will develop a highly productive, profitable, and sustainable agroecosystems that can meet the future biomass needs of the region. Furthermore, the faculty hire, Dr. Amen Kemanian, Assistant Professor of Production Systems and Modeling in the College of Agricultural Sciences, will provide critical expertise in cropping systems research and agroecosystem modeling, and coordinate a developing team at Penn State that is addressing the technical, economic, environmental, and social implications of the emerging bioeconomy.

Industry--Nanotechnology--Clarion University, Clarion (Northwest).
- The Clarion University KISK Grant will establish an applied nanotechnology research laboratory related to nanodiamond product development and commercialization by a recruited faculty researcher, Dr. Ben Legun, Assistant Professor in the Applied Research and Intellectual Property Development Department. Dr. Legun will conduct research at the lab located in the Gregory Barnes Biotechnology Business Development Center which is a 22,000SF facility that will also house the Clarion SBDC and a business incubator with KIZ status. Nanotechnology, and specifically nanodiamonds, represents unlimited potential with commercial applications of lubrication, coatings, composites, drug delivery and medical imaging.

Industry--Telecommunication/IT--Carnegie Mellon University, Pittsburgh (Southwest).
- The new faculty hire Dr. Byron Yu, Assistant Professor, Departments of Biomedical Engineering and Electrical & Computer Engineering and the addition of graduate students will enhance and expand research and educational programs in Modern Energy Systems within the Department of Electrical and Computer Engineering at Carnegie Mellon University. The KISK project will focus on bringing information technologies to the electric power system to allow for the integration of production (including wind and solar) and consumption as well as the monitoring and securing of systems through the incorporation of advanced sensor networks and secure software systems. Students graduating from this program will be the new generation of experts sought after by corporations in the Pittsburgh region and Pennsylvania.

Industry--Manufacturing--Penn State Erie, The Behrend College, Erie (Northwest).
- Funding from this KISK grant shall be used to create a medical plastics applied research and technology center at Penn State Erie, The Behrend College to successfully attract a highly qualified faculty member, Dr. Gary Smith, Lecturer in Engineering for the Plastics Engineering Technology Program (23 patents and a recipient of the GE Plastics’ Worldwide Technologist of the Year Award). The Center activities shall include undergraduate education curriculum development in medical plastics device design, materials selection, and manufacturing along with engagement in on-going applied research in the field. Graduates engaged in Center activities will develop the technical skills needed to contribute to the development of new products for the marketplace enabling regional and statewide employers to participate in the growing medical plastics device business sector.
Industry--Other--Point Park University, Pittsburgh (Southwest).

- Point Park University’s highly respected School of Communication is the only journalism/communication school in the region to offer degrees in print, photography, and broadcast journalism. The University is seeking to further distinguish the School of Communication by the successful hire of Dr. Tatyana Dumova, Associate Professor of Digital Media to help establish a state-of-the-art, converged digital media lab. These enhancements will broaden Point Park students’ applied knowledge and add to their marketability; provide an added array of internship and employment opportunities; and allow students to become involved with technology commercialization efforts and entrepreneurial activities that could lead to the establishment of related start-up companies and licensing of new products.

While the examples above illustrate the potential payoff of the KISK initiative, accountability measures are required so that the KISK initiatives are tracking positive TBED outcomes (Measuring Up, 2007). Table 2 summarizes the impact of the KISK initiatives since July 1, 2006 including more detailed breakout impact data beginning July 1, 2007. The Measuring Up (2007) report provides details for the impact measures.

Table 2 shows evidence that the KISK funded projects are an integral component for regional and state TBED activities. Table 2 details are provided in the Appendix. The data show that over $11.4 million were awarded to 64 KISK recipients where 12 of the institutions were recipients receiving 47 multiple KISK awards for a total of about $8.95 million and 17 recipients received a single award for a total of almost $2.48 million. Five KISK recipient institutions were either Class Type 15 Very High Research Activity Institutions (Carnegie Mellon University, Pennsylvania State University-Main Campus, University of Pennsylvania, University of Pittsburgh-Main Campus) or Class Type 16 High Research Activity Institutions (Drexel University, Lehigh University, and Temple University) as reported by Carnegie Classified Institutions. The other 22 KISK institutional recipients are not reported in the two classes providing evidence that a variety of IHFs were receiving KISK funding as an important element for enhancing regional and state TBED activity.

Since July 1, 2006 to December 31, 2009, KISK funding not only resulted in $11.4 million in match but resulted in leveraging these funds for a total of $30.9 million. The total leverage funding includes venture capital, private equity, debt financing, federal, local, foundation funding, or other funding sources and excludes other Pennsylvania state sources. This leverage is expected to increase as the KISK program and the individual projects mature and the metrics are collected for a period of three years after the conclusion of contractual agreements of the projects.

Over $8.9 million is devoted to technology research, development, testing and evaluation as the result of KISK funding from July 1, 2007 to December 31, 2009. In addition, there have been 56 new faculty hired, 126 presentations, 316 articles published, 117 businesses assisted, and four companies spun-out as a result of the KISK program funding. Given that KISK provides supportive funding within the very early stages of developing technologies, the Table 2: KISK Impact Metrics are expected to have larger impact figures as technologies are developed and continue to advance as the result of the KISK program funding.

The human capital impact upon Pennsylvania due to KISK funding has been positive. Since July 1, 2007, there have been 221 combined graduate and undergraduate internships. In addition, 1,569 undergraduates and 352 graduates enrolled at an IHE due to the high quality faculty hired with the encouragement of KISK funding.

Table 2: KISK Impact Metrics
The KISK initiative is positioned at the beginning of a TBED continuum strategy including idea to IP generation with KISK funding providing additional support for hiring of productive faculty (Pennsylvania Department of Community and Economic Development, 2005). Productive faculty not only have a positive effect on the creation of new firms, but have an enhancement impact on local economic activity by the commercialization of university innovations through new firm spin-off activity (Geiger and Sa’, 2008).

**CONCLUSIONS**

The Technology Investment Office of DCED has updated the KISK Guidelines (Keystone Innovation Starter Kits Program Guidelines, October 2009) to provide funds to Pennsylvania academic medical centers, non-profit research institutions and Keystone Innovation Zone (KIZ)-participating IHEs for recruitment of faculty researchers in the areas of nanotechnology and energy only. The funding for this solicitation of KISK proposals is at $1.0 million through an allocation from the BFTDA FY 2009-10 budget within the University Research Grant program approved at the October 22, 2009 BFTDA Board meeting.

Given the reduced funding from previous years for KISK and the substantial focus of the University Research Grant program funds for nanotechnology through the Pennsylvania Initiative for Nanotechnology (Armstrong, Spring 2008) and energy and the environment through the Pennsylvania Initiative for Energy and the Environment (Pennsylvania Department of Community and Economic Development, October, 22, 2009), the focus of the KISK awards for FY 2009-2010 are in the nanotechnology and energy areas. This upstream TBED strategy complements R&D of universities, high-tech industries, and is expected to create new industries (Geiger and Sa’, 2008).

As the Commonwealth continues to advance IHEs, academic medical and non-profit research institutions recruitment of productive faculty, as a key TBED initiative partnering with higher education institutions and industry, KISK will provide a key component for greater local and state sustainable economic development. The State Science and Technology Institute study done for the U.S. Department of Commerce (August 2006) reported that successful launching and supporting of knowledge economies require a “cadre” of prominent faculty and physical infrastructure needed to support research and technology development of which the KISK initiative can be a supportive key ingredient. Pennsylvania’s future KISK strategy to provide additional resources for the hiring of productive faculty should align with strategic TBED areas to competitively position future Pennsylvania industries.

**ENDNOTES**

*The author would like to thank Jeannine Marttila, Mark Cresswell, Seth Maset, Kyle Yurick, chair and discussant for their assistance and comments. The conclusions do not necessarily reflect the positions of the Pennsylvania Department of Community and Economic Development. All possible errors are the author’s.*

1. It is recognized that the TBED continuum is not necessarily a single pathway from Institution of Higher Education to the market.
Education (IHE) research to IP generation to licensing to firms where industry/firm needs may generate research that require research agreements with an IHE where IP is developed.

2. From Mowery and Rosenberg (1998), Kuznets argues that technology innovation creates new industries with enhanced characteristics of products, and their high rate of growth can offset relatively declining profitability and demand of more mature industries, contributing to net positive overall economic growth. This is one of the reasons for state support of TBED activities.

3. Faculty producing IP and transferring technology can be considered a basic extension of an IHE’s mission to teach, to research by generating new knowledge, and to provide service for society. Transfer of university knowledge to private businesses has a long tradition through agricultural extension serviced at US land grant IHEs (Rosenberg and Nelson, 1994).

4. New knowledge is transferred through training and hiring of skilled undergraduate and graduates student with tacit knowledge to be used by employers for product and process development (Armstrong, et al., 2007). This method is the traditional role of IHEs impact on economic development.

5. Zucker and Darby (April 2006) found that highly productive faculty or star scientists representing about 0.5-1.0 percent of all scientists authoring papers within six science and technology areas: Biology, Chemistry & Medicine; Computing & Information Technology; Semiconductors, Integrated Circuits & Superconductors; Nanoscale Science and Technology; Other Sciences; and Other Engineering.

6. While the distinction between applied and basic research is not completely clear, applied research is designed to solve practical problems, rather than to acquire knowledge to knowledge’s sake which is the perspective of basic research. There is no obvious commercial value to the discoveries that result from basic research; while possible commercial value may result from applied research.

7. Innovation is contributed by three types of firms: (1) inventor-entrepreneurs of unique individuals who are adept at exploiting market opportunities, (2) industry spin-offs embedded in industrial processes and manufacturing with short development horizons, and (3) university spin-offs by faculty inventors linked to university laboratories (Geiger and Sa’, 2008).

8. Excludability refers to the ability of the owner of a good to prevent others from using it, which can derive from technology, law or both. Natural excludability of IP embodied within a scientist is different paradigm of the concept of IP having public good characteristics, unless the information is protected through patents, copyrights or trade secrets, the cost for use of the information is low. Natural excludability suggests costs maybe high due to the exclusion of use occurrence needing continual faculty participation on certain discoveries. Techniques for replication involve a high degree of tacit knowledge and complexity, thus natural excludability resides among discovering scientists.

9. High levels of productive faculty can be measured by the number of articles published, number of citations to those articles, and number of patents.

10. Inventors’ shares of royalties can be a strong incentive for faculty development of discoveries leading to commercialization with firms. Jensen and Thursby (2001) report on average, the inventors’ share is about 40 percent of the IHE’s gross revenues from the invention.

11. Economic development from university inventions face three significant challenges of tendency to be embryonic technologies needing further development for commercialization, developing the technologies across the valley of death where the likelihood of failure is significant, and relying on tacit knowledge of faculty for product development (Geiger and Sa’, 2008).

12. The latest Keystone Innovation Starter Kit grant awards for FY 2009-10 data, awarded on March 2010, are not included in this paper.

13. Geiger and Sa’ (2008) mention that IHE’s may not foster clusters in of themselves, but a supporting TBED infrastructure is required to anchor and assimilate new technologies for commercialization. However, cluster hiring may occur within an IHE to augment research funding and enhance institutional recognition.

14. It should be noted that seven institutions can be considered Pennsylvania hospitals or medical research institutions that are not listed as a Type 15 or 16 Carnegie Classified Institutions based on data through 2004.

15. The TBED continuum strategy is to provide additional resources through KISK for the hiring of productive faculty, additional resources through Innovation Grants for technology transfer of protecting, developing and licensing IP to an existing firm or university start-up, and additional resources through Keystone Innovation Zones, Venture Capital program, and Ben Franklin Technology Partners for additional business and financial support where a pre-revenue firms become revenue sustainable (Pennsylvania

Proceedings of the Pennsylvania Economic Association 2010 Conference
16. The State Science and Technology Institute study done for the U.S. Department of Commerce report (August 2006) also list other key ingredients for supporting knowledge economies: (a) research leadership relevant to regional economies, (b) leadership seeing economic growth as a priority and links with business leadership; and (c) policies and legal flexibility to facilitate commercialization of research outcomes.

REFERENCES


APPENDIX:
KISK RECIPIENTS, FUNDED, AND KISK DESCRIPTIONS
<table>
<thead>
<tr>
<th>KISK Recipient</th>
<th>Funded</th>
<th>KISK Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucks County Community College</td>
<td>FY 08-09 $150,000</td>
<td>Funding to build out a laboratory in order to attract faculty to both Bucks County Community College and the PA Biotechnology center to teach advanced laboratory techniques.</td>
</tr>
<tr>
<td>Carnegie Mellon University</td>
<td>FY 05-06 $250,000</td>
<td>Funding to support a faculty hire who specializes in biomedical applications of micromechanical systems or &quot;BIOMEMS&quot;.</td>
</tr>
<tr>
<td></td>
<td>FY 06-07 $123,334</td>
<td>Funding to hire new faculty in the field of medical robotics/quality of life technology.</td>
</tr>
<tr>
<td></td>
<td>FY 07-08 $250,000</td>
<td>Funding for recruitment of a new faculty researcher in Biomedical Engineering focusing on Biomaterials.</td>
</tr>
<tr>
<td></td>
<td>FY 08-09 $150,000</td>
<td>Funding to recruit a new faculty member in the area of modern energy systems and information technology</td>
</tr>
<tr>
<td>Clarion University</td>
<td>FY 08-09 $130,000</td>
<td>Funding to establish a nanotech research lab to conduct applied research in nano-diamond production and commercialization by a newly-recruited faculty researcher.</td>
</tr>
<tr>
<td>Commonwealth Medical College</td>
<td>FY 08-09 $137,000</td>
<td>Funding used to purchase a microscope and recruit a new faculty member to test a new diagnostic procedure for a bladder condition.</td>
</tr>
<tr>
<td>Drexel University</td>
<td>FY 06-07 $250,000</td>
<td>Funding to renovate empty warehouse space into lab space; hiring of two undergraduate research interns and two graduate students.</td>
</tr>
<tr>
<td></td>
<td>FY 07-08 $225,000</td>
<td>Funding to establish a neuroengineering resource center.</td>
</tr>
<tr>
<td>East Stroudsburg University</td>
<td>FY 07-08 $82,800</td>
<td>Funding to develop a Homeland Security Technology Research Center.</td>
</tr>
<tr>
<td>Edinboro University of Pennsylvania</td>
<td>FY 06-07 $208,000</td>
<td>Funding to develop an advanced materials center, increase faculty, revise and refine Associates degree in Manufacturing Engineering Technology, develop and test a proposed Bachelor of Science degree in MET.</td>
</tr>
<tr>
<td>Fox Chase Cancer Center</td>
<td>FY 06-07 $125,000</td>
<td>Funding used in the recruitment of faculty to study new breast cancer model.</td>
</tr>
<tr>
<td></td>
<td>$125,000</td>
<td>Funding used to hire Ph.D candidate in the Immunobiology Working Group at Fox Chase.</td>
</tr>
<tr>
<td></td>
<td>FY 08-09 $150,000</td>
<td>Funding used to attract a new faculty member to develop new technologies that will enhance the Center's ability to diagnose and treat cancer.</td>
</tr>
<tr>
<td>Franklin &amp; Marshall College</td>
<td>FY 07-08 $164,933</td>
<td>Funding for recruitment of faculty to work in the areas of genomics and bioinformatics.</td>
</tr>
<tr>
<td>KISK Recipient</td>
<td>Funded</td>
<td>KISK Description</td>
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</tr>
<tr>
<td>Gannon University</td>
<td>FY 06-07 $119,772</td>
<td>Funding for creation of a software development institute for advanced information technology within the Computer and Information Science Department at the University. The Keystone Software Development Institute will be led by a new faculty member with the particular leadership, management experience and expertise.</td>
</tr>
<tr>
<td>Geisinger Clinic</td>
<td>FY 05-06 $202,000 FY 08-09 $150,000</td>
<td>&quot;BioBanking Initiative&quot; Program is in its infancy and looking to build more capacity. Studying the genetic basis of patient response to therapeutics. Funds used to help recruit faculty researcher, hire research fellow, 6 college student interns, and pay for physician training. Funding used to recruit a senior genomic medicine researcher.</td>
</tr>
<tr>
<td>Institute for Hepatitis and Viral Research</td>
<td>FY 08-09 $150,000</td>
<td>Funding used to build out a lab to help attract a faculty member in the area of diagnostic medicine.</td>
</tr>
<tr>
<td>Lankenau Institute for Medical Research</td>
<td>FY 08-09 $150,000</td>
<td>Funding used to recruit faculty to build on its zebra fish study of embryonic development, genetic regulation, drug efficacy and toxicity.</td>
</tr>
<tr>
<td>Lehigh University</td>
<td>FY 05-06 $250,000 FY 08-09 $150,000</td>
<td>Funding used to recruit top-level faculty researcher in the area of biochemistry to support Lehigh's bio/life sciences initiative. Funding to recruit new faculty in solid mechanics/advanced materials with energy applications.</td>
</tr>
<tr>
<td>Marywood University</td>
<td>FY 06-07 $133,300 FY 07-08 $200,000</td>
<td>Funding used to hire research faculty member within the science department in order to attract high-potential students into the new Professional Science Masters degree biotech program. Funding for recruitment of new faculty researcher in the area of biotechnology.</td>
</tr>
<tr>
<td>Mercyhurst College</td>
<td>FY 05-06 $75,000</td>
<td>Funding used to add a faculty member to develop a GIS curriculum and integrate GIS solutions and to build out a GIS/Spatial Systems Laboratory.</td>
</tr>
<tr>
<td>Pennsylvania State University - Main Campus (State College)</td>
<td>FY 05-06 $150,000 FY 06-07 $250,000 $200,000 FY 07-08 $200,000 $250,000 FY 08-09 $130,000</td>
<td>Funding for faculty and programs in the Material Science &amp; Engineering Department as well as in the Chemical Engineering Department of the University. Funding for recruitment of faculty member in the area of advanced power generation with expertise in high temperature coatings and materials. Funding to assist in the recruitment of a world-class cancer biologist and drug discovery expert. Funding to help support the recruitment of a tenure track Assistant Professor and an Instructor in Materials and Mechanical Engineering Technology. Funding to support the recruitment of a new faculty member in the area of fuel flexible combustion systems with a focus on coal-derived fuels as part of the Penn State Initiative on Clean Carbon Energy. Funding for recruitment of a tenure-track faculty member in the conversion of Coal to Liquids as part of the Penn State Initiative on Clean Carbon Energy. Funding for recruitment of a new faculty member in sustainable bio-energy feedstock and production systems.</td>
</tr>
<tr>
<td>KISK Recipient</td>
<td>Funded</td>
<td>KISK Description</td>
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</tr>
<tr>
<td>Pennsylvania State University - The Behrend College</td>
<td>FY 05-06 $231,300 FY 08-09 $150,000</td>
<td>Funding for creation of a sustainable applied energy research center with a focus on developing innovative, patentable and advanced Mfg products. Products that will improve energy efficiency for the industrial, power generation and transportation marketplace. Funding to build out a lab to attract new faculty in medical plastics device manufacture.</td>
</tr>
<tr>
<td>Pennsylvania State University – Hershey College of Medicine</td>
<td>FY 05-06 $250,000 FY 06-07 $250,000 FY 07-08 $250,000 FY 08-09 $150,000</td>
<td>Funding to enable a key recruit in the creation of a Center for Neural Engineering at Penn State. The Center will serve to focus Penn State’s resources in engineering, materials and neurosciences on creation of new devices and therapies in the nascent field of neurostimulation. Funds to be used for the development of a Neurodegenerative Disease Center, including the recruitment of a research group. Recruitment of a world-class cancer biologist and drug discovery expert. Funds to recruit a new top level faculty member to focus on retroviruses.</td>
</tr>
<tr>
<td>Pennsylvania State University – Navy Yard</td>
<td>FY 08-09 $150,000</td>
<td>Funding used to recruit a new faculty member in electrical energy storage systems.</td>
</tr>
<tr>
<td>Point Park University</td>
<td>FY 08-09 $53,000</td>
<td>Funding used to recruit a faculty member to focus on new digital media research.</td>
</tr>
<tr>
<td>Saint Francis University</td>
<td>FY 05-06 $71,000</td>
<td>Funding to recruit faculty member for University's new Renewable Energy Curriculum. Increase the University's ability to develop and commercialize environmental/renewable energy technology.</td>
</tr>
<tr>
<td>Temple University</td>
<td>FY 06-07 $250,000</td>
<td>Funding to support the recruitment of Chairperson of the Department of Biochemistry at the Health Science Center of Temple University.</td>
</tr>
<tr>
<td>KISK Recipient</td>
<td>Funded</td>
<td>KISK Description</td>
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</tr>
<tr>
<td><strong>University of Pennsylvania</strong></td>
<td>FY 05-06</td>
<td>Recruitment of stem cell biologist for the school of veterinary medicine. First step in the creation of a multi-disciplinary Center for Stem Cell Research.</td>
</tr>
<tr>
<td></td>
<td>$250,000</td>
<td>Funds will be used for the recruitment of Ph.D as a tenure track Assistant Professor in the Department of Cell and Development Biology at the School of Medicine.</td>
</tr>
<tr>
<td></td>
<td>$208,330</td>
<td>Recruitment of top-tier faculty member to join the Department of Cell and Development Biology.</td>
</tr>
<tr>
<td></td>
<td>FY 06-07</td>
<td>Recruitment of a leading stem cell scientist and lab build out.</td>
</tr>
<tr>
<td></td>
<td>$250,000</td>
<td>To recruit tenure track faculty for Penn Medicine’s department of cell and development biology.</td>
</tr>
<tr>
<td><strong>University of Pittsburgh</strong></td>
<td>FY 05-06</td>
<td>Recruit identified in this application will impact the area of Drug Discovery based upon research related to the design of ligands that target membrane associated G-protein coupled receptors.</td>
</tr>
<tr>
<td></td>
<td>$250,000</td>
<td>Funds to recruit new biophysics professor in Dep. of Physics &amp; Astronomy who would help anchor the building of a new research and education program in biophysics.</td>
</tr>
<tr>
<td></td>
<td>$208,335</td>
<td>Funds will be used in the recruitment of a faculty person in nanomaterials.</td>
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<tr>
<td></td>
<td>FY 06-07</td>
<td>Funds will be used for the recruitment of a faculty person in biophysics.</td>
</tr>
<tr>
<td></td>
<td>$250,000</td>
<td>To recruit a faculty member to focus on nuclear energy with an emphasis on efficiency and sustainability.</td>
</tr>
<tr>
<td><strong>University of the Sciences in Philadelphia</strong></td>
<td>FY 05-06</td>
<td>Assistance in the development of an &quot;In Vivi&quot; imaging facility at USP. Part of the Department of Pharmaceutical Sciences. Funds will assist in leveraging of more research grants.</td>
</tr>
<tr>
<td></td>
<td>$250,000</td>
<td>Funds to be used to gain a new faculty hire that will coincide with the build out of their new Center for Drug Design and Delivery.</td>
</tr>
<tr>
<td></td>
<td>FY 07-08</td>
<td>Funds to recruit a faculty member focusing on molecular engineering.</td>
</tr>
<tr>
<td><strong>Villanova University</strong></td>
<td>FY 07-08</td>
<td>Funding for recruitment of new faculty in the area of Nanomaterials and manufacturing.</td>
</tr>
<tr>
<td></td>
<td>$250,000</td>
<td></td>
</tr>
<tr>
<td><strong>Washington and Jefferson College</strong></td>
<td>FY 08-09</td>
<td>Funding used to recruit a tenure-track evolutionist/systematist with a specialty in bioinformatics.</td>
</tr>
<tr>
<td></td>
<td>$150,000</td>
<td></td>
</tr>
<tr>
<td><strong>The Wistar Institute</strong></td>
<td>FY 07-08</td>
<td>Funding used to support lab build out to attract a faculty member in the area of computational biology.</td>
</tr>
<tr>
<td></td>
<td>$192,696</td>
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</tr>
</tbody>
</table>
FINANCING TRANSPORTATION IN PENNSYLVANIA IN THE TWENTY-FIRST CENTURY

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Grove City College
100 Campus Dr. # 3018
Grove City, PA 16127

ABSTRACT
The recent battle over tolling Interstate 80 and its resolution through the decision of the Federal Highway Administration not to permit tolls illustrates some of the problems and conflicts involving transportation funding but also offers an opportunity to consider reforms that could contribute to more efficient and equitable provision of highways and public transit in the state of Pennsylvania. This research explores alternatives for solving the state’s transportation funding crisis. After explaining how and why there is a funding crisis, it reviews the literature and evaluates the efficiency and equity of alternative solutions such as raising the gasoline tax, greater use of tolls and other user fees, mileage charges, and changing the mix of federal, state, and local funding of roads and highway.

INTRODUCTION
Because of the recent decision of the Federal Highway Administration not to permit tolls on Interstate 80 in Pennsylvania, state government officials must come up with a plan for reforming transportation funding. Otherwise, the state will not be able to adequately maintain its highways and bridges or continue to provide existing levels of service on its public transit systems. Raising existing taxes, such as fuel taxes, to make up the shortfall in both highway and public transportation budgets, while continuing business as usual, is not a good solution. Instead the state should separate highway and transit funding and rely more heavily on user fees for both.

The combination of economic stimulus spending and borrowing against anticipated revenue from tolls on Interstate 80 has enabled the state to increase funding of highway maintenance and transit systems in the last few years. Without anticipated revenue from tolls on I-80, the Pennsylvania Turnpike Commission is expected to reduce its contributions for statewide use from $900 million in 2009-10 to $450 million in 2010-11. Close to $1 billion of additional spending for highway programs in the 2009-10 fiscal year resulted from the American Recovery and Reinvestment Act (Pennsylvania State Transportation Advisory Committee 2010). Very little of this stimulus money will be left to fund highways and transit in subsequent years.

TRANSPORTATION FUNDING
The size and seriousness of the transportation-funding problem in Pennsylvania is open to debate. The problem involves both inadequate highway and bridge maintenance and insufficient funding for public transit. In 2006, the Pennsylvania Transportation and Funding Reform Commission recommended that annual state highway funding be increased by $900 million and transit funding be increased by $760 million per year (97, 110). This gave rise to Act 44, the plan to raise tolls on the turnpike and impose tolls on Interstate 80. The decision not to impose tolls on I-80 reduces transit funding by $150 million and highway funding by $300 million beginning in FY 2010-11 (Pennsylvania State Transportation Advisory Committee 2010, 4).

The Pennsylvania Transportation and Funding Reform Commission (TFRC) recommended an increase in funding for public transportation of $258 million for operations and $502 million for capital investment (110). This was on top of 2006 base funding of about $800 million. Act 44, which included borrowing against anticipated future tolls on I-80, provided $300 million for transit in FY 2007-08, which grew to a projected $400 million in 2009-10.

Unlike transit, roads and highways have dedicated sources of substantial funding from fuel taxes and oil company franchise taxes. Nevertheless, revenue from these taxes has not kept up with inflation, and the legislature has not been willing to raise tax rates. Fuel taxes combine a flat tax of 12 cents per gallon with the oil company franchise tax, which involves a millage on the wholesale price of gasoline and diesel. The amount of franchise tax collected is a fixed proportion of the wholesale price when the price is between a floor of 90 cents and a ceiling of $1.25 per gallon. The wholesale price rose from the floor to the ceiling between 2003 and 2006 and has been above the ceiling since then (Pennsylvania State Transportation Advisory Committee 2010, 17). The amount of tax collected on each gallon of gasoline and diesel fuel rose during those years but will not grow further unless the ceiling is raised. Besides the fact that the tax per gallon has not increased since 2006, gasoline consumption has been declining at 1.3 percent per year since 2004. Diesel fuel consumption hit an all-time high in 2007,
just prior to the beginning of the current recession (Pennsylvania State Transportation Advisory Committee 2010, 20).

Alternatives for maintaining adequate transit funding

The commonwealth’s transit funding structure is a patchwork of multiple programs (Pennsylvania Transportation and Funding Reform Commission 2006, 84). With much less money available from Act 44 in the future compared to the past few years, the state government will need either to find an alternative funding source or reduce spending on mass transit. Funding transit with revenue from state gasoline taxes is politically appealing, but the state constitution prohibits using state gasoline taxes for purposes other than construction and maintenance of highway infrastructure. Thus, the state needs to find an alternative approach. One approach being discussed is to apply the state sales tax to fuel. At the current rate of 6 percent, this would yield approximately one billion dollars per year (Pennsylvania Transportation and Funding Reform Commission 2006, 103).

In addition to funding from the state, public transportation receives considerable money from the federal government. Until 1982, one hundred percent of federal gas tax and other federal road user fees were dedicated to highways (O’Toole 2009, 2). Beginning in 1982, Congress began diverting some revenue from gas taxes to mass transit. In the 2005 transportation reauthorization, Congress dedicated less than half of gas tax revenue for highways, while dedicating almost 16 percent to mass transit. Another 18 percent of the revenue was flexible of which about 5 percent was spent on transit (O’Toole 2009, 3).

Environmentalists and some opponents of low density development advocate using a greater share of fuel taxes to pay for mass transit. Proponents of using a substantial percentage of gas tax revenue for funding mass transit emphasize the high costs that many drivers experience in urban areas due to congestion, measured in lost time and wasted fuel. The 2009 Urban Mobility report estimates that if there were no public transportation, the consequence would have been additional travel delays and additional fuel consumption worth a combined total of $13.7 billion in 439 US urban areas in 2007 (Shrank and Lomax 2009, 14). By comparison, $10.7 billion of highway user revenue (motor fuel taxes, vehicle taxes and fees, and tolls) was used for transit in 2004 (Federal Highway Administration 2006). Adjusted for the inflation that occurred between 2004 and 2007, these two amounts are comparable. Thus, some might argue that the spending of fuel taxes on mass transit was justified since it equals the savings resulting from the use of public transportation.

Showing that total expenditures on mass transit equaled total savings does not prove that it was efficient to spend more than $10 billion of gas tax revenue on public transportation. If total expenditures approximately equals total savings then given the law of diminishing returns, the marginal dollar spent likely yields less than one dollar of additional benefits. Furthermore, some of the benefits of reduced congestion resulting from the use of public transportation are enjoyed by the users of public transportation who also bear a cost in the time they spend commuting on public transit and the fares they pay. Although there may be other benefits from public transportation besides reduced congestion and fuel used, federal, state and local governments spent a total of $28.4 billion on public transportation in 2004 (Federal Highway Administration 2006, 1). It is unlikely that other external benefits from public transit such as reduced pollution and induced denser settlement patterns offset this additional cost to taxpayers.

Diverting a greater share of fuel taxes to mass transit would be both inefficient and inequitable. Mass transit is already heavily subsidized and lacks adequate market incentives to keep costs under control. Most of public transportation spending in Pennsylvania goes to the state’s two major public transit agencies, the Philadelphia-area Southeastern Pennsylvania Transportation Authority (SEPTA) and the Pittsburgh-based Port Authority of Allegheny County (PAAC). More than 90 percent of operating grants and of transit ridership in the Commonwealth is for these two systems. Operating revenues cover less than half of operating expenses for most transit agencies in Pennsylvania, with SEPTA covering 49.6% of its expenses and the PAAC only covering 30.2% of its operating expenses from fare revenue in 2005 (Pennsylvania Transportation and Funding Reform Commission 2006, 53). Besides covering most operating expenses, subsidies also cover capital expenses of public transit systems.

Maintaining Adequate Highway Funding

The rising cost of materials and labor for highway and bridge construction and maintenance without similar increases in revenue from fuel taxes, has contributed to the highway funding crisis. Besides increasing the amount of revenue available, the recent attempt through Act 44 to implement tolls on Interstate 80 is part of a push toward greater reliance on user fees and nontraditional methods of highway financing. The proposal to lease the turnpike to a private agency is another. In addition to the above approaches, politicians and policy analysts have proposed the use of mileage charges as an alternative to gasoline taxes. This approach would use new technologies, such GPS, to transmit total mileage driven within a jurisdiction to the agency.
charged with collecting revenue (Transportation Research Board 2006, 141).

Critics of these recent proposals point out several problems. First is the problem of equity. Highway users already pay gasoline taxes. Why should users of selected highways have to pay twice? Imposing tolls on selected highways will also disproportionately affect local economic development in areas near the toll highways. Diversion is another problem— if tolls are implemented, traffic will be diverted from the highways subject to toll to alternate routes, often routes that are less capable of handling heavy traffic.

Leasing the turnpike to a private corporation has drawbacks as well. Public private partnerships take control of highways away from the government and could potentially reduce the ability of voters to influence highway policy. In exchange for leasing a highway to a private corporation, governments often agree to limit expansion of nearby public roads and highways that may compete with the privately operated highway. This in turn may increase local congestion and limit mobility.

Many transportation officials agree that vehicle mile charges are a promising long term alternative to gasoline taxes (Transportation Research Board 2006). If approved by government, implementing the technology to charge drivers for the miles they drive would take a decade or more unless all older cars were retrofitted (Transportation Research Board 2006). Opponents of vehicle mile charges emphasize the loss of privacy that may result if a government agency has information on where and how far a person travels.

REFORMING HIGHWAY AND TRANSIT FUNDING

Funding Public Transportation

Public transportation in Pennsylvania does not need more tax revenue, it needs to be run more efficiently. Rising incomes combined with low-density housing and dispersed trip patterns have contributed to transit being a declining industry and to its poor financial health since the early 1960s. The massive operating deficits that public transit systems throughout the US are experiencing are not primarily the result of declining patronage, but of government intervention (Lave 1985, 3). Government involvement has increased the cost of production faster than inflation and has reduced revenue as politicians attempt to please voters by keeping fares low. Wages have risen faster than in comparable occupations and government subsidies have also reduced the incentive of managers to choose the most economical vehicles (Lave 1985, 8).

The large deficits experienced by public transit systems in Pennsylvania suggest the need for eliminating some routes that do not generate enough revenue, for raising fares during peak periods, and for reducing costs on other routes. In some low-density areas it may be less costly to provide dial-a-ride feeder services via taxi or to operate mini buses on a fixed route basis (Lave 1985, 14). Eliminating late evening and weekend service on some routes may also reduce operating losses, since buses and trains often are nearly empty during these periods.

Raising fares during peak periods when demand is relatively inelastic is also likely to reduce deficits. The marginal cost per passenger is typically about one-third more during peak periods (Orski 1985, 261). This is because extra vehicles are required and extra drivers must be hired to work only during peak periods. The extra drivers usually must be paid for a full day’s work even though demand is insufficient to fully utilize them during the middle of the day (Morlok and Vinton 1985, 249). Thus the marginal cost per hour during the peak period equals close to the daily wage and the daily (capital and depreciation) cost of the vehicle divided by the number of peak hours.

The assertion made by the TFRC that Pennsylvania needs to spend more than $100 million per year to satisfy unmet needs for transit service is questionable. When a government agency argues for increased taxpayer funding to meet a public transportation need, that agency should be able to demonstrate not only that ridership will be high, but that the external benefits due to things like reduced congestion justify the subsidy. When the Federal Government provides subsidies to help finance transit expansion, it should not be surprising if projects get funded that are not cost effective. The North Shore Connector in Pittsburgh is one example of an inefficient government project. The Allegheny Institute estimates that this project, originally estimated to cost $360 million in 2004 is now estimated to cost $553 million. The resulting cost per rider on this light rail system is likely to be close to $20 (Haulk 2009).

One objection to reducing public transportation service during low demand periods and increasing fares is that it will disadvantage low income people who do not have access to private transportation, such as automobiles. For those who lack mobility, targeted subsidies directed to a cost effective mode of public transportation could save millions of dollars. It may cost less to subsidize taxi rides during late evenings and weekends for low income people who cannot drive rather than paying to run nearly empty buses or trains.

Government agencies in Pennsylvania and elsewhere have not done a good job of controlling costs. When governments run a transit system they face political pressure to keep
ridership high through low fares and to pay above market wages.

One way to achieve greater efficiency is competitive contracting, where government allows private companies to compete for the job of managing a transit system. Evidence from several US and European cities suggests that competitive contracting reduces costs per vehicle hour by 20 percent or more (Savas and McMahon 2002). Private firms providing bus service in the US, Australia, and the United Kingdom have costs that are typically 50 to 65 percent of the costs of public bus services in urban areas with comparable quality service in the same region (Morlok and Vinton 1985, 236).

The failure of transit agencies in Pennsylvania to control costs is illustrated by the magnitude of cost increases experienced over time. The Commonwealth Foundation notes that if cost increases had been held to inflation between 1983 and 2002, SEPTA’s 2002 operating costs would have been $165 million less, and PAT’s would have been $80.7 million less (Gulibon 2007). The combined total that cost increases exceeded inflation for the states two largest urban areas during that 20-year period is more than the revenue from tolls on I-80 that would have been used for transit. Since costs have increased substantially since 2002, the savings possible in 2010 from more efficient management would be even larger.

One way private contractors, who are not subject to collective bargaining agreements, save on costs, is by paying lower wages than unionized public transit systems now pay. Why should union members monopolize the market for their labor at the expense of cash strapped governments? Financial constraints will likely result in governments cutting expenditures. If the status quo labor contracts continue, cash-strapped governments will likely reduce service eventually. While it might make sense to eliminate some public transit routes that do not have enough riders to be cost effective, more workers could be employed and more service could be provided if wages were market-determined as they could be with competitive contracting for transit service.

When contracts are obtained competitively, private contractors can save money even while continuing to maintain union contracts, as illustrated by the examples of Copenhagen, Denmark and Stockholm, Sweden where costs dropped 25 and 20 percent with existing union contracts still in force following privatization. When private firms are competing for the right to supply transit services, they have an incentive to find better ways to use factors of production—particularly labor and vehicles. For example, some of the drivers used during peak periods could be hired to work part-time or could work at other jobs at the work-site end of the morning run rather than being paid for idle midday hours.

A popular view among policymakers is that congestion, energy consumption and pollution can be reduced by trying to alter incentives so that people will substitute transit use for driving. Various attempts at using incentives to change behavior have been tried over the last forty years. Using a portion of federal fuel tax revenue to pay for investments to expand public transportation is but one example. This behavioral approach has not worked, since urban driving has increased 250 percent since 1970 (O’Toole 2009, 17). On the other hand, technical solutions have reduced emissions and energy consumption of automobiles substantially. Incentives that are directly related to a particular problem, such as electronic tolls to discourage driving on congested highways during rush hour, are much more effective in reducing congestion than subsidizing public transportation.

Americans value the freedom and mobility that comes with auto ownership. Spending billions of tax dollars to subsidize inefficient public transportation that people do not want to use is not a cost effective way to reduce pollution, CO2 emissions or highway congestion. Too much has already been spent to build and operate rail transit systems with the intention of getting more people to use transit. Most recently constructed rail transit systems cost too much relative to the benefits they provide, while reducing driving and congestion very little if at all. Except in New York City, rail transit lines in the US do not carry as many people as one freeway lane (O’Toole 2009, 12).

Highway Funding Reforms

Much like with public transportation, government funding and control of roads and highways is also inefficient. The cost of building and maintaining highways is higher than necessary in Pennsylvania because of prevailing wage laws. The state and federal government also mandate other costs, such as environmental reviews. Although environmental reviews may serve a useful purpose, it may be possible to review only the most vital environmental consequences of a project and do so in a more cost effective manner. The above specific cost cutting measures may play a role, but more important for the long run is that highways be financed in such a way that whoever is in charge of highway construction and maintenance has an incentive to provide low cost roads of high quality and give priority to those roads and highways that drivers value most highly.

Heavy reliance on fuel taxes maintains a closer connection between the benefits and costs of highway use than is the case with public transit, which is much more heavily subsidized. Nevertheless, fuel taxes, especially those
administered by the federal government, do not provide direct incentives to spend money building and maintaining each particular road or highway in relation to the demand for that road or highway.

It is clear that user charges, such as tolls, can result in more efficient use of highways, especially in congested urban areas. User charges could preserve equity in one of several ways. One way would be for those who pay tolls to receive some kind of a credit reducing the amount of gasoline taxes that they owe. A second is to apply some kind of user charges comprehensively to all of the roads and highways in the state. Another approach is to apply user charges only to selected lanes of existing highways and to new highways built in the future, giving users of those lanes and highways an advantage over other drivers, who can continue to use more congested free lanes or alternative routes without paying extra.

Practical problems may arise with trying to apply user charges comprehensively to roads and highways that have numerous access points. The next best alternative might be to apply a mix of vehicle mile charges for ordinary roads and highways and user charges for expressways. A pilot study of vehicle mile charges in Oregon demonstrated that it is possible to implement them in a way that results in little evasion while preserving the privacy of drivers so that no one collecting the data can determine where or when any particular driver is driving (National Surface Transportation Policy and Revenue Study Commission 2007, 32).

Although it has not received much consideration by the federal government or state governments, another possible reform is to substitute state funding for federal funding, reducing or eliminating federal gasoline taxes while transferring greater responsibility for funding highway construction and maintenance to state governments. With the current system, states receive federal funds to spend on federally financed highways according to their chosen priorities. Since the federal government pays between 75 and 90 percent of the cost of these projects, this allows some states to “fund low-priority projects at the expense of road users in other states.” (Roth 2005, 6) Proponents of reducing or eliminating the role of the federal government in highway funding emphasize that greater efficiency and equity could be achieved by decentralized funding and control. One example of inefficiency and inequity that could be eliminated with greater state funding is the tendency of the federal government to spend a greater share of federal money on roads and highways in rural areas relative to their population than on highways in major metropolitan areas (Pollack 2009, 10). The equal political power of each state in the US Senate contributes to this bias of the Federal government in favor of citizens living in less populated states.

CONCLUSION

Relying more on user charges combined with increasing the responsibility of states and reducing federal government responsibility for funding both highways and public transportation will lead to a better division of resources between highways and public transportation. Revenue earned from tolls on congested highways will provide a signal about the value people place on expanding highways to improve mobility. If, as seems consistent with past behavior and settlement patterns, people are not willing to pay high enough fares to cover the cost of expanding transit, but are willing to pay tolls high enough to cover highway costs, then it would make sense to expand highways relative to public transportation. It is possible that a well-managed transit system (more likely under private contracting) could generate more than enough revenue to cover costs, and if so, it may make sense to expand transit.

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REGIONAL DIFFERENCES IN THE ECONOMIC RETURN TO INVESTMENT IN HUMAN CAPITAL

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ABSTRACT

This study examines the rates of return to investment in education for the following regions in Turkey: Aegean-Marmara, Mediterranean, Central Anatolia, Black Sea and East-Southeast Anatolia by using internal rate of return and mincerian earning equation models. The results indicated that the estimates of rates of return to education are sensitive to the model used.

INTRODUCTION

With the new growth theory, researchers focused on human capital investment and tried to show the importance of education measured mainly by schooling on economic development and growth (Gundlach, 2001). The economic value of investment in human capital, as Becker (1993) stated, can be measured by its rate of return since it provides the most complete and convenient summary. However, when the return to investment in human capital considered, studies tend to produce conflicting results with respect to the relationship between the return to education (schooling) and the level of development. For example, after estimating the rate of return to education for twenty-eight countries, Trostel, Walker, and Woolley (2002) found a small evidence of positive relationship between the rate of return to education and the level of development; whereas, Pscharopoulos & Patrinos (2004) and Kang (1993) documented the negative relationship between them. However, the question that still remains is whether the greater development leads to higher rate of return to investment in education. Given the heterogeneity of the countries for which we have empirical evidence on rate of return and economic development, the question can be answered more appropriately when we compare the rate of return to education in a more homogenous setting by using micro data. Therefore, this study provides further evidence and tries to answer the above question by concentrating on a single country, Turkey. Specifically, this study obtains rates of return for different regions of Turkey and compares them to the development levels of those regions by using all available household surveys.

As Cain (1976) argued labor market differences affect employment and earnings. Labor market differences vary according to geographic regions in Turkey, where some areas are more highly developed than others, location influences rates of employment and how much money is earned. The western part of the country is more developed and industrialized than the eastern part, which is still mainly dependent on agriculture for survival. The Turkish government has provided attractive incentives to encourage the development in the east, such as higher wage rates for government employees (especially teachers), more investment in schooling, tax breaks, and other government-induced initiatives are intended to spur development of eastern Turkey. However, there are considerable differences among the regions in terms of economic development. The five regions of Turkey, considered are: Aegean-Marmara, Mediterranean, Central Anatolia, Black Sea, East, and Southeast Anatolia. Therefore, concentrating on these five regions, this study investigates rate of return to investment in education in Turkey for each gender by employing both internal rate of return and Mincerian earning function approaches. To that end, the next section explains the model, estimation procedures, and data. The third section provides the rate of return estimates obtained by internal rate of return and mincerian earning function approach. The final section concludes the study.

THE MODEL

Two widely used models in estimating rate of return to education are Mincerian earning function approach and internal rate of return (Psacharopoulos, 1994). As Psacharopoulos (1994) stated, the internal rate of return approach is more appropriate one, but mincerian earning function is used more frequently because of its easiness in estimation. In this study, we use both approaches.
In order to calculate the internal rate of return, we follow Becker (1993) and Hansen (1963), and use the following formula:

\[
\sum_{j=1}^{n} \frac{B_j - C_j}{(1 + r)^j} = 0
\]

(1)

where \(B_j\) is the benefits of education, \(C_j\) is the costs of education, and \(r\) is the internal rate of return. Hansen (1963) explained the total resource costs as "(1) school costs incurred by society, that is, teachers' salaries, supplies, interest and depreciation on capital, (2) opportunity costs incurred by individuals, namely, income foregone during school attendance, and (3) incidental school-related costs incurred by individuals, for example, books and travel" (p. 130). In order to calculate the private resource costs, second and third component from above are included and the first component is limited to tuition and fees paid by students (Hansen, 1963). The cost figures and income stream are used in the study as calculated by Kara (2000) and are given in tables A1 and A2 in Appendix.

For the mincerian earning function approach, I used the following formula given by Mincer (1974)

\[
\ln Y = \beta_0 + \beta_1 S + \beta_2 \text{exp} + \beta_3 \text{exp}^2 + \text{error}
\]

(2)

where \(\ln Y\) is the log of individual earnings observed, \(S\) is the number of years of schooling, and \(\text{exp}\) is the number of years of labor market experience. Instead of estimating the rate of return to education as an additional year of schooling given by the coefficient of \(S\), which is \(\beta_1\), I used dummy variables for schooling level.

\[
\ln Y = \beta_0 + \beta_1 \text{literate} + \beta_2 \text{elementary} + \beta_3 \text{juniorhigh} + \beta_4 \text{highschool} + \beta_5 \text{vocationaltechnical} + \beta_6 \text{college} + \beta_7 \text{exp} + \beta_8 \text{exp}^2 + \text{error}
\]

(3)

where \(\ln Y\) is the log of individual earnings, literate, elementary (elementary or primary school graduates, 5 years), junior high (junior high school, 3 years), high school (high school, 3 years), vocational technical (vocational technical high schools, 4 years), and college (4 years) are dummy variables. Observations on individuals who are illiterate with no schooling are used as reference group.

Because of the sample selection problem associated with these types of data and estimation, Heckman's (1976) proposed a simple statistical procedure to correct the problem by introducing extra variable called “inverse mills ratio” in equation (3), sample selection becomes a missing variable problem here.

Then Heckman (1976 & 1979) also proposed a two-stage model to get consistent estimates, which is followed in this study. Then, two types of rate of return estimates are obtained by following Kawuryan (1997) from the regressions: average and marginal. Regression results for the regions are given in Tables A.3–A.7 in Appendix.

Data The data used in this study come from three surveys carried out by the Population Institute of Hacettepe University in 1968 and the State Institute of Statistic (SIS), Turkey, in 1987 and 1994. Rate of return studies typically used household surveys and therefore this study also used all available household surveys conducted to this date in Turkey. Some other partial data sets come from the Ministry of National Education and the State Planning Organization in Turkey in calculating the costs figures. In 1968, Hacettepe University organized surveys for collecting information on social and economic structure of the population, entitled 1968 Household Survey. Although the data were not published, the data set can be obtained from the Population Institute of Hacettepe University, Ankara, Turkey. In the survey, four sets of questionnaires were used as follows: (1) general information questionnaire was made up of 66 questions aimed at providing a general picture of the socio-economic conditions; (2) household questionnaire consisted of 23 questions and sought information on living conditions and household structure; (3) male questionnaire consisted of 223 questions covering occupation, source of income, education, and migration; and (4) female questionnaire was made up of 213 questions and covered approximately the same questions as in three.

Sample units for the survey were selected using a stratified cluster sampling approach, which divided the population in clusters to properly represent diversities (geographic, rural-urban, etc.) existing within the country. To achieve this, the country was first divided into five geographical regions and then each region was sub-divided into three groups according to size of the population: less than 2,000, between 2,000 and 50,000, and bigger than 50,000. Based on this 5375 households were selected and interviewed. Out of these households interviewed, 4507 individuals’ incomes were observed, and used in this study; 2506 male, 2001 female. In addition, the State Institute of Statistics of Turkey organized two nationwide household income and expenditure surveys in 1987 and 1994. The names of the surveys are “1987 Household Income and Consumption Expenditure Survey”, and “1994 Household Income and Consumption Expenditure Survey.” Although the raw data can only be obtained from the State
Institute of Statistics (SIS), the results of the surveys are offered to the public in the form of two separate publications, entitled “Income distribution” and “Consumption Expenditures” in 1990 for 1987 survey results and in 1997 for 1994 survey results. The purpose of these surveys was to gather information about household sizes, employment conditions, and status of the individuals in the household, total household income, its sources of revenue, consumption and expenditure types, and patterns. In 1987, employing a stratified multi-stage systematic sampling, the survey was applied to 1202 households in the urban areas with a population of more than 20,000, and to 998 households in the rural areas with a population of 20,000 or less. The 1994 survey is identical to 1987 survey in terms of methods and information covered. It was applied to 18,264 households in the urban areas with a population more than 20,000, and to 7,992 households in the rural areas. This study included 34,550 individuals with earnings from the 1987 survey and 33,952 from the 1994 survey.

RESULTS

Applying the models developed in the previous section, four types of rates of returns to schooling estimated: social, private, marginal, and average rates of returns. These estimates are obtained for both male and female for the five regions of Turkey, namely Aegean-Marmara, Mediterranean, Central Anatolia, Black Sea, East and Southeast Anatolia for 1968, 1987, and 1994. However, 1968 data were only used to produce marginal and average rates of return based on mincerian earning function because no meaningful results obtained for internal rates of return.

Internal Rates of Return Estimates For the Aegean – Marmara Regions, social and private rates of return appear in Tables I and II. Graph 1 also illustrates rates of return over time. Social rates of return did not vary much from 1987 to 1994. One exception was found for these rates of return: junior high equivalent cases declined between 1987 and 1994 (from 20.3 percent to 16.6 percent). Excluding vocational-technical high schools and colleges, the social returns are relatively high, as much as 20 percent. Generally, returns are larger for males than they are for females. The difference is higher at primary and junior high levels of education and quite negligible at the college level. According to the data, social returns are beneficial up to high school, but investment in vocational-technical schools and college is lower with returns below 10 percent, which is considered to be a benchmark rate due to the average rate of return to physical capital in developing countries is about 10% (Psacharopoulos, 1989).

Private rates of returns are high at all schooling levels except in the case of vocational-technical education for women (9.3 percent in 1987, and 7.6 percent in 1994). It is interesting to note that women with a college education enjoyed a high return to their investment in college. In 1994, rates of return for women increased almost 11 percentage points between 1987 and 1994 to 21.1 percent. For other educational levels, however, females experienced a small decrease in the returns. Although women’s rates of return increased at the college level, it was not the same for men. For males, rates of return decreased in all cases except for vocational-technical schools, where their rate of return on their investment increased about 2 percentage points. It is interesting to question these estimates. Why did males experience an increase in the return to vocational-technical school while women’s returns were declining? Likewise, why did college educated women enjoy a 108.4 percent increase in the return, from 10.1 percent to 21.2 percent, while men, on the other hand, had only a 7.6 percent increase from 14.7 percent to 15.8 percent? A simple answer for these questions may be a sharp increase in the demand for college educated women. Another difference, noted between the years 1987 and 1994, was at the elementary school level where in 1987, women had higher returns for achieving an elementary education. 1994 data reveals a decrease of about 4 percent in 1994, simultaneously, males witnessed an increase for the same level of education.

Results obtained from the data are similar in the Mediterranean region in terms of internal money returns to schooling. There is a general decline between 1987 and 1994 with lower levels of schooling. Decreases are higher for those with a lower level of education. The social rate of returns decreased for males at the high school level and below, while there was an increase for vocational-technical and college levels. For females, the rate of return rose at junior high schools and high schools, but decreased at other schooling levels. Similar to the results for Aegean-Marmara, the returns were high for elementary and junior high schools. There are higher returns for all levels of schooling. While females experienced decreases over the years, the decline in men’s schooling was relatively small. One striking finding is that the rates of return to
vocational-technical high schools were low for females, 7.3 percent in 1994. On the other hand, in the same year, for the same level of schooling, men received 15.6 percent returns, twice as much as women’s. Again, as seen from the Tables I and II, investment in education proved to be very profitable for both women and men, because of the high returns men and women realized.

In Central Anatolia social rates of return were above 10 percent, a high rate of return, for elementary through high school education. They were low for vocational-technical high schools (Tables I – II). In 1987, except for vocational-technical high schools, the estimated social returns fluctuated between 11.1 percent (college) and 19.6 percent (elementary). For high school education, women’s returns were below 10 percent in 1994. Returns for college and vocational schools were also low. A sharp decrease was evident in the case of college education, almost a 5 percentage point decrease for both sexes. Primary schooling returns continued to be very high, beyond an elementary level, however, rates of return declined.

Private rates of return were similar to the Aegean-Marmara and Mediterranean regions. They were high, no returns below 10 percent were observed. Although there were decreases in the returns in 1994 compared with 1987, some schooling levels showed an increase in the rates of return. For example, vocational-technical schools for both genders and elementary and junior high school are those cases for males. On the other hand, there was a substantial decrease in the rate of return for junior high and high school education for women. Decreases from 21.0 percent to 10.9 percent and from 15.1 percent to 10.2 percent can be seen in Table I and II. Despite these decreases, overall returns were high, proving that investment in education is very profitable.

Social rates of return in the Black Sea region indicate similar results. Looking at the Tables I, and II, we see that the return for elementary schooling decreased slightly. Although only vocational-technical high schools dropped below 10 percent in 1987, the social returns for vocational-technical schools were lower than 10 percent in 1994. At other levels of schooling, the returns were as high as 20 percent. Except for vocational-technical schools and colleges, the returns increased between 1987 and 1994. However, at the elementary school level, the rates of return for men increased from 16.8 percent to 18.6 percent.

With respect to private rates of returns, both men and women enjoyed high returns. Rates of return were especially high for elementary and junior high schools, for example, 26.3 percent to elementary school for men in 1987. However, there appears to be a decrease over the years in the rates of return. Vocational-technical schools deserve special note here because in other regions, men received higher returns for this level of education. However, in the Black Sea region, the return estimated was 9.4 percent and lower than returns for females. College graduates enjoyed about 14 percent-15 percent return in other regions. The rates of return turned out to be slightly lower around 11-12 percent in 1994. In all other aspects, the results indicated the similar patterns to other regions of Turkey.

The least developed regions of Turkey, East and Southeastern Anatolia, have also experienced the benefits of investment in education (see Table II). Social rates of returns for 1987 indicate high figures for all levels of schooling, except for vocational-technical high schools. As was indicated in actual expenditure for education, the state invested relatively more money in vocational-technical high schools. In 1994, in addition to vocational-technical schools, rate of return for females who completed college was also low, 7.2 percent. In all other cases, however, the returns were high. This data demonstrate the benefits of the Turkish governments’ investment in education.

Mincerian Earning Function Estimates The estimated returns to schooling are summarized in Tables 3-5. As these tables indicate, the rates of return to schooling decreased from 1968 to 1994 for both females and males. For males, returns are high, for higher levels of education (high school and beyond); however, all declined over time. It must be concluded, then, that as people become more educated, especially achieving an elementary school education, rates of return to schooling decrease. Another interesting case in 1987, returns show a lower rate than for either 1994 or 1968; the exception is college education. The marginal returns tend to be higher than average returns for all years considered.

Higher returns for women’s schooling compared to that of men are interesting to note. Unlike males, women with junior high and high school degrees enjoyed very high returns in 1968 and 1987; those rates decreased dramatically for junior high level of education and increased for college and high school levels. According to these return estimates, investment in a college education is very profitable.
The Mediterranean region, located in the south part of Turkey, is not as economically developed as the Aegean-Marmara region. The rates of return to schooling in this region are relatively higher than Aegean-Marmara. For male workers, the pattern is very similar to the Aegean-Marmara: a decline over time, with lowest returns in 1987. For women, there is a steady decline in returns over the years. It is worth noting that the return to college education is the lowest (7.7 percent) in 1987.

The higher return for workers with a college education indicates the need for a highly skilled labor force as a country develops. What is important to note is that as the numbers of people with an elementary education increases the rate of return to elementary education declines. Due to the fact that Turkey makes elementary education available to all children, the percentage of people with a primary education has attained a level of completion over 90 percent (SIS, 1994). It is important to observe that for both males and females, the rates of return to vocational-technical school education was the highest in 1994. The fact that the Mediterranean region attract many international tourists to a number of sights. This region may need more people with unique qualifications, such as an understanding of artifacts that may not require a liberal education, but vocational training in certain focused area of study.

Central Anatolia, the middle part of Turkey, combines agricultural side in the east and the industrialized side in the western part of Anatolia. In addition, the capital of the country, Ankara, requires some highly educated personnel to serve the needs of the government. The rates of return follow the similar structure as in the previous regions. The highest returns for education occurred in 1968, followed by a decrease in 1987 and a reversal of the decline with an increase in 1994. Females generally enjoyed higher returns compared to men with an exception of college-educated men who received higher returns for their investment in education; marginal returns of about 13.8 percent in 1987 and about 11.9 percent in 1994. Although the marginal return was 8.6 percent in 1968, the average return was 12.9 percent for that year. For each year, the rates of return exceeded 10 percent that is assumed to be average in return to capital in developing countries.

The Black Sea region exhibited very interesting patterns for the rate of return to education, especially for women, even in 1994, when returns were as high as 27.8 percent. In that respect 1994 and 1968 results were similar except for the case of college education, where returns were relatively low in 1968, 8.0 percent. In general, returns were all high, in all year considered for women. College education proved to be an extremely beneficial investment for them. However, the rates of return to college education decreased over time for men. Men with vocational technical training, on the other hand, have high returns in all years. One particular case of note has to do with junior high equivalent in 1994, which was the highest compared to previous years.

The eastern part of Turkey did not differ from the other regions with respect to rates of return for schooling. Females, as in the other regions, received higher returns for their investment in education when compared to rates of return to men’s schooling. 1968 data show the highest returns, especially for those with high school degrees, 35.5 percent. Although high school graduates enjoyed similar rates of return in the following years, the highest return was for vocational technical high school graduates. The rates of return for these graduates were more than the returns for a college education. Similarly, males enjoyed high rates of return to investment in education. The highest return that occurred in 1987 was for a college degree. This decreased to 10.2 percent in 1994 from 17.5 percent. Despite the fact that there are relatively high returns for higher education levels such as high school and college, there were declining returns for elementary school education over the years for both women and men. In particular, the return to schooling below high school reached to a low of 4.0 percent for men in junior high. In all regions, educational has proven to be a very important, beneficial, and rewarding investment for both males and females.

CONCLUSION

This study examined the rates of return to investment in education for the following regions in Turkey: Aegean-Marmara, Mediterranean, Central Anatolia, Black Sea and East-Southeast Anatolia by using internal rate of return and mincerian earning equation models. The results indicated that the estimates of rates of return to education are sensitive to the model used. We obtained very different estimates for the same level of schooling with each model. For example, the internal rate of return approach yields “diminishing returns” to schooling, presumably reflecting ever rising cost of higher increments of schooling whereas the earning function approach yields the exactly opposite pattern in most cases, reflecting the greater relative increase in earnings with additional schooling. However, Psacharopoulos
(1994) argued that the internal rate of return approach is more appropriate method to calculate the rate of return to investment in schooling although these two methods are both the most frequently used methods. Therefore, conclusions drawn from the study based on internal rate of return approach are given as follows.

First, in the early years of education, returns are high and decline as the level of schooling increased, exhibiting decreasing return to human capital accumulation. Second, private rates of return are generally higher than social rates of return similar to the results obtained by other researchers (Hansen, 1963; Krueger, 1972; and Psacharopoulos, 1985, 1989, and 2004). Third, it is clear from the estimates, women receive lower returns to their education even though they attain the same level of education as men in most cases. Fourth, there is a convergence over time among regions, especially for college education. Fifth, there is also a convergence of the rates of return to schooling between the sexes. Sixth, western regions reveal higher rates of return to education, while eastern regions show lower rates of return. Seventh, in the more industrialized regions, such as the Aegean and Marmara, there are generally higher returns to investment in schooling and a smaller gap in estimated rates of return between men and women. In the less developed regions, such as East and Southeast Anatolia, on the other hand, the returns are lower, and differences between the rate of return for men and women to schooling, especially at college education, are greater. Finally, since the western regions of Turkey are considered to be more developed than the eastern regions, this study concludes that the greater development leads to higher rate of return, supporting the findings by Trostel et al. (2002).

The findings have great policy implications. Due to higher returns to education in more developed areas, skilled labor with more human capital will be attracted to the more developed regions in a particular country and to the more developed nations in general by depriving less developed areas from human capital which is an important ingredient for economic growth and development. This will further retard economic growth in developing areas as well as increasing the differences in rate of return to schooling between man and women as this study finds. Our findings suggest that policy makers should promote policies to increase the rate of return to human capital (education) in developing regions.

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Psacharopoulos, G. (1985). Returns To Education: A Further International Update and
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Table 5. Rates of Return to Schooling by Regions in 1968

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<td>Marginal</td>
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<td>24.1</td>
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<td>15.3</td>
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<td>Junior High School</td>
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<td>9.7</td>
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<td>17.9</td>
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</table>
Graph 1. Rate of Return to Education in 1994, 1987, and 1968.
1987 Private Rates of Return to College Education

1987 Social rates of return to College education

1994 Average Return to College Education
1987 Marginal Return to College Education

1968 Marginal Return to College Education

1987 Average Return to College Education
1968 Average Return to College education

- Male
- Female

% Return

AGEAN-MARMARA
MEDITERRANIA
BLACK SEA
CENTRAL ANATOLIA
EAST-SOUTHEAST

Proceedings of the Pennsylvania Economic Association 2010 Conference
APPENDIX

Table A1. Annual Private Costs / Student (in Turkish Lira)

<table>
<thead>
<tr>
<th>Level of Schooling</th>
<th>Years</th>
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<td>1987</td>
<td>1968</td>
</tr>
<tr>
<td>Elementary (5 years)</td>
<td>4,659,282</td>
<td>67,122</td>
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<tr>
<td>Junior High School (3 years)</td>
<td>6,717,672</td>
<td>113,409</td>
<td>698</td>
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<tr>
<td>High School (3 years)</td>
<td>9,101,295</td>
<td>120,717</td>
<td>743</td>
</tr>
<tr>
<td>Higher Education (4 years)</td>
<td>15,441,183</td>
<td>194,724</td>
<td>1,198</td>
</tr>
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</table>

Sources: 1. Ministry of National Education Research and Planning Department

Table A2. Estimated Opportunity Costs (in Turkish Lira)

<table>
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<th>Level of Schooling</th>
<th>MALE</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>1994</td>
<td>1987</td>
<td>1968</td>
</tr>
<tr>
<td>Junior High School</td>
<td>105,665,900</td>
<td>311,826</td>
<td>2,985</td>
</tr>
<tr>
<td>Junior High School Equivalent*</td>
<td>143,805,45</td>
<td>484,311</td>
<td>6,067</td>
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<tr>
<td>High School</td>
<td>212,987,70</td>
<td>563,377</td>
<td>7,898</td>
</tr>
<tr>
<td>Higher Education</td>
<td>251,811,01</td>
<td>587,349</td>
<td>9,821</td>
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<table>
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<tr>
<td></td>
<td>1994</td>
<td>1987</td>
<td>1968</td>
</tr>
<tr>
<td>Junior High School</td>
<td>120,542,52</td>
<td>243,401</td>
<td>2,096</td>
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<tr>
<td>Junior High School Equivalent*</td>
<td>97,968,00</td>
<td>202,059</td>
<td>5,102</td>
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<td>High School</td>
<td>175,969,88</td>
<td>498,724</td>
<td>6,651</td>
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<tr>
<td>Higher Education</td>
<td>255,300,93</td>
<td>535,524</td>
<td>8,343</td>
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</table>

*. Junior high School Equivalent is the first 3 years of Vocational/technical high schools that are typically 6-7 years combining junior high and high school.

### Table A.3 Regression Results for Aegean-Marmara Region

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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambda</td>
<td>(0.075)</td>
<td>(0.108)</td>
<td>(0.081)</td>
<td>(-0.099)</td>
<td>(-0.355)</td>
<td>(-1.192)</td>
</tr>
<tr>
<td>Literate</td>
<td>0.259</td>
<td>0.180</td>
<td>-0.031</td>
<td>0.099</td>
<td>0.040</td>
<td>0.000</td>
</tr>
<tr>
<td>Elementary School</td>
<td>(-0.096)</td>
<td>(-0.156)</td>
<td>(-0.083)</td>
<td>(-0.120)</td>
<td>(-0.216)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Junior High School</td>
<td>0.440</td>
<td>0.413</td>
<td>0.314</td>
<td>0.949</td>
<td>0.710</td>
<td>1.493</td>
</tr>
<tr>
<td>Junior High Equivalent</td>
<td>(-0.074)</td>
<td>(-0.115)</td>
<td>(-0.075)</td>
<td>(-0.101)</td>
<td>(-0.438)</td>
<td>(-0.636)</td>
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<tr>
<td>High School</td>
<td>0.432</td>
<td>0.567</td>
<td>0.000</td>
<td>0.945</td>
<td>1.432</td>
<td>0.000</td>
</tr>
<tr>
<td>Vocational -Technical</td>
<td>(-0.193)</td>
<td>(-0.314)</td>
<td>(0.000)</td>
<td>(0.487)</td>
<td>(-0.524)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>High School Equivalent</td>
<td>(-0.074)</td>
<td>(-0.107)</td>
<td>(-0.076)</td>
<td>(-0.093)</td>
<td>(0.000)</td>
<td>(-0.783)</td>
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<tr>
<td>College</td>
<td>1.205</td>
<td>1.681</td>
<td>1.154</td>
<td>1.799</td>
<td>2.045</td>
<td>2.379</td>
</tr>
<tr>
<td>Experience</td>
<td>(0.078)</td>
<td>(-0.060)</td>
<td>(-0.077)</td>
<td>(-0.097)</td>
<td>(-0.883)</td>
<td>(-1.670)</td>
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<tr>
<td>Experience Squared</td>
<td>(-0.003)</td>
<td>(-0.006)</td>
<td>(-0.003)</td>
<td>(-0.005)</td>
<td>(-0.030)</td>
<td>(-0.008)</td>
</tr>
<tr>
<td>Lambda (Selection)</td>
<td>0.091</td>
<td>0.136</td>
<td>-0.468</td>
<td>-0.167</td>
<td>0.000</td>
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</table>

Numbers in parenthesis reflects standard errors.

### Table A.4 Regression Results for Mediterranean Region

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</thead>
<tbody>
<tr>
<td>Lambda</td>
<td>(0.090)</td>
<td>(0.116)</td>
<td>(0.099)</td>
<td>(-0.163)</td>
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<td>(-0.530)</td>
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<td>Literate</td>
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<td>-0.262</td>
<td>-0.064</td>
<td>0.241</td>
<td>0.470</td>
<td>0.000</td>
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<tr>
<td>Elementary School</td>
<td>(-0.107)</td>
<td>(-0.180)</td>
<td>(-0.095)</td>
<td>(-0.268)</td>
<td>(-0.222)</td>
<td>(0.000)</td>
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<tr>
<td>Junior High School</td>
<td>0.290</td>
<td>0.211</td>
<td>-0.077</td>
<td>0.665</td>
<td>0.635</td>
<td>1.448</td>
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<tr>
<td>Junior High Equivalent</td>
<td>(-0.080)</td>
<td>(-0.101)</td>
<td>(-0.068)</td>
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<td>High School</td>
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<td>High School Equivalent</td>
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<td>(-0.110)</td>
<td>(-0.084)</td>
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<td>(-0.761)</td>
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<td>(-0.157)</td>
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<td>(0.000)</td>
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<td>0.064</td>
<td>0.087</td>
<td>0.041</td>
<td>0.062</td>
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<tr>
<td>Lambda (Selection)</td>
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<td>(-0.005)</td>
<td>(-0.010)</td>
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Numbers in parenthesis reflects standard errors.
Table A.5  Regression Results for Central Anatolia Region

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<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
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<td>Constant</td>
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<td>1.066</td>
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<td>College</td>
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</table>

Numbers in parenthesis reflects standard errors

Table A.6  Regression Results for Black Sea Region

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<tbody>
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<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
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<td>-0.117</td>
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Numbers in parenthesis reflects standard errors
Table A.7 Regression Results for East-Southeast Anatolia Region

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Numbers in parenthesis reflect standard errors.
Wage rates are forced down when government extracts taxes from firms. Labor will migrate from taxed firms to firms under an anarchistic regime unless government from its surplus tax revenues can generate a public good that will overcompensate for the fall in wages. A particular public good, law enforcement, provides positive feedback to the efficacy of the tax collectors who fund it because they have recourse to it against firms. A tax rate above which Leviathan can compete with anarchy can be determined for given production and force technologies. In the United States, the current tax rate is two and a half times the threshold tax rate needed for Leviathan of about 10 percent of gross income; government produces a public good whose magnitude is about two and a half times the outlays to government outlays other than law enforcement or military, and tax collectors have roughly an eightfold advantage over firms on account of their access to law enforcement.

INTRODUCTION
This paper is the sequel to a previous work, in which Linn (2007) explored conditions under which competitive firms could exist in the absence of government, a condition which is described in Thomas Hobbe's Leviathan as bellum omnium contra omnes, or the “war of all against all”. Here, Leviathan, or the state, is introduced. Its income is generated solely through involuntary taxation, in a levy against firms which is resisted by those firms by the use of force. Conditions are identified under which Leviathan can be a going concern, meaning when it can improve upon the anarchistic model.

THE GENERAL MODEL
The same assumptions about force in the anarchistic model are extended to include government. Firms produce and defend their assets against outsiders who now include tax collectors as well as private individuals. The tax collectors are like those of New Testament times, living on the difference between what they can extract and what they are required to forward to government. A force technology links effort to force, and an allocation rule links force to winnings. A ratio rule is assumed, under which winnings are exhaustive and the share of winnings to the \( i \)th agent employing force \( F_i \) is

\[
\phi_i = \frac{F_i}{\sum_j F_j}. \tag{1}
\]

Firms produce force and output, assumed to be flow variables, produced by homogenous, divisible labor that can be employed either as "workers" or "guards." Factors other than labor will not be considered in this model. Unemployed private individuals constitute “outliers” who use force but who do not act collectively on the margin. Tax collectors produce force but act collectively on the margin under direction of government. The output of one firm is fought over in an arena that includes one firm, outliers, and tax collectors. The number of arenas is sufficiently large that the firms face a purely competitive output market.

The own-force elasticity of a user’s share of winnings is

\[
\frac{F_i}{\phi_i} \frac{\partial \phi_i}{\partial F_i} = 1 - \phi_i. \tag{2}
\]

and the cross-force elasticity of winnings is

\[
\frac{F_i}{\phi_i} \frac{\partial \phi_i}{\partial F_j} = -\phi_i, \quad i \neq j. \tag{3}
\]

The production functions for the firm’s output and force in elasticized form are

\[
\frac{L}{Y} \frac{\partial Y}{\partial L} = \alpha, \tag{4}
\]

and

\[
\frac{G}{F_G} \frac{\partial F_G}{\partial G} = \beta, \tag{5}
\]

where \( L \) is the quantity of workers and \( G \) is the quantity of guards. As explained in the Appendix of the original paper, Marshallian stability requires a value of \( \beta \) greater than unity. The upper bound for \( \alpha \) in a purely competitive output market is unity.

The production function for the government’s force in elasticized form is

\[
\frac{T}{F_T} \frac{\partial F_T}{\partial T} = \beta, \tag{6}
\]

where \( T \) is the number of tax collectors. To simplify the mathematics, the assumption is made that the force elasticity for tax collectors is the same as that for guards.
CASES TO BE CONSIDERED

Two scenarios will be considered. First, the base of the tax will be the income of those individuals whose presence engenders the argument of the need for government—the outliers. Second, the base of the tax will be the income of those individuals who are to benefit from the presence of government—the firms. To further simplify the mathematics, the government will not be constrained to balance its budget on the margin; it will be constrained to impose a tax at a constant rate \( t \).

BASE OF THE TAX IS OUTLIER INCOME

The profit maximizing function of the firm, subject to the constraint of a fixed rate tax on outlier income, is

\[
\pi = \phi Y - wL - wG + \lambda(\phi_T - t\phi_U),
\]

where \( \phi, \phi_T, \) and \( \phi_U \) are after-tax shares of winnings to firms, tax collectors, and outliers respectively, and \( t \) is defined on the range \([0,\infty]\). The value of the wage is not necessarily the same for all forms of labor but subscripts for \( w \) will not be carried in the equations because the particular factor to which the wage applies will be known from the context.

The firm’s first-order condition for its workers is

\[
\frac{a\phi Y}{L} - w = 0,
\]

and for its guards is

\[
\frac{\beta\phi(1 - \phi)Y}{G} - w - \frac{\beta\phi T}{G} + \frac{\beta t\phi U}{G} = 0.
\]

The government’s first-order condition for its tax collectors is

\[
-\beta\phi\phi_T Y \left( \frac{\beta\phi_T(1 - \phi_T)}{T} + \frac{\beta t\phi_T\phi_U}{T} \right) = 0,
\]

and the first-order condition for \( \lambda \) is

\[
\phi_T = t\phi_U.
\]

When Equation (11) is applied to Equations (9) and (10), the expression multiplied by \( \lambda \) in Equation (9) vanishes and there is cancellation in the expression in braces in Equation (10), and a value is for \( \lambda \) is obtained:

\[
\lambda = \phi Y.
\]

Substitution of Equations (8) and (9) into Equation (7) will yield the firm’s competitive equilibrium share of winnings

\[
\bar{\phi}Y[1 - \alpha - \beta(1 - \bar{\phi})] = 0,
\]
or

\[
\bar{\phi} = \frac{\alpha + \beta - 1}{\beta}.
\]

This outcome is invariant with respect to \( t \) and is unchanged from the anarchistic equilibrium. The share of winnings of the tax collectors is solely at the expense of the outliers (as might be expected since outlier share of income is the base of the tax) and is given by

\[
\bar{\phi}_T = \frac{(1 - \alpha)t}{\beta(1 + t)}
\]

For sufficiently large \( t \) the share of outlier income becomes infinitesimally small, and the firm is facing force-using tax collectors instead of force-using outliers.

The question to be addressed now is: A competitive equilibrium exists under this tax regime. But are workers better off under this equilibrium than they would be in the anarchistic equilibrium? Would workers migrate to arenas under the tax regime and abandon the anarchistic arenas?

Insight in answering this question can be obtained by considering a special case: the government recruits precisely one tax collector out of a pool of outliers in what was up to that moment an anarchistic arena. There is no effect on the firm; it is facing a combined force having one less outlier and one more tax collector, and one tax collector alone enjoys no advantage that more than one would have. The effect, then, of hiring precisely one tax collector is neutral.

We can go on to infer that having a number of tax collectors greater than unity will confer an advantage to the arena. Since tax collectors have a greater force elasticity than outliers, fewer tax collectors than outliers would be needed to produce the same amount of force opposing the firm. The government would generate a surplus, which can be devoted to production of a public good or distributed as an increase in the wage. Thus, except in cases where the arenas are too tiny, the government would be successful in supplanting the anarchistic arenas.

BASE OF THE TAX IS FIRM INCOME

We have shown that a tax base of outlier income will yield a regime where government replaces anarchy, but the government is unlikely to have Leviathanian proportions because outlier income may be small to start with and there is not room to build a large government surplus out of it. So we will now take the opposite extreme. A tax base of firm income is large. Taxing firm income will create some disincentives, but the large tax base may be a foundation for a large social surplus.

The profit maximizing function of the firm, subject to the constraint of a fixed rate tax on firm income, is

\[
\pi = \phi Y - wL - wG + \lambda(\phi_T - t\phi_U),
\]

where \( \phi, \phi_T, \) and \( \phi_U \) are after-tax shares of winnings to firms, tax collectors, and outliers respectively, and \( t \) is defined on the range \([0,\infty]\). The firm’s first-order condition for its workers is

\[
\frac{a\phi Y}{L} - w = 0,
\]

and for its guards is
The government's first-order condition for its tax collectors is
\[ \frac{\beta \phi (1 - \phi) Y}{G} - w - \lambda \frac{\beta \phi \phi_T}{G} - \beta t \phi (1 - \phi) = 0. \] (9')
The government's first-order condition for its tax collectors is
\[ -\beta \phi \phi_T Y \frac{T}{\lambda} + \beta \phi (1 - \phi) \frac{T}{\phi_T} - \beta t \phi \phi_T = 0. \] (10')
and the first-order condition for \( \lambda \) is
\[ \phi_T = t \phi. \] (11')
Substitution of Equation (11') into Equation (10'), yields a value for \( \lambda \) of
\[ \lambda = \phi Y, \] (12')
and the first order condition for \( G \) becomes
\[ \beta \phi (1 - \phi + t) Y \frac{1 - \alpha - \beta (1 - \phi)(1 + t)}{G} - w = 0. \] (9'')
The firm's competitive equilibrium share of winnings is
\[ \frac{\phi Y}{\beta} (1 - \alpha - \beta (1 - \phi)(1 + t)) = 0 \]
or
\[ \phi = \frac{\alpha + \beta - 1}{\beta (1 + t)}. \] (13')
If the values of \( \alpha \) and \( \beta \) are fixed, the tax collectors' share of winnings is solely at the expense of the firm as can be seen from calculating the winnings of outliers:
\[ \phi_u = 1 - \phi (1 + t) = \frac{1 - \alpha}{\beta}, \] (14')
which is the same as if there had been no tax. The tax will force down the net marginal product of labor in proportion to the firm's net winnings, and firm size will be unchanged at the competitive equilibrium.

**OPTIMIZING THE PUBLIC GOOD**

Let us suppose that the government budget at equilibrium is given by
\[ \phi_T Y = b(wT + wT_0 + wK_0), \] (15)
where \( b \) is a coefficient whose value, it is hoped, is greater than unity, \( T_0 \) represents "inert" government workers—those who are not tax collectors and who produce goods and services that are not pure public goods, and \( K_0 \) is the amount of capital allocated to the non-public goods. The labor and capital outlays for the direct producers of the public good—law enforcement officers and military—are not explicitly stated in Equation (15) because they are to be paid from the government surplus. The public good is manifested in recourse that all users of force have against all others, with the exception that recourse is not available against tax collectors.

The difference between \( b \) and unity is the government surplus expressed as a percentage of tax collector and non-public good outlays. If the government surplus were to be used to purchase a purely private good to be distributed equally over the total population, the government surplus per capita for the whole population would be a fraction of the government surplus per government worker. But if the surplus is used to purchase a pure public good, there would be no diminution of the per capita value of the surplus over the total population.

Figure 1 is a combination of two graphs that show the relationship between the government surplus and the quantity of the public good produced. The right hand side shows the optimum quantity of the public good. The left hand side shows the government surplus required. Optimization of the public good does not necessarily imply that government surplus is also maximized, but government planners might lose track of the distinction. The magnitude of the government surplus is also the public good's contribution to gross domestic product.

If the value of the public good is exactly its contribution to gross domestic product measures the quality of life for every member of the population is given by the expression \( bw \) and the test for viability of a government regime is whether the value of \( bw \) is greater than that of \( w \) in the anarchistic regime. If the value of the public good is greater than its contribution to gross domestic product, the \( bw \) test is a sufficiency condition.

**FINDING THE PARAMETER ESTIMATES**

By combining Equations (11'), (8'), and (15) we obtain the following:
\[ b = \frac{wL}{\alpha(wT + wT_0 + wK_0)}. \] (16)
For \( \alpha \) we combine Equations (8'), (9''), and (14') to obtain
\[ 1 - \frac{\alpha}{\alpha} = \frac{wG}{wL}. \] (17)
The left-hand side of Equation (17) is defined over the interval \([0, \infty]\) and will be used as the statistic for estimating \( \alpha \).

For estimation of \( \beta \) we combine Equations (9'') and (14') and obtain
\[ \beta = \frac{wG}{wL} + \frac{wG}{wL + wG}. \] (18)
When \( \beta \) is a constant, the force outputs are exponential functions of the force effort inputs. We then use Equation (1) to obtain
\[ \frac{t \phi}{\phi} = t \left( \frac{cT}{G} \right) ^\beta, \] (19)
where \( c \) is a coefficient of the comparative potency of tax collectors and guards. Unlike the factor ratios used in Equations (16), (17), and (18), the quantities here are the raw factor quantities, not their compensations. Though labor hired as tax collectors or guards is homogenous, the value of
$c$ is greater than unity because tax collectors facing guards have recourse to government force while guards do not. The value of $c$ is calibrated to generate a $t$ that matches the observed value of $t$.

**THE THRESHOLD CONDITION FOR GOVERNMENT VIABILITY**

If the government drives down the equilibrium wage, it can remain a viable competitor in the market if it can generate a public good whose value, when combined with the money wage, exceeds the wage that would prevail in the anarchistic markets.

Taxation causes the wage to fall by a factor $1/(1+t)$ compared to the anarchistic equilibrium. Then, for government to be competitive with anarchy it is sufficient that the value of $b$ be greater than $(1+t)$. From Equation (16), we find the threshold condition

$$b = \frac{twL}{\alpha(wT + wT_0 + w\bar{K}_0)} \geq 1 + t,$$

or

$$\frac{t}{1 + t} \geq \frac{\alpha(wT + wT_0 + w\bar{K}_0)}{wL}.$$

The expression on the left-hand side is the tax rate expressed as a percentage of the before-tax tax base and is defined on the interval $[0,1]$. For a given level of taxation, there is an upper limit on the compensation of government employees, as would be expected, and for a given compensation of government employees, a minimum tax level is needed.

**A NOTE ON THE COMPENSATION OF CAPITAL**

Except for capital outlays for government-produced non-public goods, the data below show labor compensation only. The magnitudes of $\alpha$ and $\beta$ are calculated below by use of labor compensation ratios as if labor is the sole contributor to national income. We will assume that the ratios of capital compensation to labor compensation are fixed. We can then accept the labor data as indicative of the whole economy without having to include capital data explicitly.

**THE DATA**

Table 1 shows the compensation data and their sources.

**IMPLICATIONS OF THE RESULTS**

The value of $\alpha$ is 0.9949 with a standard deviation of 0.0002, very close to the value of unity that would be seen in the conventional competitive firm that returns all the value of its output to its factors. The value of $\beta$ is 1.36 with a standard deviation of 0.32. The value of $\beta$ has a greater degree of uncertainty than the value of $\alpha$ because the former is sensitive to winnings of outliers which is hard to measure.

The sufficient before-tax tax rate for government viability is 0.101 with a standard deviation of 0.011, well below the current before-tax tax rate which is about 25 percent. The value of $b$ is 3.65 with a standard deviation of 0.48. So the amount of the public good is about 2.65 times the size of government non-public-good outlays.

The amount of the public good is sensitive to two quantities. One of these is the amount of government non-public good outlays, and the other is the magnitude of the advantage that tax collectors have in being able to call upon law enforcement. If there is an increase in the former or a decrease in the latter, the amount of the public good that the government can generate will decrease.

**REFERENCES**


Figure 1. Government Funding for the Public Good for a Given Wage.

Table 1. Estimates of the Parameters

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<td>Non-Public-Good Gov’t Capital Outlay</td>
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<td>$96.1 billion*</td>
<td>$105.9 billion*</td>
<td>$wK_0$</td>
</tr>
<tr>
<td>Outlier Income</td>
<td>FBI</td>
<td>$17.1 billion</td>
<td>$17.8 billion</td>
<td>$wU$</td>
</tr>
<tr>
<td>Guard Income</td>
<td>OES 33-9032</td>
<td>$20.6 billion</td>
<td>$27.0 billion</td>
<td>$wG$</td>
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<tr>
<td>Guards</td>
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<td>977,650</td>
<td>1,046,070</td>
<td>$G$</td>
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<tr>
<td>Gov’t Surplus Multiplier</td>
<td></td>
<td>3.31</td>
<td>3.99</td>
<td>$b$</td>
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<tr>
<td>Tax Collector Advantage</td>
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<td>6.43</td>
<td>8.83</td>
<td>$c$</td>
</tr>
<tr>
<td>Worker Income</td>
<td>OES 00-0000 (less sector 99) less OES 33-9032</td>
<td>$4045.2 billion</td>
<td>$5,204.4 billion</td>
<td>$wL$</td>
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<tr>
<td>Statistic for $\alpha$</td>
<td>196.37</td>
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<td>Statistic for $\beta$</td>
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<td>Threshold before-tax rate for government viability</td>
<td>0.108</td>
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*Inferred from ratio of capital outlays to employee compensation in 1992.*
DOES THE INTERNAL RATE OF RETURN CALCULATION REQUIRE A REINVESTMENT RATE ASSUMPTION?—THERE IS STILL NO CONSENSUS

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ABSTRACT
In financial management and related courses, professors teach various capital budgeting methods, including payback period, net present value (NPV) and internal rate of return (IRR). Many textbooks state that the IRR calculation implicitly assumes interim cash flows are reinvested at the IRR. Thus, as an example, if a project has a 25 percent IRR, the calculation implicitly assumes interim cash flows are reinvested at 25 percent, until the end of the project. In contrast, many textbooks state that the NPV method assumes interim cash flows are reinvested at the firm’s risk-adjusted weighted average cost of capital (WACC). Many argue that the reinvestment assumption implicit to the NPV calculation is more realistic than the assumption used for the IRR calculation, because the WACC is less than the IRR for a favorable project. However, a thorough review of the textbooks used by professors teaching capital budgeting techniques finds that some textbooks state there is no reinvestment rate assumption made in IRR calculations while many others are silent about the assumption. In addition, there are scholarly articles that argue that the IRR calculation does not require a reinvestment assumption. For example, Keef and Roush (2001) term it the “fallacious reinvestment assumption.” The lack of consistency among the textbooks and scholarly literature on such a basic finance concept that is taught to so many students is troubling because it produces confusion. This paper summarizes our findings from current textbooks used in a range of disciplines, revealing the stark inconsistency in the use of this assumption for IRR calculations.

INTRODUCTION
Suppose there were two first grade classes in an elementary school with one teacher instructing the students that 2+2=4, while across the hall the second teacher was instructing the students that 2+2=5. It wouldn’t be long before the incompetence of the second teacher was discovered by parents and administrators. When it comes to the presentation of basic material in the classroom, we expect our teachers and their supporting pedagogy to be correct and void of ambiguity.

In the field of financial management, there are few things more fundamental and ubiquitous than the net present value (NPV) and internal rate of return (IRR) calculations. Both are germane to capital budgeting practices used by today’s corporate managers. These concepts are taught to thousands and thousands of students in finance, accounting, and economics courses, and not just to business students but also to engineering students. While the cash flows and discount factors required for these calculations involve case-by-case judgment calls, the intrinsic calculations themselves should not be arbitrary. We should expect that professors and textbooks are uniform in the underlying steps and the need for assumptions in the calculation. This does not imply that the pedagogical materials must be identical or that professors need to use the same methods to present the concepts; instead, we argue that the underlying steps and the need for assumptions should be consistent. Our research finds that this is not the case. Based on the inconsistencies we’ve uncovered in current, well-known textbooks, the following fictitious vignette illustrates what could be happening on campuses across the country:

At a certain prestigious university Professor Black is teaching his investments class. He is instructing his students how to calculate the yield to maturity of a bond. As he keys the
Our paper is arranged in the following order. In the next section, we discuss key pieces of literature that reveal the inconsistency in the usage of the reinvestment assumption and show what several scholars have said about this topic. In the third section, we present our research methodology. In the fourth section, we discuss our research findings and present some analysis of the data. In the fifth section, we include a discussion, and then we end with our conclusions and recommendations for future research.

**INCONSISTENCY IN THE LITERATURE**

One of the earliest papers to clearly reject the reinvestment rate assumption is titled “The Internal Rate of Return and the Reinvestment Fallacy” by Keane (1979). He states “…it is desirable to clarify…issues which are constant sources of confusion,” one being that “…neither the IRR nor the NPV method contains any implicit assumptions about the reinvestment rates available for the intermediate cash flows” (p. 49). The debate regarding the validity of the assumption revolves around the conflict that can emerge between the NPV and IRR methods. When looking at the NPV profiles of two projects, the Fisher rate (see Dudley, 1972) is the discount rate where the profiles intersect and NPVs are equal. At discount rates below the Fisher rate, one project’s NPV will be higher, while the other project’s IRR will be higher. This “conflict” leaves it up to the analyst to decide whether to use the NPV or IRR method to decide the ranking between the two projects. Some argue that the different reinvestment assumptions for NPV versus IRR create this conflict. Yet, Keane’s position is that there are other factors to explain this, and he is dismissive of the reinvestment assumption argument. There are others who long ago have shown that there is no implicit reinvestment assumption when calculating IRR (see Alchian, 1955; Beidleman, 1984; Doenges, 1972; Dorfman, 1981; and Dudley, 1972).

The teaching of the reinvestment assumption is not new. As far back as Corporation Finance, Schwartz (1964, p. 200) states, “the implicit assumption of the internal rate-of-return formulation is that the fund throw-off over the life of the project can be reinvested at the same rate as that earned by the initial project.” Trusting that professors taught what was in their books, this indicates that Dr. Schwartz was teaching students at Lehigh University about the reinvestment assumption nearly half a century ago. Ironically, another Lehigh professor, Carl R. Beidleman, wrote in an article some 20 years later (1984, p. 128) that “the mere suggestion that the models attributed any return to the cash flows after

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**Note:** The document text is fragmented and contains incomplete thoughts and sentences. The author is discussing the inconsistency in the usage of the reinvestment assumption in capital budgeting, focusing on the comparison between Internal Rate of Return (IRR) and Yield to Maturity (YTM). The text also references various scholars and their works, such as Schwartz (1964) and Keane (1979), to highlight the evolving understanding of these concepts over time.
release has led to errors in texts and in teaching DCF capital budgeting since its inception.” Yet, not only do textbooks today continue to use the reinvestment assumption, but they are not presenting, or even alluding to, the debate that can be found in scholarly articles. For example, in their most recent update to their popular *Fundamentals of Financial Management* textbook, Brigham and Houston (2009, p. 346) state “The NPV calculation is based on the assumption that cash inflows can be reinvested at the project’s risk-adjusted WACC, whereas the IRR calculation is based on the assumption that cash flows can be reinvested at the IRR.”

The apparent inconsistency, if not confusion, about the importance of making a reinvestment assumption is summarized succinctly by Bierman and Smidt (1993). They acknowledge that “it is frequently claimed that the IRR method assumes reinvestment at the IRR” (p. 92). They believe this claim is “inexact.” They argue that the IRR calculation can be computed without making any assumption about reinvestment...and that is correct. When finance professors teach IRR to students, they don’t typically consider how the cash flows will be utilized. They could be used to pay dividends; they could be used to invest in new projects; they could be used to purchase financial assets. Yet, Bierman and Smidt go on to say that the cost of the cash used for a project and the value of the cash produced “are necessary to decide if an investment is acceptable.” Thus, they make the distinction between the mathematical calculation of IRR and the subsequent use of IRR to make a decision about whether to accept or reject a project. They fall into a different “camp” than others we have read because they are clearly not making a reinvestment assumption that the values of cash produced equal the IRR. Instead, they recognize that some sort of reinvestment assumption would have to be made in some instances in order to value the cash produced and to make a decision about a project. It is not surprising to us to find a more thorough and nuanced discussion of the reinvestment assumption in a capital budgeting textbook than what is typically found in more general finance textbooks that devote less space to any one topic.

A student learning IRR for the first time could be totally confused if they were reading *Engineering Economy* by Sullivan, Wicks and Koelling (2009). The authors assume the reinvestment assumption for NPV calculations, but say that the IRR method “is not limited by this common assumption.” They even go on to footnote the Bierman and Smidt (1993) reference that we cited earlier in our paper, which makes it clear that there is no need for a reinvestment assumption when calculating IRR. After making it clear to the reader (likely an unsuspecting engineering student who is seeing material on capital budgeting for the first and only time) that IRR doesn’t require a reinvestment assumption, in a later section of the book the authors state “the reinvestment assumption of the IRR method may not be valid in an engineering economy study” (p. 217). They then give an example of a project with an IRR of 42.4 percent and a cost of capital of 20 percent, and observe that “it may not be possible for the firm to reinvest net cash proceeds from the project at much more than 20 percent.” In order to solve this problem (and the multiple IRR problem), the authors introduce the external rate of return (ERR) method, which is identical to the MIRR method taught in many finance books. Thus, within the same chapter of this textbook, an engineering student is taught that the IRR calculation doesn’t require a reinvestment assumption, but then is taught the ERR method as a remedy to this unrealistic (reinvestment) assumption. How are students supposed to understand capital budgeting with that sort of expose? The nuance that a student is left to grasp is that IRR does not require any explicit reinvestment assumption in order to calculate IRR. However, as observed by Bierman and Smidt (p. 60), “one might need to know the reinvestment rates to compare alternatives.”

While some scholars in academia might believe that the debate over the use of the reinvestment rate assumption for IRR calculations is long over, a quick check of the practitioner literature shows that some in industry are still grappling with the issue. For example, Kelleher and MacCormack (2004), consultants with McKinsey & Company, encourage managers to “avoid using IRR entirely or at least make adjustments for the measure’s most dangerous assumption: that interim cash flows will be reinvested at the same high rates of return” (p. 16). They say that this flawed reinvestment assumption “can lead to major capital budgeting distortions” (p. 17). The simple way for practitioners to avoid the problems with IRR is to discontinue its use. However, as long as those in industry perpetuate its use and business professors continue to teach it, it’s highly unlikely that financial managers will abandon its use and solely rely on the NPV methodology. In fact, Graham and Harvey (1999) surveyed Fortune 500 companies and found that the IRR method is the leading evaluation technique among 12 alternatives.

**RESEARCH METHODOLOGY**

The methodology we used was influenced by the approach taken by Keef and Roush (2001) ten years ago. They examined textbooks in only two areas: management accounting and finance and they applied several constraints to their search: (1) “they were clearly undergraduate texts”; (2) “the texts contained a copyright date of 1995 or later”; (3) “they were available in a New Zealand library.” They also rejected books if they did not “explicitly discuss the NPV versus IRR conflict.” In our research, we were just as interested to see if MBA textbooks were using the reinvestment assumption as undergraduate texts, so we did not limit ourselves to undergraduate books. Below we discuss the copyright date criterion we used and, of course, we did not limit our search to a New Zealand library because our
schools are in the United States. As for the NPV versus IRR
conflict, we did not limit our search in that regard either.
Of course, capital budgeting concepts are taught in other
courses and not just business courses. For instance, we
wonder how many finance professors are aware of the
extensive teaching and writing from the engineers on capital
budgeting. One unique contribution of our research is that we
looked at more disciplines than Keef and Roush in order to
obtain a broader sense about the continued use of the
reinvestment assumption. McDaniel, McCarty, and Jessell
(1988) noted that “many texts in financial management, real
estate, engineering economy, etc., state that DCF methods
have implicit reinvestment assumptions.” The areas we
researched were: (1) financial management/managerial
finance, (2) corporate finance, (3) capital budgeting, (4)
financial and/or managerial accounting, (5) engineering
economics, (6) managerial economics, and (7) real estate
finance. Our goal was to find at least 15 textbooks in each
discipline to raise the confidence level of the statistical
testing discussed later in the paper. We decided to look at the
financial management and the corporate finance textbooks as
two distinct categories, because corporate finance books
often contain more advanced material. It is more likely that
an MBA corporate finance textbook, or even an
undergraduate-level corporate finance text, would discuss the
reinvestment assumption than an introductory financial
management text. You would expect that authors of books
with more basic treatment of finance principles would be
more inclined to sidestep the reinvestment rate assumption
topic to avoid confusing students.

Textbooks in each of the disciplines were located at the
libraries or ordered through the Interlibrary Loan systems at
Kutztown University of Pennsylvania and The Pennsylvania
State University. Also, there were other ways to obtain access
to the books: for example, we teach finance courses at our
respective schools and have various textbooks sent to us by
publishers for our review. Keef and Roush (2001) uncovered
a dramatic inconsistency among finance and managerial
finance textbooks, so we were interested to see if the
textbooks today are any more uniform on the reinvestment
assumption. Their sample included 48 books with a copyright
date of 1999 or earlier, 11 books with a copyright of 2000,
and just one book with a copyright date of 2001. Their paper
was submitted in May 2000 for peer review, thus explaining
why the majority of books had earlier copyrights. Evidently,
as the paper went through the review and editing phase prior
to publication, this gave the authors time to update their list
of books with more current textbooks. Because we wanted to
see what the textbooks since the Keef and Roush paper were
using as assumptions, we limited our research to books with
copyright dates after 2000.

We reviewed each textbook to see first if it presented the
NPV and IRR concepts; if so, we then checked for an explicit
mention of the reinvestment rate assumption, as it pertains to
these calculations. We had two research assistants helping us
with this project. In order to obtain consistent information on
each textbook, we used a common checklist for screening the
books, shown in Appendix 1. We categorized the findings
into (1) “yes,” the text discusses and uses the reinvestment
assumption for the IRR calculation, (2) “no,” the text
discusses the assumption, but does not use it, and (3) the text
is “silent” about the reinvestment rate assumption. If a book
was silent about the assumption, we made no assumptions as
to why. An author could leave out the assumption because he
does not believe it is necessary or a decision has been made
to exclude it from the book for brevity reasons. Here we
deviate from the approach taken by Keef and Roush (p. 111)
as they “assume that silence on the reinvestment assumption
is an act of commission rather than an act of omission.” They
make the argument that “it is not necessary to deny a false
proposition.” It is our belief that an author could agree with
the assumption, but decide to exclude it from his book and
leave it for discussion in more advanced textbooks. Thus, we
did not make an absolute assumption that silence was an act
of commission or omission.

RESEARCH FINDINGS AND ANALYSIS

We examined a total of 64 textbooks across seven
disciplines, with the breakdown shown in Table 1. Most of
the books (22) are finance books, with roughly half of them
covering financial management and the other half covering
corporate finance. The complete list of books by discipline is
provided in Appendix 2. Capital budgeting topics are most
closely associated with finance courses, but they are by no
means exclusive to business students. For instance, many
engineering students are taught these concepts in their
engineering curriculum. Typically, these courses are taught
by engineering faculty using textbooks written by
engineering professors. For example, one of the well-known
engineering economics professors is Chan S. Park of Auburn
University. He is the author of three textbooks in the area of
engineering economics. Consistent with having engineering
faculty teach and write textbooks on capital budgeting
techniques, the engineering disciplines have a journal titled
The Engineering Economist as an outlet for scholarly
research related to capital budgeting and other finance-related
topics.
Each book in Table 1 presents the IRR methodology and was categorized as “yes” it uses the reinvestment assumption, “no” it does not use it, or “silent” if it says nothing about the assumption. For example, we obtained 12 corporate finance textbooks with copyright dates after 2000. Of those books, 6 state that the IRR calculation utilizes the reinvestment rate assumption; 3 state they do not use it; and 3 are silent regarding the assumption. Earlier, we quoted from Brigham and Houston (2009) to provide an example of what is said in support of using the assumption. To provide an example of an opposing view, below we quote from Ross, Westerfield and Jordan (2008), authors who do not invoke the reinvestment assumption:

We will take a stand on one issue that frequently comes up in this context. The value of a project does not depend on what the firm does with the cash flows generated by that project. A firm might use a project’s cash flows to fund other projects, to pay dividends, or to buy an executive jet. It doesn’t matter: How the cash flows are spent in the future does not affect their value today. As a result there is generally no need to consider reinvestment of interim cash flows.

We also conducted a chi-square test of independence on the Keef-Roush data. We found there to be no dependency on discipline. Thus, this might explain why the earlier authors restricted their analysis to these two disciplines.

### CHI-SQUARE TESTS OF INDEPENDENCE

Based on the data that we collected for this study, one question we had was the following: Is the decision to use the reinvestment assumption dependent on discipline? For example, are the finance authors utilizing the assumption more so than the engineering economists? Simple inspection of the data in Table 1 indicates that the answer is “yes,” the portion of books using the assumption is dependent on discipline, but can we verify that statistically?

#### Chi-square test of independence – Walker-Check-Randall data from Table 1

- **H_0:** discipline and reinvestment assumption are independent
- **H_1:** discipline and reinvestment assumption are not independent

\[ \chi^2_{\text{calculated}} = 22.07, \chi^2_{\text{critical}} = 21.03, \text{i.e., significant at } \alpha = 0.05 \]

We reject the null hypothesis and conclude that there is a statistically significant dependency between academic discipline and treatment of the reinvestment assumption in the data from which Table 1 is a sample.

We also conducted a chi-square test of independence on the Keef-Roush data. We found there to be no dependency on discipline. Thus, this might explain why the earlier authors restricted their analysis to these two disciplines.

#### Chi-square test of independence - Keef and Roush data from Table 2

In Table 2, we report the findings from Keef and Roush’s (2001) paper. They found (p. 111) that 43 out of 60 textbooks, or 72 percent of the books, used the reinvestment assumption. Their research categorized books differently than ours in that they used “yes” when the “text clearly implied that the reinvestment assumption is the cause of the NPV versus IRR conflict.” We simply looked to see if the textbook used the assumption. Typically the authors would state the assumption without providing the motivation for it. Nevertheless, in order to do a more apples-to-apples comparison to the data collected by Keef and Roush, we combined our finance books into one category. Likewise, we changed the heading from “Financial and/or Managerial Accounting” to “Managerial Accounting,” as none of the textbooks we surveyed was strictly a financial accounting textbook. The final change we had to make was to shift the “silent” books into the “no” column, in essence applying the same assumption as Keef and Roush regarding silence. These changes in our data enabled us to put our data into Table 2 using the identical configuration used by Keef and Roush and to ask the question: Are more or less authors utilizing the reinvestment rate assumption now as compared to that found ten years ago? Simple inspection of the data indicates that fewer are using the assumption today, but can this be verified statistically?
H₀: discipline and reinvestment assumption are independent
H₁: discipline and reinvestment assumption are not independent

χ² calculated = 0.40, χ² critical = 2.71, i.e., not significant at α = 0.10

We fail to reject the null hypothesis and conclude that there is no statistically significant dependency between academic discipline and treatment of the reinvestment assumption in the data from which Table 2 is a sample.

DISCUSSION

The impetus behind this area of research is the feedback one of the coauthors of this study received on a research paper submitted to The Engineering Economist in 2007. In the manuscript, the reinvestment assumption was used in the analysis. A reviewer stated that this was “theoretically incorrect” and felt strongly enough about this to recommend the paper be rejected for publication. When we did our literature search, we found that the engineers have already grappled with the validity of the reinvestment assumption and seem to have resolved this issue years ago. In the engineers’ world, this issue is an old one that apparently no longer needs discussion. In a paper published in The Engineering Economist, Lohmann (1988) claims that he has illustrated “the fallacy of the ‘reinvestment rate assumption’ numerically, mathematically, and intuitively.” Not surprisingly, we see that the highest percentage of texts that are either silent or refute the use of the assumption is in the area of engineering economics. In fact, 80 percent of the authors are either silent or say “not needed” to the use of this assumption, while the next closest discipline to take this stance is real estate at 75 percent. Why is there less of a consensus among finance professors? Do the engineers know something we don’t know or vice versa?

In this debate about whether the IRR analysis uses or doesn’t use an implicit reinvestment assumption, the focus is generally on the inconsistency between the NPV and IRR methodology when selecting between two mutually exclusive projects. At a discount rate below the Fisher rate, the NPV will point to one project as being the best, while IRR will point to the other. Prior scholars observe that this inconsistency is a result of two different reinvestment assumptions—NPV assumes reinvestment at the cost of capital, while IRR assumes reinvestment at the IRR. It was not this debate about the proper reinvestment rate assumption that piqued our interest in whether or not the IRR calculation requires the reinvestment rate assumption. Instead, we approach this issue by drawing a parallel to fixed-income investing and the analytics used in that area.

Earlier, in the introduction of our paper, we told a vignette of a professor teaching YTM to his investments class. The YTM calculation on a bond takes into account coupon interest and any capital gain (or loss). Fabozzi (2006) observes that the YTM also “considers the interest-on-interest component, although implicit in this computation is an assumption that the coupon payments can be reinvested at the computed yield to maturity.” Fabozzi observes (p. 140) that if the coupon interest payments are not reinvested at the YTM, “the actual yield realized by an investor will be greater than or less than the yield to maturity.” Note that it is possible to reinvest coupons at a higher or lower yield than the YTM, so the realized yield could actually be higher than the “promised yield” (another term for YTM). We have been unable to uncover any source that refutes the need to make a reinvestment assumption when calculating YTM.

If an investor on the outside of the firm is exposed to a realized bond yield that is potentially higher or lower than the promised yield because of uncertain reinvestment rates on coupon payments, it follows (doesn’t it?) that a corporate manager could be exposed to a realized return on a project that is potentially higher or lower than the IRR because of uncertain reinvestment rates on the project’s cash flow. In Table 3, we show three projects with identical IRRs. If management’s investment criterion is based on IRR, which project is “best” for the corporation? All three projects have identical investments of $5 million, equal lives, but different cash flows. Project 1 has a constant cash flow; project 2 has cash flows that grow at 20 percent per year; and project 3 has a lump sum at the end of the project’s life. Based on IRR, the firm should be indifferent between these three projects. It is conceivable that a firm is indifferent to the cash flow differences. Yet, our analysis finds that project 1 has the greatest reinvestment risk. When we used a 12 percent reinvestment assumption, project 1’s return drops the most, to 16.26 percent. If the IRR calculation does not require an implicit reinvestment assumption, which some scholars argue, then it seems that project analysis might require another return metric to fully assess a project—one that does require a reinvestment rate assumption. In the world of fixed-income investing, the YTM calculation conveniently serves both purposes. Why that isn’t the case with IRR calculations (in the minds of some authors) is a debate for future research.
CONCLUSIONS

So where do we stand ten years later? Keef and Roush (p. 110, 2001) stated that “Our assessment of the literature since 1979 is that there has not been a robust denial of the fallacy of the reinvestment assumption.” Based on our research, we can make the same assertion ten years later. The use of the reinvestment assumption is found online (see Investopedia.com) and it is found in many of the current textbooks being used by faculty at countless colleges and universities. While there has been debate on the validity of the assumption, we believe that future research should attempt to resolve the dispute once and for all. The assumptions are just as important as the calculations themselves, and academics and practitioners need to come to agreement as to “best practices.” Not so long ago, Adler (2006, p. 4) wrote, “The assumptions related to DCF are increasingly becoming so disconnected from business reality that its continued use should come with the following warning, ‘This financial management technique is hazardous to your business.’”

Earlier we identified Bierman and Smidt (1993) as making the distinction between the mathematical calculation of IRR and the usage of IRR. They present a convincing argument for employing the reinvestment assumption when deciding whether or not a project is acceptable. The purpose of teaching IRR is not to teach students the IRR calculation per se. Rather, faculty are presenting IRR as another capital budgeting tool to be used by corporate managers. If a professor subscribes to Bierman and Smidt’s argument, then he should utilize a textbook that explains the importance of the reinvestment assumption. It follows, then, that textbooks should also discuss the concept of reinvestment risk in the context of capital budgeting and project analysis. Our research found that most finance textbooks do discuss reinvestment along with IRR, but that most engineering economics textbooks do not. Perhaps the engineering professors should send their students to the college of business when it comes time to teach their students capital budgeting.

Many different disciplines teach IRR and NPV concepts, including management accounting and managerial economics. They aren’t just taught in finance courses. Our research found that there is still significant inconsistency between books when it comes to using the reinvestment rate assumption. Moreover, there is lack of consistency across disciplines. Finance books fall at one end of the continuum with 64 percent using the assumption while the engineering economics books fall at the other end with just 20 percent using the assumption. Why can’t all the disciplines come to an agreement? Elementary school teachers all agree that 2 + 2 = 4, so why can’t professors agree that IRR does or does not involve the implicit assumption that all interim cash flows can be reinvested at the IRR? We can understand ongoing debate and controversy over more advanced theories and calculations, such as the capital asset pricing model, but IRR calculations are too basic and ubiquitous for this degree of inconsistency. In Appendix 3 we discuss a “capital budgeting paradigm” that provides a starting point for building a consensus.

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### APPENDIX 1

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<th>Textbook Author(s)</th>
<th>Textbook Publisher/Location</th>
<th>Textbook Edition</th>
<th>Copyright Year</th>
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</tr>
</tbody>
</table>

#### Financial Management/Managerial Finance


Do the books use the reinvestment assumption? (8 Yes; 0 No; 2 Silent; 10 Total)

### APPENDIX 2

#### A. Financial Management/Managerial Finance


Do the books use the reinvestment assumption? (6 Yes; 3 No; 3 Silent; 12 Total)

#### C. Capital Budgeting

Do the books use the reinvestment assumption? (3 Yes; 1 No; 2 Silent; 6 Total)

D. Financial and/or Managerial Accounting


Do the books use the reinvestment assumption? (5 Yes; 0 No; 4 Silent; 9 Total)

E. Engineering Economics


Do the books use the reinvestment assumption? (3 Yes; 5 No; 7 Silent; 15 Total)

F. Managerial Economics

... implicit. We observe that the two sides of the issue, in our main purpose they are presented in this Appendix. Since our conclusions are peripheral to our main purpose they are presented in this Appendix. Dante Alighieri wrote “The hottest places in Heaven are reserved for those who in times of great moral crises maintain their neutrality.” Perhaps there is a special place in Heaven reserved for those who observe controversy and provide consensus. Since our conclusions are peripheral to our main purpose they are presented in this Appendix. The lists of authors on both sides of this issue are long and impressive. We observe that the two sides of the issue, in many ways, are talking past one another, i.e., not arguing consistent circumstances. There are ex-ante and ex-post, implicit and explicit, and internal and external interpretations given to the reinvestment assumption. Even authors who argue vehemently against any reinvestment assumption will discuss how invested funds “grow” at this rate or that. We are greatly swayed by the following example. Suppose a municipality is planning to finance the construction of a toll bridge by selling a municipal bond. The bridge will require an initial investment of $1000, will produce net cash inflows of $60 per year for five years, and will be sold after five years for $1000. The municipal bond will have a $1000 par value, a five-year maturity, pay 6 percent annual coupons annually, and be sold at par value. The time line for the municipality to use in evaluating the financial impact of the bridge is:

```
0 1 2 3 4 5
($1000) $60 $60 $60 $60 $1060
```

The time line for an investor considering the purchase of the municipal bond is:

```
0 1 2 3 4 5
($1000) $60 $60 $60 $60 $1060
```

Clearly the internal rate of return (IRR) of the bridge is 6 percent. When the investor calculates ex-ante the expected yield to maturity (YTM) on the municipal bond he/she will implicitly assume that the intermediate cash flows will be reinvested at the yield to maturity, and the calculated yield to maturity is 6 percent. If the municipality and the investor are using the same calculator, the key strokes used to calculate the IRR and the YTM are identical. If we were to calculate the modified internal rate of return (MIRR) of the project we would explicitly use a reinvestment rate of 6 percent and again using similar key strokes on our calculator find that the MIRR = IRR = YTM = 6 percent.

While few would argue against the reinvestment assumption being implicit in the YTM calculation and no one could argue that there wasn’t an explicit reinvestment rate used to calculate the MIRR, many would argue there is no reinvestment assumption in the IRR calculation. Therefore, we suggest the following definition of capital budgeting and a framework for internalizing all intermediate cash flow circumstances.

Capital budgeting is a process which examines the effect of a financial transaction on the transactor’s wealth when the...
transaction’s cash flows are sufficiently distributed in time as
to be affected by the time value of money. Depending on the
method used, the effect on wealth may be expressed as a
dollar change, a rate of return on investment, or merely as an
increase or decrease in wealth.

Capital budgeting can be applied *ex-ante* to proposed projects
as a decision methodology on whether the projects should be
undertaken, or *ex-post* to projects already concluded to
calculate the effect on wealth. Depending on the method used, the
wealth effect may be expressed as a dollar change, a rate of return on
investment, or merely as an increase or decrease in wealth.

When capital budgeting is applied *ex-ante* it relies on
numerous assumptions regarding future events and
conditions. For a corporation* examining a capital project,
some of those assumptions are the:

- amount and timing of the initial investment;
- amounts and timing of any changes in revenue;
- amounts and timing of any changes in explicit costs;
- amounts and timing of any changes in depreciation expense;
- applicable tax rate(s);
- lifetime of the project;
- after-tax cash flow from the disposal of assets at the end
  of the project;
- change in net working capital at the end of the project;
- effect the project has on the riskiness of the firm;
- amount of uncertainty in all of the above; and
- intended disposition of cash inflows during the project.

Regarding the disposition of cash inflows during the project:

1. If the corporation knew the intended disposition of cash
   inflows occurring during the project, then the cash flows
   resulting from that intended use should be included in
   the capital budgeting process.

2. If the corporation knew that cash inflows occurring
   during the project were to be left idle, then all cash
   inflows should be assumed to occur at the end of the
   project when they become available for other use.

3. If the corporation knew that cash inflows occurring
   during the project were to be discarded (thrown away)
   when they occurred, then the analysis should include an
equal and concurrent cash outflow and the rate of return
on such a project would always be −100%.5

4. If no specific knowledge exists regarding the disposition
   of cash inflows occurring during the project, then the
capital budgeting process must include some
assumption, explicit or implicit, regarding that disposition.

For example, assume a corporation is examining a project
with cash flows that just happen to be the same as the
municipality in our earlier example.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tr>
<td>$1000</td>
<td>$60</td>
<td>$60</td>
<td>$60</td>
<td>$60</td>
<td>$1060</td>
</tr>
</tbody>
</table>

The corporation plans to discard cash flows 1 and 2, allow
cash flow 3 to lie idle until the end of the project, and to
reinvest cash flow 4 at 20 percent. Then, the future value of
the inflows would be:

\[ FV_5 = (S60 - S60) + (S60 - S60) + S60(1+.00)^2 \]
\[ + S60(1+.20)^1 + S1060 \]
\[ = 1192 \]

and the project’s IRR would be 3.58%.

If instead of planning to discard cash flow 1 the corporation
made no explicit assumption about how cash flow 1 would be
employed, then the mathematics used to calculate the
project’s IRR would implicitly assume reinvestment at the
IRR. Thus, the future value of the inflows would be:

\[ FV_5 = S60(1 + IRR)^4 + (S60 - S60) + S60(1+.00)^2 \]
\[ + S60(1+.20)^1 + S1060 \]  \hspace{1cm} (2)
\[ FV_5 = 1192 + S60(1 + IRR)^4 \]

and the project’s IRR would be 4.80%.
REFERENCES


ABSTRACT

This study examines the decline in the economic power of faculty labor unions in public higher education in the United States in recent years. By analyzing collective bargaining agreements between the Association of Pennsylvania State College and University Faculties and the Pennsylvania State System of Higher Education, the authors construct bargaining indices. Applying an historical perspective approach this study offers evidence of and explanations for this decline. Evidence of the reduction in this bargaining power include: the bargained reduction of non monetary benefits; and the failure to limit the increase in employment of part-time and adjunct faculty through the bargaining process. The authors argue that private sector labor unions in the U.S. had similar experiences decades earlier, and this relatively low level of bargaining power remains today.

INTRODUCTION

In the early days of the labor movement in the United States there was no legislation to deal explicitly with the issue of workers’ rights to form labor unions and to collectively bargain with their employer. In the absence of such legislation, the Courts generally ruled in favor of business when disputes between business and labor arose. For example, the Cordwainers Case in 1806 and Commonwealth of Massachusetts v Hunt in 1842 each applied the Conspiracy Doctrine to rule that workers’ joining together for their own benefit was harmful to society. As a result, union membership was about six percent of the labor force before 1930 (Myer, 19; U.S. BLS, 28).

While the Railway Labor Act of 1927 was the first federal law to cover the collective bargaining process, it was not until the Great Depression of the 1930s that labor unions gained political power across industries nationwide. This power resulted in legislation to cover all workers in the private sector. Notably, the Norris-LaGuardia Act was passed in 1932 and the Wagner Act was passed in 1935. In large part, this legislation led to an increase in union density from six percent of the labor force in 1932 to about twenty-four percent by the mid-1950s.

In the years of the American labor movement after the passage of this pro-labor legislation, labor unions often developed from the grassroots; John L. Lewis in the coal industry, Walter Reuther in the auto industry, I.W. Abel in steel, and Jimmy Hoffa in transportation are examples of individuals who organized workers in the occupations from which these organizers came. During this period many workers from these occupations enthusiastically joined labor unions. In the post-1935 period, labor unions usually formed in industries where firms had monopoly power in the product market and/or where employers often had monopsony power when they hired workers. In the days immediately following the passage of pro-labor legislation, workers sought unions to join. Today, labor union organizers more often seek workers. This change, along with many other changes in society, means that contemporary labor leaders have incentives that differ from their predecessors. For example, in the early years of the labor movement labor unions were interested in increasing wages and benefits for their members as well as improving conditions in the workplace; today union leaders – while they still have the incentive to increase wages and benefits for their members - may seek to organize workers because of the “profitable potential” of bringing new workers into their organizations.

Traditional models usually treat a labor union as a family that is attempting to maximize income. In a departure from this approach, Smith (26) models the labor union as a “firm” attempting to maximize net revenue. In this model, the process of organizing workers is treated as production, which is subject to the law of diminishing returns, and consequently the law of increasing costs. Dues of the members represent revenue to the firm. Equilibrium in this model is established by the firm (entrepreneur or union leader) equating marginal cost of organizing with union dues paid per member – marginal revenue.

Data are reported here which suggest that labor unions in public higher education in the United States have lost bargaining power in recent decades. Is this apparent reduction in bargaining power due to behavior of the faculty labor unions, strategies of management (AFL-CIO,1), market conditions, or a combination of these factors?
This paper will offer explanations for the difficulty faculty labor unions in public higher education face today in securing increased salary and benefits and, in some cases, maintaining salary and benefit levels for their members. The explanations offered here are in addition to the traditional explanations given for the difficulty public sector labor unions face; for example, public sector unions bargain with the executive branch, while the legislative branch must provide the funding for the benefits negotiated by the executive branch (Davey, 5).

Union density reached its peak in the United States economy in the mid-1950s, when it was about 34% of the non-agricultural labor force (Meyer, 19; U.S.BLS, 28). This level was achieved to a large extent by organizing workers in industries that were highly concentrated, such as auto and steel. Also, labor unions located in industries where there was a high degree of monopsony power, such as textiles and mining. Soon after this period, market conditions and management strategies slowly began to reduce this level of union density and the relatively high level of bargaining power for labor unions that was associated with it.

Several factors have come into play in the past fifty years that have weakened private sector union strength. In the decades immediately following World War II the Japanese, Asian and European economies began to compete with the U.S. economy with increased intensity. By the 1960s, workers in Detroit, Indiana, and Pennsylvania were competing with workers in Munich, Japan, and South Korea. This move toward globalization contributed to declines in union density and union bargaining power for organized workers in the private sector in the United States. Also, in the 1960s and afterwards, management began taking advantage of improved technologies to substitute capital for labor in industries that were highly unionized in the private sector, primarily manufacturing. Management later found that outsourcing reduced labor costs as well as reducing labor union bargaining power in the economy. Employing part-time and temporary workers in large numbers is a more recent tool used by management to improve its position in labor markets. On November 19, 2005 the New York Times (Hakim, 10) reported that the United Automobile Workers in the United States had lost its once influential role in American society.²

This paper will offer several specific explanations for the decline in bargaining power among faculty labor unions in public higher education. However, we first will examine some empirical evidence and use, as an example, collective bargaining agreements from Pennsylvania between the Association of Pennsylvania State College and University Faculties (APSCUF) and the Pennsylvania State System of Higher Education (PaSSHE). APSCUF was established in 1971.

EVIDENCE OF THE DECLINE IN BARGAINING POWER

Economists have long recognized the importance of cost/benefit analysis in the collective bargaining process between labor unions and management (Pigou, 22; Hicks, 13; Chamberlain, 6). We recognize the importance of this approach in developing our bargaining indices below.

Historically, labor unions have tried to secure relatively high wages and salaries for their members. Because part-time temporary workers are generally paid lower wage and salary rates than established full-time workers, union leaders are averse to management employing part-timers, especially when these workers are substitutes for the established full-time workers. In the aggregate, we can see from Table 1 that the employment of part-time faculty in higher education in the United States has been on the rise in recent decades and for the academic year 2009-2010, Table 2 shows a high level of non-tenure track faculty employed at public universities in the United States. In addition to competing with lower paid colleagues for salaries, full-time tenure track faculty may object to the employment of these part-time colleagues because the quality of education offered by the college or university will likely be reduced (Jaeger; Eagen, 14).³

By reviewing recent collective bargaining agreements between APSCUF and PaSSHE, we see that the ceiling on part-time faculty has been increasing. In the early days of these contracts no ceilings were established with regard to part-time temporary faculty (3, 4).

The first language to address this issue can be found in the contract that was in effect from July 1, 1990 to June 30, 1993. In each year of this contract, management agrees to employ 5% fewer part-time temporary faculty in the current year than were hired in the previous year. The contract that was in effect from July 1, 1993 to June 30, 1996 is the first time the administration and the union agreed to set a ceiling on the employment of part-time temporary faculty; the ceiling was set at 7% of all faculty, and head count was used as the measure. The ceiling of 7% was maintained in subsequent contracts through June 30, 2007.

The contract that is currently in effect until June 30, 2011 represents a major concession by APSCUF on this issue. This ceiling has now been raised to 25%, and the measure is full-time equivalent (FTE) faculty instead of head count. In addition, there is a clause in the contract that is open-ended with regard to this ceiling so long as the local APSCUF agrees. See Table 3 for a summary of these ceilings on part-time faculty.

Typically, labor unions are interested in maintaining or increasing a wage differential between some base wage, and the union wage. For example, many labor economists
maintain that labor unions support the minimum wage and increases in it because these wage floors will give labor unions rationale for increasing their own wages. We apply this thinking to this current topic by considering the average yearly income for workers in the private nonagricultural industries as the base income level for comparison by the ABSCUF labor union.\(^4\) In Table 3 we report these incomes along with the yearly incomes for the highest step full professor in the pay scale. The yearly private sector incomes were calculated from government tables, which report average weekly income.

From Table 3, we see the Bargaining Index (BI) for APSCUF is the ratio of the annual salary paid to a full professor at the highest step \((Y^*)\) to the average annual income for private nonagricultural industries \((Y)\). Take note that each salary is expressed in money terms. The results in Table 3 illustrate an increase in this index over time, indicating \(P\) – according to the index – an increase in bargaining power from 1972 to 2009. In more recent times -1999 to 2009 – this index showed a slight decrease.

Because there is much concern within the labor movement in the United States about part-time temporary workers,\(^5\) we develop a Composite Bargaining Index (CBI) that includes the costs – from the union perspective – of employing these workers. The CBI takes the following form:

\[
CBI = BI \times (1 - P)
\]

Where \(P\) = proportion of part-time faculty permitted in the contract. This proportion is a ceiling. Theoretically, it has the following range:

\[0 \leq P \leq 1\]

The value of \(P\) is obtained from the contract.

Under the current collective bargaining agreement between APSCUF and PaSSHE – July 1, 2007 to June 30, 2011 - this proportion \(P\) is equal to .25. In the early days of the collective bargaining agreement – prior to July 1, 1993 - \(P\) was effectively equal to zero.\(^6\) From the period July 1, 1993 to June 30, 2007 this proportion \(P\) was equal to .07.

The CBI as it is defined in this study is similar in application to the “expected wage” that we find in the labor migration literature and in the field of economic development (Harris-Todaro, 11). In the Harris-Todaro model, the potential migrant will discount the observed wage in the market based on the unemployment rate. Regarding the current analysis, we must discount any measure of labor union bargaining power when the faculty labor union agrees to have a portion of part-time faculty employed by management.

Table 3 presents comparative data for the 1972 to 2009 period. From this table we see that – according to the CBI – there is a decline in the bargaining power of APSCUF over this period. From 1999 to 2009 the decline is much more pronounced. It is noted here that this study is concerned with the change in bargaining power over time. A cross-sectional analysis of bargaining power at one point in time may call for a different selection for the base income.

**EXPLANATIONS FOR THE DECLINE IN BARGAINING POWER**

We now offer some explanations for the decline in bargaining power as measured by these bargaining indices discussed above. First, the decline in union density and union bargaining power in general has contributed to a similar decline in faculty labor union bargaining power. Government has been intervening more and more in areas where labor unions once found it necessary to take an active role. These areas include safety on the job, pay schedules for overtime work, and mandatory minimum wage pay. The Fair Labor Standards Act (1938) and the federal Occupational Safety and Health Act (1970) are examples of government taking roles away from labor unions. The recently passed health care legislation in the United States may result in diminished influence of labor unions nationwide because labor unions historically have bargain for health benefits for their members. Second, attitudes of the population is likely to be a contributing factor causing the decline in labor union bargaining power in general and public sector bargaining power in particular. Studies by Ashenfelter-Pencavel, (2), Smith, (26), and Lumsden-Petersen, (17) have found evidence that attitudes of the general population influence union density in the United States economy. These studies have concluded that public attitudes can have strong influences over the outcome of labor union negotiations with management.

While general trends in society and in politics can explain a portion of the decline in bargaining power of faculty labor unions in the U. S. in recent years, we believe that the dismantling of a structured master plan for public higher education in the various states has contributed significantly to the reduction in bargaining power for these unions.

Today in public higher education in the United States – particularly in community colleges and middle-tier four-year-degree granting institutions – we see similar conditions that existed earlier in the private sector. Competition between and among different tiers of public higher education is occurring today where in a previous period the reins on mission differentiation were held more tightly. While industrial unions in the 1960s and 1970s first saw competition from the international sector, faculty labor unions in public higher education today see competition because of the lack of a well-defined master plan.\(^7\)
For the past five decades a large portion of public higher education in the United States has been characterized by the three-tier system developed by Clark Kerr in California in the 1950s and 1960s. Kerr’s ideas were put into place by the California Master Plan for Higher Education in 1960 (30). This model was characterized by mission differentiation in each of three tiers. These three tiers were: community colleges offering associate degrees; mid-level universities offering undergraduate education; and research universities offering Ph. D. programs. The central purpose of this model was to provide the opportunity for some form of higher education for anyone who graduated from a high school in California. This model allowed children of parents who were not college graduates to have higher college participation rates than this group previously attained. Also, this model established public universities in California that competed with the most prestigious private universities in the nation. In its obituary of Clark Kerr, the New York Times (12) referred to his model as “an ingenious mixture of elitism and populism.”

Without intention, the three-tier structure of public higher education had characteristics favorable to the location of faculty labor unions. Essentially, the California model is a regulated monopolistically competitive market for public higher education that reduces labor competition. Increased labor competition, however, can reduce this effect and have the same result for members of a faculty labor union as it had for unionized industrial workers employed in the private sector as discussed earlier.

Faculty labor unions in public higher education face increased competition from the non-unionized faculties at private colleges and universities that compete with the public institutions represented by these unions. Also, the increase in “intra-tier competition” and “inter-tier competition” in public higher education in the United States has moved it away from the traditional three-tier structure. In the decades that followed the 1960s, administrators in public higher education in the United States failed to hold the reins on mission differentiation as Kerr had advised. This mission creep led to a proliferation of multi-level academic program offerings at many public higher education institutions, which is now the norm rather than the exception. Today we find community colleges offering four-year programs, traditional undergraduate institutions offering associate degree programs in competition with community colleges, and graduate research universities establishing branch campuses that offer two and four-year degree programs in direct competition with community colleges and traditional four-year institutions.8

This proliferation of the diversification of mission of these institutions has increased competition among these institutions. Faculty bargaining power at the traditional four-year institution – where many of the faculty labor unions are located - is eroded by this competition. In contrast to this situation, consider public sector police and fire departments. No similar competition exists and a type of monopoly results in the supply of labor services by unions to police and fire departments. Consequently the unions representing these public service workers may have lost bargaining power for other reasons discussed in this paper but they have faced no erosion of bargaining power because of increased competition from other workers. While competition from the international sector weakened industrial labor unions earlier, the dismantling of the Kerr model has had a similar effect on faculty labor unions in public higher education today.

In the United States in recent years more capital-for-labor substitution has occurred in higher education similar to the capital-for-labor substitution in the manufacturing sector in the past several decades. “Distance” education, such as World-Wide-Web-based courses, interactive television courses, and significantly increased class sizes facilitated by large high-technology classrooms are all examples of this trend toward increased capital intensity. The impact of this increased capital utilization on union strength in higher education is the same as the impact in the industrial sector in prior decades. Each has resulted in reduced employment and increased productivity, that is, fewer workers with higher earnings.

The equivalent of service sector outsourcing to reduce labor costs that has occurred in recent years is also occurring in higher education. Articulation agreements between four-year degree granting universities, and community colleges results in some “production” being outsourced to low-cost labor in the community colleges because students can take credits with guaranteed transferability to four-year programs from community colleges. The impact of this form of outsourcing on faculty union bargaining strength is similar to the impact of outsourcing on private sector union strength discussed above. This type of outsourcing has occurred in other public sector settings as well. Private non-union companies competing for contracts to provide social services, prison guards, and janitorial services to state and local governmental units are examples.

SUMMARY AND CONCLUSIONS

In summary, this paper proposes two possible measures of public-sector union bargaining power and provides evidence of a decline in bargaining power for organized faculty in Pennsylvania. An explanation of the existence of this decline in spite of stable union density is offered with several possible causes each with a direct corollary to a contributing factor in the decline in industrial union bargaining power in the United States. First, the increased competition faculty labor unions are now experiencing from the dismantling of the California three-tier model espoused by Clark Kerr is similar to the increased competition U.S. manufacturing

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faced from the international sector. Second, the increased use of capital intensive teaching techniques including distance education and web-based courses, and increased class sizes facilitated by large high-technology classrooms is similar to capital-for-labor substitution in the manufacturing sector. Third, outsourcing has occurred in both manufacturing and in public higher education. Outsourcing work to non-union companies in the private sector is similar to the effect of articulation agreements in higher education that outsource work to lower-cost educational institutions. Lastly, the increased use of part-time and temporary employees, common in both manufacturing and public higher education, has moved work from regular union members to lower-cost workers enjoying weaker benefits and job security and has weakened bargaining power of unions in both areas.

While public sector unions have fared far better than their private sector counterparts due primarily to the maintenance of union density, the loss in bargaining power of unions has, none-the-less been widespread and universal and this trend is not likely to be reversed in the near future. It is more likely that the competition faced by public sector unions will increase in the future as governments attempt to control costs and balance budgets.

It is more likely that capitalization and use of labor-saving technologies will increase in the near future. Just as larger class sizes facilitated by enhanced use of technologies is the most likely scenario for higher education, new technologies are just as likely to reduce the demand for highway toll-takers. Increased use of technology and capital-intensive production techniques cut both ways, however. Weakened union bargaining power overall and fewer union workers is often accompanied by increased earnings due to the increased productivity resulting from the use of capital and technology intensive production techniques.

Outsourcing may or may not continue to grow in the future. Private companies can often compete for outsourced public sector jobs because of lower labor cost due to a lower level of benefits offered their employees, particularly health care coverage. The recent passage of universal health care in the United States may actually mitigate the practice of outsourcing, at least at the domestic level in the public sector. Outsourcing services overseas is usually not a viable option with public sector service jobs as it often is with private sector service jobs.
### Table 1
The Shifting Face of College Faculty

<table>
<thead>
<tr>
<th>Year</th>
<th>Tenured</th>
<th>Tenure-Track</th>
<th>Non-Tenure Track</th>
<th>Part-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>36.30%</td>
<td>20.30%</td>
<td>13%</td>
<td>30.20%</td>
</tr>
<tr>
<td>1989</td>
<td>33.10%</td>
<td>13.70%</td>
<td>16.90%</td>
<td>36.40%</td>
</tr>
<tr>
<td>2005</td>
<td>21.80%</td>
<td>10.10%</td>
<td>20.10%</td>
<td>48.00%</td>
</tr>
</tbody>
</table>

The percentage of part-time faculty has steadily increased in the past three decades, while the percentages of full-time tenured faculty and full-time tenured track faculty have declined. Above data are for all U.S. degree-granting institutions.


### Table 2
2009-2010
Public Universities – U.S.

<table>
<thead>
<tr>
<th>Academic Rank</th>
<th>Non-Tenure Track</th>
<th>Tenure Track</th>
<th>Tenured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>4.0%</td>
<td>0.8%</td>
<td>95.1%</td>
</tr>
<tr>
<td>Associate</td>
<td>6.6</td>
<td>7.0</td>
<td>86.5</td>
</tr>
<tr>
<td>Assistant</td>
<td>17.3</td>
<td>75.6</td>
<td>7.1</td>
</tr>
<tr>
<td>Instructor</td>
<td>87.8</td>
<td>10.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Lecturer</td>
<td>95.3</td>
<td>2.5</td>
<td>2.3</td>
</tr>
<tr>
<td>No Rank</td>
<td>89.9</td>
<td>2.4</td>
<td>7.6</td>
</tr>
<tr>
<td>All Combined</td>
<td>23.1</td>
<td>22.7</td>
<td>54.2</td>
</tr>
</tbody>
</table>

Source: American Association of University Professors (23)
### Table 3
Bargaining Indices – for APSCUF

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Income$^{1} - Y$</th>
<th>Annual Salary$^{2} - Y^*$</th>
<th>Bargaining Index$^{3}$</th>
<th>P</th>
<th>Composite Bargaining Index$^{4}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>$7,483.32</td>
<td>$21,240.00</td>
<td>2.84</td>
<td>0</td>
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<tr>
<td>1973</td>
<td>$7,944.04</td>
<td>$23,420.00</td>
<td>2.95</td>
<td>0</td>
<td>2.95</td>
</tr>
<tr>
<td>1981</td>
<td>$13,618.28</td>
<td>$33,820.20</td>
<td>2.48</td>
<td>0</td>
<td>2.48</td>
</tr>
<tr>
<td>1982</td>
<td>$14,200.68</td>
<td>$35,849.40</td>
<td>2.52</td>
<td>0</td>
<td>2.52</td>
</tr>
<tr>
<td>1983</td>
<td>$14,881.36</td>
<td>$35,849.40</td>
<td>2.41</td>
<td>0</td>
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<tr>
<td>1984</td>
<td>$15,496.00</td>
<td>$36,566.40*</td>
<td>2.36</td>
<td>0</td>
<td>2.36</td>
</tr>
<tr>
<td>1990</td>
<td>$18,187.00</td>
<td>$55,997.00</td>
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Definitions:
BI = Bargaining Index – see footnote 3 below
CBI = Composite Bargaining Index – see footnote 4 below

Notes: The CBI as defined here is similar in use to the “expected wage” that we find in the labor migration literature and in the field of development economics. Regarding the labor migration model, the potential migrant will discount the wage in the market based on the unemployment rate. Regarding the current analysis, we must discount any measure of bargaining power by the fact that a faculty labor union is allowing a portion of part-time faculty to be employed by management.
1 – Private nonagricultural industries in U.S.– Current $.
2 – Annual Salary for Highest step for Full Professor – beginning in August. *Beginning January
3 - BI = Y*/Y
4 - CBI = BI x (1 – P), where P = proportion of part-time temporary faculty permitted by contract.
REFERENCES


20. The Penn State University – Web Page


27. U.S. Bureau of Census


29. U.S. Department of Education


1. In a *New York Times* article - William Serrin (24) points out that union leaders targeted public employees in Columbus, Ohio for organization because these workers represented “profitable potential.”

2. Prodded by its once-powerful and socially conscious union, the auto industry served as a 20th-century trailblazer in spreading prosperity to millions of workers and their families and fostering middle-class security through higher wages and company-sponsored benefits. But as Detroit has lost its control of the American market to strong and nimble foreign competitors, the model of a “social contract” that auto makers and the United Automobile Workers created has begun to unravel (10).

3. The authors of this study have shown that students’ exposure to part-time faculty significantly reduces the likelihood of these students completing the associate degree.

4. While there could easily be debate as to which labor market to use as the base, with union density in the private sector holding at a very low level - about 8% according to the BLS - this selection seems reasonable. Ideally, we want to select the best proxy for a market equilibrium wage and then convert it to annual income.

5. The Association of Pennsylvania State College and University Faculties has characteristics of both an industrial union and a craft union. Similar to an industrial union, it prefers more members to less; also, APSCUF is interested in expanding the size of the bargaining unit. Similar to a craft union, it prefers to have members who are highly skilled and highly qualified. A highly-skilled membership generally results in higher pay, because of the limited availability of substitute workers.

6. We make this point, because APSCUF did not bargain for a ceiling on part-time faculty in the early contracts.

7. The state of Ohio recently adopted a master plan for public higher education, with the intent of reducing this competition. The Executive Summary of the Strategic Plan reads as follows - The University System of Ohio will end the counter-productive competition among institutions for scarce resources. The historic strengths and traditions of our individual universities will be drawn upon to create distinctive missions for each, leading to the establishment of nationally and internationally-recognized Centers of Excellence that will be drivers of both the regional and state economies and that will complement the comprehensive, quality education available at each institution. Each institution will delineate these Centers of Excellence, together with specific goals and measurements by which the goals can be evaluated (31).

8. In Pennsylvania, the Pennsylvania State University has 25 branch campuses outside its main campus in University Park. Nineteen of these campuses offer four year degree programs, while the erstwhile mission of these campuses was to serve as feeder campuses to the main campus. These nineteen campuses are in direct competition with the Pennsylvania State System of Higher Education. Five of the six remaining Penn State branch campuses are either professional or graduate schools. The sixth is a community-technical college – Pennsylvania College of Technology, in Williamsport – which offers both associate degrees and bachelor degrees (20).

A similar situation has evolved in the Wisconsin system. According to Dr. Petro Roter, Vice Chancellor for Student Affairs at the University of Wisconsin – Oshkosh, some traditional four-year degree campuses in the University of Wisconsin system are now offering Ph.D. programs, and community colleges in this system are now offering baccalaureate degrees.
CURRENT ACCOUNT SUSTAINABILITY IN AFRICAN ECONOMIC COMMUNITIES: ARE THERE REGIONAL DIFFERENCES?

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ABSTRACT

This paper examines current account sustainability of countries three economic communities in Africa, Eastern African Community (EAC), Economic Community of Central African States (ECCAS) and South African Development Community (SADC). Through these economic communities, the inter-regional and intra-regional challenges and opportunities are examined. Using the intertemporal solvency framework of Hakkio and Rush (1991) and Husted (1992), cointegration methodology and dynamic OLS; the relation between exports and imports of the current account is estimated. Of our sample only Botswana (SADC) has a sustainable current account position. About half of our sample countries including Uganda (EAC), Central African Republic, Congo and Rwanda (ECCAS), and Lesotho, South Africa and Zambia (SADC) have a statistically significant but weak relation between exports and imports. The rest including Kenya (EAC), Cameroon, Chad and Gabon (ECCAS), and Malawi and Swaziland (SADC) have unsustainable current account deficits.

INTRODUCTION

Sub-Saharan Africa (hereafter SSA) has achieved some gains in promoting growth and accomplishing economic stability over the past two decades. However, much more progress is necessary. Table 1 displays some selected indicators of SSA. SSA recorded several years of robust economic expansion with an annual average growth rate nearly 7% between 2005 and 2007. SSA slowed down considerably from 2008 onwards because of the global economic recession. As expected, oil exporter countries of SSA outperform the oil importers in growth; however, inflation is a bigger concern for oil exporting countries compared to oil importing countries. More importantly, SSA as a whole has current account deficits from 2005 to 2010 except in 2006. SSA’s oil importers observe negative current accounts over the period except in 2006, while oil exporters have current account surpluses in all years but 2009 and 2010.

Our paper analyzes current account imbalances in SSA countries. High and growing current account deficits are a concern because of the accumulation of foreign debt requiring future payment by the government to service and repay the debt. We focus on the sustainability of the current account imbalances for different regional communities in SSA namely, East African Community (EAC), Economic Community of Central African States (ECCAS), and Southern African Development Community (SADC).

We employ the intertemporal solvency model of Hakkio and Rush (1991) and Husted (1992) to test for current account sustainability. The theory examines the relation between exports and imports. If the latter contributes to a country’s export base, current account deficits are sustainable. This theoretical approach has been used to study developed and developing countries by several authors including Husted (1992), Leachman and Thorpe (1998), Arize (2002), Baharumshah, Lau and Fountas (2003), Irandoust and Ericsson (2004), Narayan and Narayan (2005), Oğuş Binatlı and Sohrabji (2008), Sohrabji (2010), and Sissoko and Sohrabji (2010). We extend this literature by analyzing the current account sustainability of countries from different communities in Africa (EAC, ECCAS and SADC). While Sissoko and Sohrabji (2010) analyze current account sustainability of the Economic Community of Western African States (ECOWAS), our paper is the first (to the best of our knowledge) that examines current account sustainability for countries in these African economic communities. Through our work, we analyze individual and joint vulnerabilities of these countries and compare our results to those found for ECOWAS.

The paper is organized as follows: the next section provides background information, which is followed by the theoretical and empirical methodology used to examine current account sustainability in countries in different African economic communities. Section 4 describes the data and preliminary results. Following that, the inter-regional and intra-regional current account challenges and opportunities are examined, and the last section concludes.
BACKGROUND

There are eight regional blocs or regional economic communities in Africa that constitute the pillars of the African Economic Community (AEC). The EAC, ECCAS and SADC are among the pillars of AEC. The EAC consisting of Burundi, Kenya, Rwanda, Tanzania and Uganda, was founded in 1967, but collapsed in 1977 and was officially revived in 2000. Currently, the members of EAC are Kenya, Tanzania and Uganda. EAC aims at achieving the promotion of sustainable growth and equitable development of the region, including rational utilization of the region’s natural resources and protection of the environment, and the promotion of good governance, including adherence to the principle of democracy, rule of law, accountability, transparency and social justice.

The ECCAS was created in 1983 and currently includes Angola, Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo (DRC – former Zaire), Equatorial Guinea, Gabon, Rwanda, and Sao Tomé and Principe. ECCAS aims to achieve collective autonomy, raise the standard of living of its populations, and maintain economic stability through harmonious cooperation.

The SADC was established in 1980 with the member countries of Angola (left SADC in 1999 to join ECCAS), Botswana, DRC (left ECCAS in 1997 to join SADC), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland, Tanzania, Zambia and Zimbabwe. The SADC aims to achieve development and economic growth, alleviate poverty, enhance the standard and quality of life of the people of Southern Africa, and support the socially disadvantaged through regional integration.

Table 2 shows a comparison of some of the selective poverty and social indicators among the three regional blocs covered in this study. On average, SADC has a higher GNI per capita and a lower population growth rate in 2003 than EAC, ECCAS and Sub-Saharan Africa. Table 3 displays the economic structure of EAC, ECCAS and SADC in the 1983-2003 period. The contribution of the agricultural sector to GDP is much more important for EAC with more than 40% in 1983, and 1993 and more than 25% for ECCAS for the 1983-2003 period. The main economic activity in SADC focuses on services followed by the industrial sector contributing over 50% and 30%, respectively, to GDP.

Table 4 shows the key economic ratios and long-term trends of EAC, ECCAS and SADC from 1983 to 2003. The ratio of Gross Domestic Investment to GDP seems to favor SADC over EAC and ECCAS for the 1983-1993 period, although that ratio is higher for ECCAS in 2002 and 2003. SADC also outperforms EAC and ECCAS with lower total debt service to GDP and lower debt service to exports from 1983 to 2003. The total debt service to GDP ratio is over 100% for EAC in 1983 and 1993, and over 100% and 90% for ECCAS in 2002 and 2003, respectively. The interest payments to GDP ratio favor SADC over EAC and ECCAS. The current account balances to GDP ratios are all negative for the three economic communities with the lowest balances observed in SADC. Given this background, we now turn to the theoretical and econometric methods that are used in analyzing current account sustainability of the countries in these economic communities.

CURRENT ACCOUNT SUSTAINABILITY: THEORY AND ECONOMETRIC METHODOLOGY

Hakkio and Rush (1991) and Husted (1992) provide the basis for examining current account sustainability. The theoretical model assumes that the amount that a small open economy borrows or lends in international markets equals the present value of the future trade surpluses. If the country is intertemporally solvent then future surpluses will repay currently incurred deficits. This requires that the debits on the current account lead to an increase in exports over the long run. Thus, the estimated econometric model is given as

\[ EX_t = \alpha + \beta IMM_t + \epsilon_t \] (1)

where \( EX_t \) are exports of goods and services and \( IMM_t \) refers to imports of goods and services, net unilateral transfer payments and net investment income payments. Imports of goods and services, net unilateral transfer payments and net investment income payments are denoted as imports+ for the rest of the paper.

If \( EX_t \) and \( IMM_t \) are cointegrated then the long-run relation between exports and imports can be estimated and current account sustainability can be analyzed. The first step is to test for stationarity which is examined using Augmented Dickey-Fuller (ADF), Phillips Perron (PP) and KPSS. If both series are integrated of order one, we test for cointegration using the standard Johansen method and the Gregory and Hansen (1996) procedure. While the former assumes that the cointegrating relationship is unchanged through the sample period, the latter allows for a break. The Gregory and Hansen (1996) procedure determines the break endogenously for three different models with a level shift, a level shift and trend or a regime shift (see Baharumshah et al., 2003 and Sohrabji, 2010 for details).

If cointegration between exports and imports exists, the long-run relation is estimated using Stock and Watson’s (1993) dynamic OLS (DOLS) technique given as

\[ EX_t = \alpha + \beta IMM_t + \delta(IMM_t - IMM_{t-1})D_{t-1} + \Phi d(L)\Delta IMM_t + \epsilon_t \] (2)
where $EX_t$ and $IMM_t$ are as defined earlier, $IMM_t$ is imports plus at the structural break point (from the Gregory-Hansen procedure), $\Delta IMM_t$ is the first difference of imports+, and $d(L)$ captures lags and leads of the first difference of the regressor.

We test for statistical significance and the strength of $\beta$ to shed light on sustainability of the current account. If tests show that $\beta \leq 0$ the current account deficit is unsustainable, and if $\beta \geq 1$ the current account position is sustainable, and if $0 \leq \beta \leq 1$ the current account position is weakly sustainable at best. We present and analyze the empirical work on a sample of countries from EAC, ECCAS and SADC in the following section.

**DATA AND PRELIMINARY RESULTS**

The purpose of the paper is to compare current account sustainability of countries in different African economic communities. Due to data constraints we focus on only a few countries from each of the three communities including Kenya and Uganda from EAC, Burundi, Cameroon, Central African Republic, Chad, Congo, Gabon and Rwanda from ECCAS, and Botswana, Lesotho, Malawi, South Africa, Swaziland and Zambia from SADC. The data period ranges from the 1960s to 2006, but varies for each country depending on availability (noted on tables). The trade and current account balances as a ratio of GDP are shown in Figures (1 a-b), (2 a-g) and (3 a-g). Both EAC countries have current account deficits during the sample period. The experiences are mixed for the other two communities, but the earlier results of healthier current account balances in the SADC are confirmed in the individual country data.

The relation between exports and imports+ is estimated using the methodology discussed in the earlier section. The exports series includes export of goods and services and imports+ includes import of goods and services, net unilateral transfer payments and net investment income payments. Following the literature, we use real exports and real imports+ as a percentage of real GDP (base year of 2000) referred to as $RXY$ and $RMMY$ for the remainder of the paper. All data is available from the World Bank.

Nonstationarity tests show that the series are I(1) in levels and I(0) in differences (reported in Table 5). Cointegration results are conducted using the Johansen and Gregory-Hansen tests. Before conducting the Johansen test, the number of lags for the VAR is determined using Akaikie information criterion (AIC) and Schwarz criterion (SC) reported in Table 6 with the Johansen test results. The Johansen cointegration test results show cointegration for Kenya, Central African Republic and Botswana, and no cointegration for the rest.

The Gregory-Hansen test shows cointegration for most countries except Burundi and Botswana (for at least one of the models). They show that most countries have seen an improvement in the current account position assuming a break point. Results for this test including the break period are presented in Table 7.

Based on these preliminary results, we estimate the sustainability of current account positions for our sample countries using equation 2. Through this, we can discuss the intra-regional and inter-regional challenges and opportunities for our sample countries. The empirical results are analyzed in the following section.

**CURRENT ACCOUNT SUSTAINABILITY OF AFRICAN ECONOMIC COMMUNITIES**

Using the Gregory-Hansen, results we estimate the long-run relation between exports and imports+ using dynamic OLS according to equation (2). The lag length for the differenced $RMMY$ terms is determined by AIC and SC. The regression is tested for serial correlation, heteroskedasticity, stability and normality. These results reported in Table 8 show diagnostic problems for certain countries. If the LM test showed evidence of serial correlation, we used dynamic GLS, and if heteroskedasticity was a concern, we corrected it by using heteroskedastic consistent standard errors.

DOLS or DGLS results are reported in Table 8 which also includes results for ECOWAS countries from Sissoko and Sohrabji (2010). We would expect to find positive coefficients for our sample countries because all showed evidence of cointegration using either the Johansen or Gregory-Hansen tests. In general, we do find a positive relation between exports and imports+ for all countries except for Cameroon, Malawi and Swaziland, all of which have not statistically significant negative coefficients. We find that the relation between exports and imports+ for Uganda, Central African Republic, Rwanda, Botswana, Lesotho, South Africa and Zambia are positive and statistically significant (Table 8), similar to Ghana, Niger, Sénégal and Togo from Sissoko and Sohrabji (2010). Thus, for these countries we conclude that exports in these countries grow in response to increasing imports and other debits. This indicates that debits are not a drain on the economy. However, there is significant variance among these countries. The relation between exports and imports+ is strongest for Botswana with 0.95 and similar to Sissoko and Sohrabji’s (2010) result of Sénégal and Togo the null of $\beta \geq 1$ cannot be rejected in favor of the alternative $\beta < 1$ (Table 8). Based on this result, we conclude that Botswana’s current account position is sustainable over the sample period.
Of the other countries with statistically significant coefficients, we reject the null of $\beta \geq 1$ (similar to Ghana and Niger in Sissoko and Sohrabji, 2010). This indicates that while exports grow in relation to imports for these countries, the latter outpaces export growth and thus it is difficult for these countries to close the trade gap. Thus, the current account positions are at most, weakly sustainable. It is important to note that the experiences of the countries do vary. At 0.18, it is much harder for Lesotho to attain a healthy current account position than it is for Zambia at 0.62.

While the current account positions of these countries are problematic, they are less of a concern than for Kenya, Cameroon, Chad, Congo, Gabon, Malawi and Swaziland. Our results show that the relation between exports and imports for these countries is not positive for some and even if positive, is not statistically significant. This indicates that countries are importing without adding sufficiently to their export base. These results are comparable to those found by Sissoko and Sohrabji (2010) for Burkina Faso, Côte d'Ivoire, Mali and Nigeria. We can conclude that these countries have unsustainable current account positions.

In general, the current account positions of the SADC are healthier than of the other two African communities in our study. This is not surprising given their better economic indicators (discussed earlier). The better current account positions can partly be explained by the fact that SADC includes the most advanced and economically successful country in Africa, namely South Africa (exports include gold, diamonds, platinum and other metals). Several studies, including Hull and Jones (1999) and Gallup et al. (1998) have shown a strong relationship between location in the tropics, other geographical factors and economic growth. The temperate climate of South Africa gives it a significant advantage in a continent where countries are hurt by their tropical climates (diseases such as malaria and low agricultural production due to poor soil). Moreover, the South African currency, the rand, is one of the strongest and most stable currencies in Africa. Thus, even though its current account position is only weakly sustainable, South Africa’s participation in SADC helps other member countries.

In some ways, the results of SADC as a whole resemble those of ECOWAS by Sissoko and Sohrabji (2010). In both cases, there is at least one country with a sustainable current account position (two for ECOWAS). Also, ECOWAS had two other countries with weakly sustainable current account positions and SADC has three such countries. One major difference, however, is that the major economy in ECOWAS, Nigeria has an unsustainable current account position, while the leader of SADC, South Africa has a weakly sustainable current account position. This makes the overall position of SADC healthier than that of ECOWAS.

ECCAS has some challenges compared to SADC. The leading economy in this region, Cameroon, has an unsustainable current account position (similar to ECOWAS). Moreover, there are no countries from this community in our sample that have strongly sustainable current account positions (unlike both SADC and ECOWAS). This is a significant problem for ECCAS. Nevertheless, there is reason to be hopeful. Half the ECCAS countries in our sample have weakly sustainable current account positions, including Central African Republic, Congo and Rwanda. Also, besides Rwanda, all other ECCAS countries in our sample are part of the CFA zone (again, similar to ECOWAS). Having a common currency increases trade and investment opportunities and thus benefits member countries.

The weakest results are seen for EAC. Uganda has a weakly sustainable current account position while Kenya’s current account position is unsustainable. The dependence on agriculture (noted earlier) coupled with the erratic climatic conditions poses a problem for countries in this community. Moreover, EAC is a very small economic community with only three countries (including Tanzania). There is no “anchor” country in this community that can help the others to economic success. Also, given the size of this community, participation in this union does not generate as great intra-trade benefits as for other communities.

CONCLUSION

Our results show weak current account positions for countries in the three African communities in our sample. Overall, the SADC, which is the economically strongest community in our study, has the most healthy current account position. In fact, the only country in our sample to enjoy a sustainable current account position, Botswana, is a member of this community. Having an economically prosperous country like South Africa as part of this community appears to have benefited the group as a whole.

ECCAS has weaker economic conditions. Also, Cameroon which is one of the most powerful economies in that group has an unsustainable current account position. However, given that many of these countries are part of CFA zone improves the prospects for this community. In fact, half our sample countries have weakly sustainable current account positions. EAC has the weakest results, with Kenya’s current account position being unsustainable, and Uganda’s being weakly sustainable. For EAC, the problem is the lack of a “leader” in the community. Given that it is also the smallest community with only three members, the countries do not benefit as much from intra-regional trade as well.

Overall, greater inter-regional trade will benefit ECCAS and EAC especially with more successful communities like
SADC and ECOWAS. SADC is likely to benefit more by greater intra-regional trade.

TABLES

Table 1: Sub-Saharan Africa: Selected Indicators, 2005-10

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**Percent of GDP**

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<td>21.3</td>
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<td>Terms of trade (percent change)</td>
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<td>2.9</td>
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<td>0.9</td>
<td>0.2</td>
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<tr>
<td>Reserves (months of imports)</td>
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<td>5.6</td>
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<td>5.4</td>
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**Memorandum items:**

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<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<td>64.3</td>
<td>71.1</td>
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<td>GDP Growth in SSA (WEP definition)</td>
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<td>6.6</td>
<td>6.9</td>
<td>5.5</td>
<td>1.7</td>
<td>3.8</td>
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Sources: IMF, African Department database; and IMF, World Economic Outlook database.
Notes: Data as of April 1, 2009. Arithmetic average of data for individual countries, weighted by GDP.
1Excludes Zimbabwe. See Statistical Appendix tables for the list of Sub-Saharan African countries.
2Consists of Angola, Cameroon, Chad, Republic of Congo, Equatorial Guinea, Gabon, and Nigeria.
3Includes the countries listed in the Statistical Appendix tables plus Djibouti, Mauritania, and Sudan.
Table 5: Unit Root Tests

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<th><strong>KPSS</strong></th>
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<tr>
<td>Kenya (1975-2006)</td>
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<tr>
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<tr>
<td>$\Delta R_{XY}$</td>
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<td>-5.07* (3)</td>
<td>0.08 (3)</td>
</tr>
<tr>
<td>$R_{MMY}$</td>
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<td>-0.79 (1)</td>
<td>0.17* (4)</td>
</tr>
<tr>
<td>$\Delta R_{MMY}$</td>
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<td>Uganda (1961-2006)</td>
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<tr>
<td>$R_{XY}$</td>
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<td>-1.67 (3)</td>
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<tr>
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<td>-6.16* (3)</td>
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<td>0.17* (5)</td>
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<td>$\Delta R_{MMY}$</td>
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<td>Cameroon (1968-2006)</td>
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<tr>
<td>$R_{XY}$</td>
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<td>0.07 (3)</td>
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<td>$R_{MMY}$</td>
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<td>Chad (1961-2004)</td>
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Table 5 (continued)

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<td><strong>Rwanda (1966-2006)</strong></td>
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<td>( RMMY )</td>
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<td><strong>Swaziland (1965-2006)</strong></td>
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Table 5 (continued)

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<th><strong>KPSS</strong></th>
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<td>-2.74 (2)</td>
<td>0.16* (5)</td>
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<td><strong>△RXY</strong></td>
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<td><em><em>0.20</em> (3)</em>*</td>
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<td>-6.08* [0]</td>
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<td><em><em>0.18</em> (1)</em>*</td>
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</table>

Notes: The null hypothesis for ADF and PP tests is that the series is nonstationary while the null hypothesis for KPSS is that the series is stationary. All tests are conducted assuming a constant and trend. Numbers in brackets for ADF test denotes lag (maximum lags were set at 3 and lag length is determined using AIC). Numbers in brackets for PP and KPSS correspond to lag truncation parameter determined by Newey-West criteria. * and ** indicates rejection of the null hypothesis at 5% and 10% level of significance, respectively. Results in bold indicated unexpected results.

Table 6: Johansen test results for cointegration between **RXY** and **RMMY**

<table>
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<tr>
<th><strong>EAST AFRICAN COMMUNITY</strong></th>
<th>Lags</th>
<th>No. of CE(s)</th>
<th>Trace value</th>
<th>Eigenvalue</th>
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<td>[1]</td>
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<td>5.23*</td>
<td>5.23*</td>
</tr>
<tr>
<td>Uganda (1961-2006)</td>
<td>[1]</td>
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<td>6.09</td>
<td>3.08</td>
</tr>
<tr>
<td></td>
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<td>At most 1</td>
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</table>

| **ECONOMIC COMMUNITY OF CENTRAL AFRICAN STATES** | | | |
|-------------------------------------------------|------|--------------|-------------|------------|
|                                                  |      | At most 1    | 0.61        | 0.61       |
| Cameroon (1968-2006)                            | [3]  | None         | 7.95        | 5.95       |
|                                                  |      | At most 1    | 1.12        | 1.12       |
|                                                  |      | At most 1    | 2.73        | 2.73       |
|                                                  |      | At most 1    | 5.58*       | 5.58*      |
|                                                  |      | At most 1    | 2.70        | 2.70       |
|                                                  |      | At most 1    | 3.42        | 3.42       |
| Rwanda (1966-2006)                              | [1]  | None         | 7.71        | 6.70       |
|                                                  |      | At most 1    | 1.01        | 1.01       |

| **SOUTHERN AFRICAN DEVELOPMENT COMMUNITY**       | | | |
|-------------------------------------------------|------|--------------|-------------|------------|
| Botswana (1976-2006)                            | [1]  | None         | 18.84       | 17.29      |
|                                                  |      | At most 1    | 1.54        | 1.54       |
|                                                  |      | At most 1    | 0.83        | 0.83       |
|                                                  |      | At most 1    | 3.07        | 3.07       |
|                                                  |      | At most 1    | 0.65        | 0.65       |
| Swaziland (1965-2006)                           | [1]  | None         | 12.17       | 6.94       |
|                                                  |      | At most 1    | 5.23*       | 5.23*      |
|                                                  |      | At most 1    | 3.97        | 3.97       |

Note: Lag length of the underlying VAR was determined by AIC and SC. The null hypothesis is that there is no cointegration. * indicates rejection of the null hypothesis at 5% level of significance.
Table 7: Gregory-Hansen test results for cointegration between *RXY* and *RMMY*

<table>
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<th>Level shift/trend</th>
<th>Regime shift</th>
</tr>
</thead>
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<td>-5.11*</td>
</tr>
<tr>
<td>(1975-2006)</td>
<td>[3]</td>
<td>[3]</td>
<td>[3]</td>
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<td>1989</td>
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<td>Uganda</td>
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<td>-7.42*</td>
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</tr>
<tr>
<td>(1961-2006)</td>
<td>[0]</td>
<td>[0]</td>
<td>[0]</td>
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<table>
<thead>
<tr>
<th>ECONOMIC COMMUNITY OF CENTRAL AFRICAN STATES</th>
<th>Level shift</th>
<th>Level shift/trend</th>
<th>Regime shift</th>
</tr>
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<tr>
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</tr>
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<th>Level shift/trend</th>
<th>Regime shift</th>
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Table 7 (continued)

<table>
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Notes: The table provides Gregory-Hansen cointegration results for all three models. The table reports the t-statistic, lag length (in square brackets) and the endogenously determined break period for all countries. Null hypothesis is that there is no cointegration. *, ** and *** indicates rejection of the null at 5%, 10% and 15% level of significance, respectively.
### Table 8: Dynamic OLS results

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<tr>
<th>Country</th>
<th>Diagnostic test results</th>
<th>DOLS/DGLS estimation results</th>
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<tr>
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<td>LM test (p-value)</td>
<td>White test (p-value)</td>
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<td>Kenya (1975-2006)</td>
<td>7.60 $^*$</td>
<td>8.48 (0.86)</td>
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<td>Uganda (1961-2006)</td>
<td>5.28 $^{**}$</td>
<td>11.59 (0.87)</td>
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<td>Cameroon (1968-2006)</td>
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<td>9.01 (0.53)</td>
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<td>7.56 (0.27)</td>
</tr>
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<td>Chad (1961-2004)</td>
<td>4.48 (0.11)</td>
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<tr>
<td>Congo (1961-2000)</td>
<td>6.96 $^*$</td>
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<td>21.22 $^*$</td>
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<td>Rwanda (1966-2006)</td>
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<td>Botswana (1976-2006)</td>
<td>13.54 $^*$</td>
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<td>3.41 (0.18)</td>
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<td>0.90 (0.64)</td>
<td>25.91 $^{**}$ (0.10)</td>
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<td>Zambia (1961-2004)</td>
<td>3.51 (0.17)</td>
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Table 8 (continued)

**ECONOMIC COMMUNITY OF WESTERN AFRICAN STATES**

<table>
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<tr>
<th>Country</th>
<th>Period</th>
<th>( R^2 )</th>
<th>( \Delta R^2 )</th>
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<td>0.82</td>
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<td>-7.83*</td>
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<tr>
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<td>(1967-2005)</td>
<td>0.89</td>
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<tr>
<td>Niger</td>
<td>(1963-2005)</td>
<td>0.89</td>
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<td>Nigeria</td>
<td>(1960-2005)</td>
<td>0.48</td>
<td>0.03</td>
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<tr>
<td>Sénégal</td>
<td>(1968-2006)</td>
<td>0.33</td>
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<td>Togo</td>
<td>(1966-2005)</td>
<td>0.69</td>
<td>1.68</td>
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</table>

Note: For each country the break period from the Gregory-Hansen procedure were used in the dynamic OLS estimation. The lag and lead length for differenced RMMY terms were determined by AIC and SC. The appropriate lag/lead length was 0 for Côte d’Ivoire, Central African Republic and Gabon, 1 for Sénégal, Cameroon and Chad, 2 for Botswana, Gabon, Ghana, Kenya, Malawi, Rwanda and South Africa and 3 for Lesotho, Nigeria, Swaziland and Zambia. The table reports estimation results and diagnostic tests including LM (serial correlation), White (heteroskedasticity), RESET (stability) and Jarque-Bera (normality) tests. The null is of no serial correlation, homoskedasticity, stability and normality. * and ** denote rejection of the null at 5% and 10% level of significance, respectively. If the LM test showed evidence of serial correlation, dynamic GLS was used in the estimation. If the White test revealed evidence of heteroskedasticity, heteroskedastic consistent standard errors were used.

* Results for ECOWAS are from Sissoko and Sohrabji (2010).
ENDNOTES

*Because of space constraints, the Figures and some Tables have been eliminated.

1We compare our results here with those from countries in ECOWAS (Sissoko and Sohrabji, 2010).

2Unilateral transfers data was not available for most countries except Botswana.

3Using the Johansen test we find evidence of cointegration for Botswana. However, there is no cointegration for Burundi in either test.

4For Botswana we leave out the structural break term in equation (2).

5If AIC and SC did not have the same results, we used other measures such as LR tests to determine the lag length.

REFERENCES


THE BALEEN WHALES’ SAVING GRACE; THE INTRODUCTION OF PETROLEUM BASED PRODUCTS IN THE MARKET AND ITS IMPACT ON THE WHALING INDUSTRY

John McCollough and Henry Check
Department of Business and Economics
The Pennsylvania State University-Lehigh Valley
Center Valley, PA 18034

ABSTRACT
This paper attempts to empirically answer the question of when a competitive industry is engaged in the harvesting of a natural renewable resource and if that industry is left unregulated, will it continually over harvest that resource past its maximum sustainable yield. If so, then it is conceivable that a competitive industry could over harvest a resource to such stressful levels that the resource might not be able to repopulate back to its healthy sustainable population. A historical analysis of the American whaling industry and America’s demand for whale oil during the 1800s will be employed to help answer this question. The whaling industry is selected because it was such a significant and viable industry during the 1800s. In addition, whale bi-products were in great demand in both the household and industrial sectors of a rapidly expanding American economy.

Keywords: Sustainable yield, whaling, sperm whales, baleen whales

INTRODUCTION
Empirically, this paper attempts to answer the question of when a competitive industry is engaged in the harvesting of a natural renewable resource, if that industry is left unregulated, will it continue to over harvest that renewable resource beyond its maximum sustainable yield. If so, then it is conceivable that a competitive industry could over harvest a resource to such stressful levels that the resource might not be able to repopulate back to a healthy sustainable population.

It is well known from the environmental economics literature that when individuals are engaged in the harvesting of either a renewable or non-renewable resource on common property grounds these individuals will tend to carry out a rapacious harvest, neglecting the cost they pose on the larger community, hence the Tragedy of the Commons. Therefore there is a need to regulate the harvesting of a natural resource within common property boundaries so that the resource is not harvested beyond the maximum sustainable yield. However, from a classical point of view, regulation should be held to a minimum. The reason for this is that in the case of a natural renewable resource, as the population declines it becomes more and more difficult to harvest the remaining population. The more difficult it becomes, the more costly it becomes and, hence, the marginal cost associated with this activity begins to increase (assuming extraction technologies are held constant). This makes the harvesting of the resource less profitable to those engaged in the activity and they will then begin to refrain from the activity, which now gives the resource an opportunity to recover to more healthy population levels.

As Clark points out (1973, pp. 951), “It has been noted, that harvesting costs rise with decreasing population levels, a rent-maximizing policy will automatically lead to biological conservation, with an equilibrium population in excess of the population corresponding to maximum sustained yield”. With respect to whaling in the 1800s, Bardi (2007, pp. 302) notes that “Evidently, the reduction in whale populations were sufficient to make whaling progressively more expensive and difficult, given the technology of whaling at that time.”

For the most point, this classical argument makes a good deal of sense. However, continued harvesting of a natural renewable resource can occur at such a rate that market supply begins to diminish, which in turn can cause a rapid price increase. As the price increases, those engaged in the harvesting are encouraged to continue their efforts. For instance, the declining stocks of whales resulted in diminishing supplies (most noticeable with the harvests of the 1850s) which put continued upward pressure on prices. The higher price supported higher operating costs, encouraging and allowing whalers to continue hunting fewer numbers of whales. As Coleman (1995, pg 281) notes, “This projected higher price was enough to lure captains and their vessels into
more dangerous areas looking for new and previously undiscovered pods of whales.” Any new discovery led to profits that were “tremendously high” and soon “everybody had a ship on the new grounds” (Coleman 1995, pg 281).

The classical argument also does not take into account other demand factors, such as rising incomes, populations, or changes in taste which can increase price, giving firms more incentive to harvest ever decreasing, and therefore, costlier remaining resources in question. A case in point can be seen with rising incomes, especially in fast developing economies, increasing world demand, putting upward pressure on today’s oil prices, which gives oil firms incentives to drill in locations that were once cost prohibited.

Because of these considerations, governments need to continue vigilance in overseeing the harvesting of renewable resources on common property. Perman, Ma, and McGilvray (1996, pp. 194) state that “in these circumstances, if the parameters of the demand function shift so that demand increases and the resource price becomes higher at any harvested quantity, the revenue function shown … will have a higher maximum value. In this case, the open access equilibrium will exist at a lower resource stock level.” However, it needs to be kept in mind that there are natural market forces that constrain prices from rising too high. This, of course, is the existence of substitute products, like coal oil, could help to constrain the price of sperm and whale oil from rising too high.1

To answer the question of whether an unregulated, competitive industry could harvest a renewable resource beyond its sustainable yield a counter factual experiment based on the American whaling industry of the 1800s will be employed. The whaling industry is selected because it was such a significant and viable industry during the 1800s. In addition, whale bi-products were in great demand in both the household and industrial sectors of a rapidly expanding American economy. During this period of time, demand factors such as rising household incomes, rising population, and industrialization could very well have kept price high enough to offset the increasing marginal costs associated with the harvesting of whales.

For most of the 1800’s, America was the undisputed leader in whaling, but in the late 1850s and early 1860s there were significant structural changes in the market for which whale bi-products competed, eventually resulting in the collapse of the American whaling industry by 1915. These structural changes, for the most part, resulted from the introduction of cheaper, superior substitute products, in particular those from refined petroleum products (i.e., kerosene).

It is interesting to consider that the discovery of petroleum products, a major contributor to green house gas emissions, was instrumental in relieving much of the stress placed on the whale populations during the golden age of whaling. This historical analysis is also interesting in reminding us of the power that market forces have at holding down prices and reducing demand for a valuable commodity (such as petroleum oil in today’s markets) when a competitively priced alternative product is introduced.

Following this introduction the paper will briefly review the whaling industry in terms of demand for its product as well as supply considerations for the industry. This review is necessary to establish the competitive nature of the environment. After the demand and supply analysis the paper then turns its attention to the estimation of whaling populations at the beginning of the 1800s as well as the total harvest and maximum sustainable yield figures of whaling populations in question. An empirical model is then presented so that forecasts of whale harvests can be projects based on the assumption that the introduction of both petroleum based kerosene and petroleum based lubricants onto the market could have been delayed for a period of years. A conclusion and discussions then presented at the end of the paper.

MARKET ANALYSIS – DEMAND AND SUPPLY CONSIDERATIONS

During the 1600s, whaling was primarily a Dutch concern, but from 1750 to the early decades of the 1800s, England dominated the whaling industry. In 1816, the British had sent 150 vessels to harvest whales in the North Atlantic as compared to only two American vessels.2 However, within a span of just a few years, America dominated the whaling industry and maintained its preeminence from the 1820s to the first decades of the 1900s. Starting from the 1840s America was considered to hold a monopoly on whaling. By 1853 the whaling industry had become the 5th largest industry in America employing tens of thousands of workers.3 During this period American whaling hunted primarily five different kinds of whales. They were the sperm whale and four different types of baleen whales: the right, grey, bowhead, and the humpback.
After 1915, America played a limited role in the whaling industry as Norway and Japan started to dominate the whaling industry. However, both Norway and Japan hunted different kinds of whales and for different purposes than did the Americans. For instance, Norway hunted the rorquel whales which provided Norway with a source of cooking oil and meat.

Both the industrial markets and the consumer markets drove the American demand for whale bi-products. These bi-products are: sperm oil, whale oil, and whale bone. Sperm oil, produced by sperm whales, was used as a lubricant for light fast moving mechanical parts such as spindles. It was also used as an illuminant for lighthouses, street lamps, and public buildings. Whale oil (or tran oil), produced from baleen whales, was used as a lubricant for heavier machinery. Whale oil was also used as an illuminant for homes and as a cleansing agent. Finally whale bone, which is also produced from baleen whales, was used much like industrial plastic or "spring steel" is used today. In addition, whale bone was used in making corsets, skirts, and umbrellas.

Sperm and whale oil had a number of substitute products. These were coal oil (the original kerosene; considered sooty, smelly and low quality), manufactured gas (derived from coal), camphene (derived from turpentine and alcohol), camphor oil (considered bright, sweet smelling, cheap yet volatile), lard oil (used as an illuminant and lubricant but more expensive than coal oil; considered low quality and smelly), linseed oil, and petroleum products (the “new” kerosene used in illumination and lubrication).4

Coal oil was refined in the mid 1850's and eventually became cheaper than sperm & whale oil. Wholesale price of coal oil in 1860 was $.75 a gallon. America started to substitute both coal oil and manufactured gas for whale and sperm oil by the mid 1850's. It was, however, refined petroleum that soon became the prime competitor to whale oil. A few years after the discovery in 1859 at Titusville, Pennsylvania, petroleum based products were refined into high quality illuminants and lubricants. By 1862 the petroleum industry, by making good use of an existing liquid fuel infrastructure, became well established.5 Illuminating oil, which is kerosene, was the most important of all refined petroleum products. Table 1 below will give the reader some idea as to the dominant impact refined petroleum products had on the whale and sperm oil industries. Searching and drilling for oil had its risks, however, it was far less risky and more profitable to drill for oil than hunt for whales. Compared with whaling ventures Coleman (1995, pg 279) writes "Now it took fewer people less time to produce more crude at, or near, major markets or transportation systems."

Table 1 – Decade averages on gallons of sperm and whale oil harvested as well as prices for sperm and whale oil (per gallon) and the price of petroleum (per barrel).6

<table>
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<td>1.5</td>
<td>5.63</td>
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<td>31.64</td>
<td>2.8</td>
<td>15.07</td>
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<td>1.3</td>
<td>25.61</td>
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<td>11.27</td>
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<td>19.45</td>
<td>.86</td>
<td>10.48</td>
<td>19.45</td>
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<tr>
<td>1890s</td>
<td>.44</td>
<td>14.28</td>
<td>.27</td>
<td>9.50</td>
<td>20.11</td>
</tr>
</tbody>
</table>

Harvest of sperm oil for the American markets peaked in the 1840s with an annual average of 4.1 million gallons. The annual average harvest in the 1850s was 2.7 million barrels. By the 1860s the harvest of sperm oil for the American markets had dropped to 1.7 million gallons and by the 1890s the average annual harvest was 440 thousand gallons of processed sperm oil. The average price for sperm oil held up best during the 1850s. During that period the average price was $34.06 a gallon (in 2008 dollars). By the 1890s the average price for the decade had declined to $14.28 a gallon (in 2008 dollars). The harvest of whale oil followed a similar pattern. The harvest for the American markets peaked in the 1840s at over 7.5 million gallons. The average harvest in the 1850s was close to 6.8 million gallons. After that the harvest dropped rapidly and by the 1890s the harvest of processed whale oil was just a fraction of its peak years. Prices for whale oil held up best during the 1850s and 1860s with prices at about $15.07 a gallon (2008 dollars) but by the 1890s it was under $10 a gallon (in 2008 dollars).

With large petroleum reserves nearby, the price of petroleum in America plummeted. The average price of kerosene declined by over 75% from 1865-1894. Production of kerosene expanded rapidly. For instance, in 1865 the production was just under 1 million barrels. In 1870 the Standard Oil Company had “standardized” kerosene, making it safe for home consumption and by 1914 it was well over 46.5 million barrels. In 1862 the average wholesale price in current dollars was $.32 a gallon (compared to $1.43 for sperm oil, $.60 for whale oil, and $.75 a
gallon for coal oil in 1860). While the industry for petroleum based kerosene was expanding the production of sperm and whale oil was moving in the opposite direction in the last half of the 1800s. Eventually, due to competition from petroleum based products, the market for sperm and whale oil declined drastically in the decades following the Civil War and it never recovered to the prominence it displayed during its golden years.

Oddly enough, the market for whalebone held up well after the Civil War. The whaling industry’s greatest level of production was achieved in the 1850s with close to 2.8 million pounds of whale bone harvested for American consumption. During these years the average price was $14.08 a pound of whalebone (2008 dollars). Total industry production of whalebone fell for the rest of the century, however, per vessel catch (after declining for 30 years following the period of 1846-1855), picked up again from 1886-1905, almost to its golden-year levels.

The reason why per vessel harvest levels of whale bone returned to its golden-year levels had to be the steep increase in the price for a pound of whale bone from 1876-1906. This gave whalers a good incentive to continue harvesting whale bone despite declining whale oil prices. The price of a pound of whale bone averaged $20.57 (2008 dollars) in the 1860s, but rose steadily for the rest of the century. In 1904, its price peaked at $140.70 (2008 dollars). Soon after, however, the whalebone market collapsed. "In 1908 the introduction of flexible-form steel and a change in women's fashion caused the baleen market to collapse, and in 1915 only one whaler (with no reported catch) made a voyage to the western Arctic" (Conrad, pp. 979)

An analysis of the whaling industry by Davis, Gallman, Hutchins (1991) shows it to be a highly competitive industry producing a basic homogeneous commodity. There where a large number of supplying firms (thought of as whaling vessels) as well as a large number of entrepreneurs. By 1835 there were over 1000 American vessels engaged in the harvesting of whales. Of these 1000 vessels, 700 of them had their home port in the New Bedford area (New England). The remaining vessels were concentrated in port cities such as San Francisco and others.

Each whaling vessel could be considered an individual firm. A vessel was most likely to be owned by an agent, a firm, the captain, or any combination thereof. “Because the agents, the captain, and even the owners frequently changed from one voyage to the next, the vessel-voyage approximates the notion of a firm in economic theory, and is a particular useful unit of analysis" (Davis, Gallman, Hutchins 1991, pp. 193).

Agents typically managed the voyages, and often times the agents were the owners or at least part owners, but this is not true in all cases. Agents were responsible for "preparing the craft for sea: seeing to the renewal of the masts, spars and rigging, replacing lost or broken whalecraft, provisioning, and hiring the officers and men” while the ship was in port (Davis, Gallman, Hutchins 1991, pp. 217). A share of the net proceeds would depend on how carefully the preparations for the voyage were carried out.” In addition, agents were responsible for “assuring that credit and access to cash were available to the captain when he put in to overseas ports. Information was exchanged regularly between the agent and the captain” (Davis, Gallman, Hutchins 1991, pp. 218)

Of the 275 agents associated with the New Bedford whaling industry, 197 managed 10 or fewer voyages. Agents were typically entrepreneurs who were engaged in other businesses as well. Some of these businesses were in markets totally unrelated to the markets for whale bi-products. Still, some of the business ventures were in markets that were considered to be either compliments or substitutes for whaling bi-products. The single largest agent was only involved in 3% of the voyages by himself. His joint ventures with other partners amounted to no more than thirteen percent of the total voyages originating from New Bedford.

Costs incurred by the owner/agents included the cost of the vessel, which was a one time capital outlay that depreciated over time. The average age of a whaling vessel was somewhere between 38 and 47 years (depending on the type of vessel). Other costs were labor, crew provisions (i.e., food, etc.), ship maintenance supplies, whaling supplies (harpoons and small whalecraft for approaching the whales), etc. Labor, crew provisions, and maintenance supplies could be considered marginal cost, with labor being the largest cost of a voyage. Whaling supplies could be considered fixed costs since they could be reused repeatedly if not damaged or lost in the hunt.

Labor costs were a fraction of the net proceeds derived from the harvest and therefore were considered to be a constant marginal cost. The term for this fractional share of net proceeds was called a “lay”. Each crew member would sign a contract before the voyage which stated his own fractional
share of the proceeds. The individual “lay” would reflect the relative worth of the crew member. A crew member’s earnings varied from voyage to voyage which depended on current market conditions as well as the total harvest.

It is important to know that throughout the 1800’s the total lay of the entire crew for a typical voyage was pretty much constant. The total lay ranged between 30%-32%, or just about a third of total revenues. There was a fifteen year period (from 1850-1865) where the total lay did creep up to about 36%, but this was abnormally high. From 1840-1858, the average lay was still only 33.2% (this average included 8 of the 15 years of higher than normal lays).11

Over a 90 year period, from 1816-1905, the American whaling industry returned to all American ports with over 176.6 million gallons of Sperm oil, over 264.9 million gallons of whale oil, and 81 million pounds of whale bone for American consumption.12 Total industry revenue for the American market during the 90 year period was $8 billion dollars (in 2008 dollars), or roughly $88.6 million per year. Between 1826 and 1865 the American whalers returned to American ports with nearly 128 million gallons of Sperm oil per year, 218.2 million gallons of whale oil, and 66.8 million pounds of whale bone. During these years 2,325 voyages returned to whaling ports on the east coast.13 The total harvest per boat, in terms of revenue, during this time period was $2.67 million (2008 dollars). This dollar amount has to be taken in context. During this time period the average length of a voyage could have lasted anywhere from 2 – 3 years and not every whaling vessel returned with a full load of whale oil or whale bone.

Despite the competitive nature of the industry, whaling was very profitable for those partaking in it. From 1816-1825 the average rate of return was 31.6%. From 1826-1835 the average rate of return was 57.8%. And from 1836-1842, the average rate of return was 36.9%. Overall, the average rate of return for the period of 1816-1842 was 42.7%.14 One reason for such profitable returns was the nature of the business. Whaling was risky and dangerous and the harvest uncertain. The average loss rate of vessels at sea was 3.2% per year.15

It is apparent from this review of the demand and supply factors facing the whaling industry that it was very competitive. There were numerous vessels engaged in harvesting both sperm and baleen whales with not a single agent large enough to exert control over the market. The industry product was a homogenous product with many substitutes. Although the profits were handsome, the reader has to be reminded of the risks involved with whaling.

MAXIMUM SUSTAINABLE YIELD ESTIMATES FOR THE SPERM AND BALEEN WHALES

Both the populations of sperm and baleen whales prior to intensive commercial hunting have been estimated. Scarff (1977) has estimated the sperm whale population prior to intensive commercial hunting to be 1.78 million while Allen puts the sperm whale population at 2.4 million. Each sperm whale, on average, could yield 33.6 barrels of oil.16 Knowing the numbers of barrels bought back to port for American consumption and assuming a 10% loss rate, Davis, Gallman, and Hutchins (1988) estimate that between 8% and 18% of the initial stock of sperm whales were harvested over a 90 year period between 1804 – 1900 and that in the largest year of harvest the whalers only took less than half of one percent of the initial stock. This leaves Davis, Gallman, and Hutchins (1988) to conclude that sperm whales during the golden age of whaling were not in trouble of being overharvested.

For the baleen whales it was a different story. Piecing together data from various scientists on the baleen whale sub-populations Davis, Gallman, and Hutchins (1988) estimate that the initial stock of the baleen whale “probably originally numbered at least 367,000” (pp. 584). Using an estimate of 73 barrels of whale oil per baleen whale and assuming a loss rate of 10%, Davis, Gallman, and Hutchins (1988) estimate that nearly 180,000 baleen whales were harvested between 1804 and 1900. Furthermore, they find that American whalers never took more than 7,000 baleen whales in any given year. The natural rate of increase for baleen whales reaches its maximum at 60% of the population. Once the population drops below this number then the natural rate of increase begins to fall putting the population under stress and in jeopardy of not being able to repopulate back to its original levels. Therefore, for the baleen whales the population where the natural rate of increase is at its greatest would be 220,000 (367,000 * .60).17 Applying the natural rate of increase of the grey whales to the entire baleen whale population, estimated at .047 by Rice and Woolman, then this would mean that the maximum sustainable yield for the baleen whales as a group would be 10,400 (220,000 *.047).
In their analysis, Davis, Gallman, and Hutchins (1988) conclude that the American whalers never reached the maximum sustainable yield for the baleen whales as a whole. However, they caution that they are applying the natural rate of increase found in the grey whales to other species of baleen whales and this might not be accurate. In addition, some breeding grounds could have been harvested more heavily than others as could some species of baleen whales, for instance, the grey whales, which yielded a relatively small amount of oil and bone versus the right whale which could yield between 100-120 barrels of oil would make whalers want to concentrate more heavily on the right whale.

The analysis of Davis, Gallman, and Hutchins suggests that with the existing technology both the worldwide stock of Sperm and Baleen whales were not in danger of being overharvested. However, this does not rule out the fact that individual stocks of whale populations were not overharvested. For instance, Allen and Keay (1999) analyze how British and Dutch whalers managed to exploit the stock of Eastern Arctic Bowhead whales off the coast of Greenland to extinction with less advanced whaling techniques than the Americans. British and Dutch whalers did enjoy government subsidies which made whaling more profitable for them. But Allen and Keay find that the subsidies were not responsible for the extinction of the Greenland bowheads, rather it was the productive capabilities of the British Whalers. What is not clear however, is if the British and Dutch whalers would have generated a large enough fleet without the various government subsidies.

**EMPIRICAL MODELING**

The quantity of whales harvested, both sperm and baleen, is a function of the number of whaling ships searching for whales as well as the number of whales available. The number of whaling ships searching for whales is a function of the expected profit from a whale harvest. Expected profit can be thought of expected revenue less costs and further, expected revenue is equal to expected price times expected quantity. The number of whales available is dependent upon harvests from prior years.

Expected price can be estimated via an inverse demand equation. Expected price is a function of the price of substitute products, real gdp per capita, as well population levels. The expected quantity is also a function of all prior year’s harvest. Greater harvests in prior years will entice whalers back for another voyage.

Finally, the main costs of a whaling operation are; the cost of the whaling ship itself, supplies and provisions for the voyage, and labor costs. The whaling ship was a one- time capital expenditure. Since whaling ships had no other marine purpose there were no opportunity costs associated with the ships. Therefore, the capital expenditure, considered as a sunk cost, would not weigh in on the decision to oversee another voyage. Only those costs directly associated with a whaling voyage would play a part in that decision. Supplies and provisions for the voyage could be thought of as an insignificant in the overall cost of a voyage. The major cost of a voyage was labor.

As stated previously, labor in the whaling industry, unlike many other trades, was paid a percentage of the harvest. This made the decision for the ship’s owner to manage a voyage very easy. If the ship came back empty, then the owner did not incur any labor cost, only the cost of provisioning the voyage. However, the owner must be able to find men willing to engage in lengthy voyages. If the ship came back with a weak harvest, that meant less money for the crew. Also, if wages were rising in other professions, then the opportunity cost of going on a voyage would rise. Both of these events could cause the crew to demand a higher percentage of the harvest which in turn would reduce the owner’s profits.

Therefore, the empirical model for the quantity of either whale or sperm oil for the period of 1805 - 1858 can be specified and follows;

\[
\text{Qty}_X = a + b_1 Y + b_2 P_X + b_3 W + b_4 T + b_5 L + b_6 \text{Pop} + b_7 \text{Qty}_{X(t-i)}
\]

Where:

- \( \text{Qty}_X \) = quantity of whale oil
- \( P_X \) = average price of sperm
- \( Y \) = GDP per capita
- \( W \) = index of unskilled wages (used as a proxy to represent the opportunity cost for crew members to engage in a lengthy voyage)
- \( T \) = average price of turpentine per gallon (primary ingredient for camphene)
- \( L \) = average price of linseed oil per gallon
- \( \text{Pop} \) = U.S. population
- \( \text{Qty}_{X(t-i)} \) = Quantity of previous harvest

Regressions were run for two different time periods. The first was the period of 1805 through 1858, the year before petroleum was discovered in Titusville, Pennsylvania. The second regression was run for the
period of 1859 through 1905. After 1859 the market for both sperm and whale oil began to fall apart. The explanatory variables are lagged one year before the dependent variable due to the length of a typical voyage. Table II below displays the regression results for the harvest of baleen whale oil.

**Table II – regression results on the quantity of Baleen Whale oil between the years 1805 – 1858**

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Coefficients</th>
<th>&quot;t&quot;-value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per capita</td>
<td>9.7</td>
<td>1.732</td>
<td>.092</td>
</tr>
<tr>
<td>Price of sperm oil</td>
<td>-1,804.2</td>
<td>-3.234</td>
<td>.003</td>
</tr>
<tr>
<td>Wages</td>
<td>11,858</td>
<td>.589</td>
<td>.559</td>
</tr>
<tr>
<td>Price - turpentine</td>
<td>-712.8</td>
<td>-5.99</td>
<td>.553</td>
</tr>
<tr>
<td>Price - linseed oil</td>
<td>629.1</td>
<td>.748</td>
<td>.459</td>
</tr>
<tr>
<td>U.S. Population</td>
<td>-.051</td>
<td>-.207</td>
<td>.837</td>
</tr>
<tr>
<td>Qty t-1</td>
<td>.121</td>
<td>.800</td>
<td>.429</td>
</tr>
<tr>
<td>Qty t-2</td>
<td>.273</td>
<td>1.856</td>
<td>.072</td>
</tr>
<tr>
<td>Qty t-3</td>
<td>.460</td>
<td>3.108</td>
<td>.004</td>
</tr>
<tr>
<td>Qty t-4</td>
<td>.043</td>
<td>.229</td>
<td>.820</td>
</tr>
<tr>
<td>R-sq</td>
<td>.827</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The regression results show that real GDP per capita is both significant and positively related to the harvest of whale oil. During this period of American development the demand for illumination increased with the growth of cities and mass urbanization. In addition, industry also required great amounts of sperm and whale oil lubricants as the number of machines and equipment with fast moving parts increased due to America’s rapid industrialization. This phase of industrial growth finds gdp per capita almost doubling from 1805-1858.

The whaling industry was interested in both sperm whales and baleen whales. The regression analysis shows the price of sperm oil to be both significant and negatively related to the quantity of baleen whale oil harvested. The negative relationship that sperm oil has with respect to whale oil shows the interrelationship of the two types of oil. As the price of sperm oil rose, whalers would shift their focus from harvesting baleen whales to harvesting more sperm whales.

The proxy representing the opportunity costs for crew members to engage in whaling is insignificant for this regression. Whaling, as previously mentioned, was an extremely well paying profession. As long as the harvests were bountiful and as long as sperm and whale oil prices held up well, then it appears that owners did not have any trouble attracting crew members to man the voyages.

Linseed oil, turpentine, and the U.S. population were all found to be insignificant in the regression. However, it appears that harvests from lagged periods did have a positive and significant impact on the current harvest. Obviously, bountiful harvests from previous voyages would continue to entice owners and crew members to engage in whaling. On the other hand, smaller harvests, most likely due to declining whale populations from previous years would discourage whaling activities.

The specification for the empirical model for the period of 1859 – 1905 is the same as that for the period of 1805 – 1858 except that petroleum prices and coal prices are added as explanatory variables. Starting in 1859 petroleum products became commercially available. A few years prior to that coal oil was being refined so that it could compete in quality with sperm and whale oil as an illuminant. The regression results are displayed in table III.

**Table II – regression results on the quantity of Baleen Whale oil between the years 1859 – 1905**

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Coefficients</th>
<th>&quot;t&quot;-value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of Petro</td>
<td>58.12</td>
<td>2.13</td>
<td>.041</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>.32</td>
<td>1.087</td>
<td>.286</td>
</tr>
<tr>
<td>Price of sperm oil</td>
<td>-414.3</td>
<td>-3.32</td>
<td>.742</td>
</tr>
<tr>
<td>Wages</td>
<td>-23,067</td>
<td>-1.951</td>
<td>.060</td>
</tr>
<tr>
<td>Price - turpentine</td>
<td>-332.8</td>
<td>-2.087</td>
<td>.045</td>
</tr>
<tr>
<td>Price - linseed oil</td>
<td>1,280.5</td>
<td>3.78</td>
<td>.001</td>
</tr>
<tr>
<td>Price of coal</td>
<td>56,549</td>
<td>1,515</td>
<td>.140</td>
</tr>
<tr>
<td>U.S. Population</td>
<td>-.681</td>
<td>-.331</td>
<td>.743</td>
</tr>
<tr>
<td>Qty t-1</td>
<td>.039</td>
<td>.240</td>
<td>.812</td>
</tr>
<tr>
<td>Qty t-2</td>
<td>.660</td>
<td>3.689</td>
<td>.001</td>
</tr>
<tr>
<td>Qty t-3</td>
<td>-.091</td>
<td>-.454</td>
<td>.653</td>
</tr>
<tr>
<td>R-sq</td>
<td>.938</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The empirical results from the regression run after the introduction of petroleum based products onto the market shows that the price of petroleum is both positive and significant at the 4% level. These results strongly attest to the disruptive impact petroleum had on the whaling industry. Petroleum oil soon overtook both sperm and whale oil as the major source of illuminating oil and lubricant within the economy. The dramatic misfortunes of the whaling industry
after 1859 meant that even rising incomes for the population could not create enough demand for whale and sperm oil to remain viable in the marketplace. This is demonstrated by the fact that during this time period real GDP per capita was insignificant in generating any impact on the whale oil market.

As the petroleum industry began to develop, the price of petroleum began to decrease. This impacted both the price whale oil and sperm oil. This in turn reduced the revenue from any harvest, which in turn reduced the crew wages. During this time period of 1859 – 1905, the regression results show that wages in other trades became a factor in the whaling industry, unlike the period prior to 1858. With wages rising for common labor in alternative employment endeavors and with declining harvests and prices, the regression results show how competing wages had a negative and significant impact on the quantity of whale oil.

The price of turpentine and the price of linseed oil are both shown to be significant. However, the sign on the price of turpentine is in the wrong direction. The price of coal is positive but insignificant. As in the period before the introduction of petroleum, prior year’s harvest also impacted the whaling industry. However, instead of three prior years impacted the quantity of whale oil only two prior years of harvesting had a positive impact on quantity. Perhaps, due to the introduction of petroleum and its effect on whale oil prices, owners were not as enthusiastic to engage in whaling voyages.

Assume for the moment that technological discoveries are random events throughout history and that the discovery of oil in Titusville, Pennsylvania would not have been discovered for another 30 years. Then what would the annual harvest of whale oil have looked like by 1890? Based on the results from table II, GDP per capita was a significant contributor to the demand for whale oil. Is it possible that rising incomes in America could have stimulated demand beyond the maximum sustainable yield for each of the product? The regression results for the time period between 1805 and 1858 show that for every dollar increase in GDP per capita whale oil would have increased by an additional 9,704.21 gallons.

From 1858 to 1890 GDP per capita increased by $2,250 (in 1967 dollars). Assuming a straight line relationship between the demand for whale oil and GDP per capita, the demand for whale oil would have increased by 21,834,472 million gallons over its 1858 level of 7,653,366 million gallons of consumption in 1858. This would have led to a total demand of 29,487,838 gallons of whale oil, or 936,121.84 barrels, by 1890. Of course, this is assuming that the price of whale oil, as well as, the price of all substitute products are held constant and that petroleum had not yet been discovered.

Using Davis, Gallman, and Hutchins (1988) figures that an average baleen whale would yield 73 barrels, then the 1890 harvest would have seen 12,923 baleen whales harvested. Davis, Gallman, and Hutchins (1988) estimated the maximum sustainable yield for baleen whales to be 10,400. They also report that American whalers never took more than 7,000 baleen whales. However, based on this linear extrapolation, it is apparent that had the discovery of petroleum been delayed there is a good chance that demand for baleen whales, due to rising incomes, would have exceeded the maximum sustainable yield.

**CONCLUSION**

The purpose of this paper is to address the question of when a competitive industry is engaged in the harvesting of a natural renewable resource and if that industry is left unregulated, will it continue to harvest that resource past its maximum sustainable yield. The American whaling industry of the 1800s was used for a counter factual study to address this point. Classical arguments along these lines suggests that regulation of common property renewable resources be held to a minimum since the marginal cost of harvesting will rise as the resource is depleted. This will cause the price to rise in a competitive industry as the marginal cost of harvesting increases, thus choking off demand. As firms leave the industry, the renewable resource has time to repopulate back to sustainable levels. However, this paper demonstrates that other factors that impact the resource price also need to be considered.

The empirical results of this paper show that rising incomes due to America’s rapid industrialization of the 1800s was great enough to put upward pressure on demand and prices to keep the whaling chasing fewer and fewer whales. The results show that eventually, all other factors remaining the same, the whaling industry would have eventually increased harvesting beyond the maximum sustainable yield, thus jeopardizing the baleen whales populations.

A number of factors need to be kept in mind, however, when considering this point. First, it took nearly three decades for incomes to rise high enough to generate sufficient demand for the whaling industry to harvest such levels. Had the discovery of petroleum in Titusville, Pennsylvania been delayed...
from 1859 to 1890, for instance, then it is just as conceivable that another product superior to whale oil could have been developed. In fact, coil oil was being refined just prior to 1859 and that could have replaced sperm and whale oil as the primary oil for illumination and lubrication.

Although rising incomes would take between two or three decades to generate enough demand to put the baleen whale population at risk, this time frame cannot be inferred upon all other renewable or non renewable resources. Demand factors such as rising incomes could take a considerable shorter time. It would all depend on the income elasticity of the product in question.

Second, in the case of the American whaling industry technical advances were, for the most part, static. There were no significant improvements with respect to harvesting for the industry from the 1830s on. Improvements in technology, such as harpoon cannons or steamships outfitted for whaling were never adopted by the American whaling industry until well after the demise of the industry. Had the industry been aggressive in adopted improved harvesting techniques then it is more than likely the time frame associated with rising incomes that was mentioned would have been shorter.

Finally, and most importantly, it is important to consider the increasing marginal harvesting cost factor for either renewable or non renewable resources. The American whaling industry was unique in the fact that labor was paid a percentage of the harvest. Owners did not have to directly concern themselves with rising marginal costs. Their only concern was whether or not they could find enough crew members for a voyage. To address this variable this study uses as a proxy an index of wages for unskilled workers during the 1800s. If labor was receiving less pay due to smaller revenues either from a decreasing price on the harvest or a reduction in the harvest itself, then higher wages in alternative employment opportunities would make it difficult for owners to attract crew members for a voyage.

In this analysis the alternative employment opportunities did have a significant impact on the industry and the quantity of whales harvested. However, this was found to be significant only after the introduction of petroleum products onto the market. This was not found to be the case prior to 1859 when whale oil prices were still high. Had prices of whale oil remained high after the introduction of petroleum, then perhaps alternative employment opportunities would not have had a insignificant impact on the industry just as was the case before the introduction of petroleum onto the markets.

There are other demand factors to take into consideration, such as population growth or increases in international trade due to globalization. With respect to the analysis on whale oil, population growth appeared to be insignificant, but that might not be the case with all common property resources.

REFERENCES


“They Used to Say Whale Oil was Indispensable Too”, *N.Y. Times*, 08/03/2008 (Applebome, P.)

3. Coleman (1995) reports that 70,000 people serviced the industry in 1846.

4. For information concerning the qualitative characteristics please see *The Whale Oil Myth* at www.radford.edu/~wkovarik/misc/blog/8/whaleoil.html
5. Williamson, Andreano, and Menezes (1966)
8. The export market for sperm and whale oil was much more insignificant than the American market. “The overseas market, however, faced with rising supplies of first coal gas, then camphene, and finally kerosene and increasingly cut off by continental tariffs, never recovered from the interruption of the Civil War” (Davis, Gallman, and Hutchins (1991), pg. 199).
10. See Davis, Gallman, Hutchins (1991) for analysis on agents of whaling vessels
11. See Davis, Gallman, Hutchins (1991) for analysis of labor costs within the industry
12. Source on sperm and whale oil quantities and prices comes from Tower (1907). Figures are based on a 31.5 gallon barrel.
14. See Davis, Gallman, Hutchins (1989) for analysis on industry returns
15. In one particularly bad year (1871) a fleet of 33 ships were trapped by ice off the North Coast of Alaska and destroyed costing the industry $1.6 million dollars (Coleman (1995).
16. estimates on barrels of oil per sperm whale range from 25 barrels to 45 barrels. According to Davis, Gallman, and Hutchins (1988) “the firmer set of figures” from 1804 – 1900 shows a typical sperm whale yielding 33.6 barrels oil.
18. For purposes of the regression analysis all commodity prices were based in 1967 dollars.
ABSTRACT

With the yearly changes in consumer income tax reporting and its perceived complexity, many individuals and couples have regularly sought the help of accounting and tax professionals at tax season, for extensions on filing, and for direction during audits. However, the market segmentation of buyers versus non-buyers may be further segmented into groups of buyers based on timing of their expenditures. Because of the struggling economy individuals may be more strongly motivated to find the largest possible refunds and, in addition, their employment and personal circumstances relating to sources of personal income and/or losses and wealth may be an even larger factor than before. Managerial implications for accounting and tax professionals are then discussed.

INTRODUCTION

In 2008, the U.S. economy suffered the worst financial crisis since the Great Depression. This historic event created an atmosphere of financial uncertainty and turmoil within American households. Many families were forced to alter both their spending habits and their saving behaviors in an attempt to withstand the crisis (Gounaris & Prout, 2009). Simple trips to the grocery store or to fill up the family car served as daily reminders of how things had changed for the worse. As household cash flow drives consumer spending (Steidtmann, 2009), households in this crisis become acutely aware of the need to maximize their tax refund.

The present study examined the expenditure patterns for accounting fees in American households with four consecutive quarters (from Q1 2008 through Q1 2009) of expenditure reporting in the 2008 Consumer Expenditure Survey Interview Survey Public Use Microdata by the Bureau of Labor Statistics, U.S. Department of Labor (2009). The data set includes fourth quarter 2008 and first quarter 2009 reporting of expenditures and therefore covers the period of financial shock and its immediate aftermath on the 2009 tax season. Parallel households were also examined for these four consecutive quarters that did not have expenditures on accounting in order to perform two types of market segmentation--buyer versus non-buyer segments, and--within buyers--further segmentation by their timing patterns. Buyers are also placed in subgroups based on timing of their expenditures. Each segment was profiled or described by their typical socio-demographic, wealth, expenditure, and tax data in order to gain further insight into their behavior. The earlier segments may exhibit slightly different employment and/or personal circumstances and may have slightly different sources of personal income and/or losses and wealth than the later segments. Although the data set does not provide day, month, and year for expenditures, but only month and year (e.g., April, 2008 instead of April 15, 2008), reasonable approximations of important time periods can be computed by taking the entire month. Although the micro-data do not include attitudes, values, or motives that would help to explain the rationale for such differences, if they exist, they do include a wealth of socio-demographic and economic variables. If such segments exist, then future survey research could provide more in-depth profiles of their behaviors.
attitudes, lifestyles, and motives as well as more services marketing attributes of their transactions. In addition, as new years of micro-data become available, it should also be possible to use this same series one or two years before and one or two years after to examine whether or not the seasonal patterns and other segment characteristics are stable or shifting.

LITERATURE REVIEW

The accounting profession has increasingly adopted services marketing tactics to increase sales, profits, and market share and to create and maintain good customer relationship management. In the early 1990s, much literature on marketing of accounting services focused on the promotion. Eric Wiegers (1995), for example, provided an overview of the usefulness of advertising, networking, community service, and public relations. The focus has gradually been expanded to include strategic marketing planning (Garman, 1993; Glick, 2009; www.ioma.com/cpa, 2010), branding strategy, Anon (2003), and customer relationship management (Gleaves, Burton, Kitshoff, Bates, Whittington, 2008). Researchers also explored on-line marketing topics such as web site creation and maintenance, Elfrink (2002), social media and social networking (www.ioma.com/cpa, 2009; www.ioma.com/cpa, 2010). There is relatively little published on market segmentation and profiling; one such study addressed marketing accounting services to baby boomers, Davidson, (2005); another considered niche marketing, Glick (2009); and another generally mentioned the need to conduct market segmentation and targeting especially during tough times, Verity (2009). This study looks at the extent to which it is possible to segment household buyers and non-buyers of accounting services and to further segment buyers by timing pattern. In this way, it expands upon the subtopic of market segmentation and targeting of accounting services.

METHODS

This study selected the Survey of Consumer Expenditures primarily because of the recency of the data—including the last quarter of 2008—so that household spending on accounting fees during that period could be explored. Although, as a nationwide, rotating panel study from 6794 to 6942 US households a quarter for four quarters in succession using a probability sample, the number of households with four quarters of expenditure reporting on this service reduces to 2496. (1) because each quarter about one-fifth of households rotate off the panel and new households are added to replace them, (2) some households skip reporting in any quarter, and (3) some households stop participating. In all, sample size was reduced to 574 households that are buyers and 1922 households that are not buyers with two overlapping time series: Q1 to Q4 2008 and Q2 2008 to Q1 2009; both series include Q4 2008. The Consumer Expenditure Survey has a definite advantage in size and representativeness over other secondary sources of data, but it also has important limitations—lack of inclusion of detailed service marketing variables, and of attitudinal, lifestyle, and motivational variables. The authors considered the trade-off acceptable in exploratory work; if this initial analysis of segmentation is workable at the general level, additional study can be made in future research at the detailed level. Nevertheless, the limitations are important and will be discussed later.

The variables proposed for segmentation of households were: (1) user or non-user status of households with expenditure on accounting fees; and (2) further segmentation of users by time period. Although user/non-user status is simply a 0/1 dichotomy coded after summing all accounting fees over the four quarters, segmentation by time period is an approximation of the relevant time periods. Expenditures cannot be broken down into categories by day of the month. Therefore, we can approximate January to April 15 as January to April only and likewise for the other time periods, September to October, and November to December. In addition to these four time periods, when the expenditures on users all fall within a single period, there are a few households classified as "other" because they have expenditures that fall in more than one period. The “other” households are excluded from the analysis because of the small size of the subgroup. These time periods would reflect the traditional tax season, the change in the mid-2000s from an automatic extension old date of August 15 to the new date of October 15 within the confines of the BLS month-to-month data. The variables proposed for profiling the resulting segments to focus on potential differences in employment and/or personal circumstances and in sources of personal income and/or losses and wealth included the following:

- Household head’s marital status (married, widowed/divorced/separated, and never married); gender; of Hispanic origin; of white race;
- Household head with managerial or professional occupation; self-employed; employed in sales, in military, in farming; household head can’t find work; is ill or disabled; is retired;
- Before tax income; income (loss--could be negative) from sale of household goods; from lump sum payment of trust or estate; from lump sum child support payment; from alimony income: from child support income; dual income households;
- Total taxes paid; home owners; rental equivalent of owned home;

It was expected that these variables would be related to excess or scarcity of resources; complexity of filing a return by one’s self; or motivation to receive the largest possible refund.

This study proposed these two hypotheses, both in null form:
There is no significant difference between buyers and non-buyers in employment, personal circumstances, sources of personal income and/or losses and wealth, level of income or taxes;

There is no significant difference between buyers in different time periods in employment, personal characteristics, sources of personal income and/or losses and wealth, level of income or taxes.

The method of data analysis was cross-tabulations with a chi-square test at a level of .05 or better for significance when both segmentation variable and profiling variable were categorical. When the profiling variable was interval or ratio (level of income, level of taxes, level of rental equivalent of owned home), then t-tests were used. T-tests were used for buyer/non-buyer segmentation or one-way ANOVA for time period segmentation.

RESULTS
First, the descriptive results on segmentation for buyer/non-buyer status are examined. What are the profiles of the two segments? What similarities do they share? What differences? Which of these differences are statistically significant? Second, the results on time period are examined. Then, their profiles are scrutinized to probe similarities, differences, and statistical significance for those differences.

BUYER/NON-BUYER SEGMENTATION AND PROFILING
In exploring buyer/non-buyer status segmentation, of the 2496 households with a year of data, 574 had expenditures on accounting fees and 1922 did not. Of these, 568 excluded the “other” category. By definition, non-buyer households had zero expenditure on accounting fees while buyer households had $312.42 average spending over the year.

As Table 1, “Profiles of Buyers versus Non-Buyers,” indicates, buyer households:

Personal circumstances:
- Have a smaller but statistically significant percentage of household heads (HH) are of Hispanic origin (8.4% buyer versus 12.0% non-buyer), are of white race (88% versus 81.2%), and are not now and never were married (11.7% buyer versus 18.3% non-buyer).
- Are similar to non-buyer households in the percentage with female HHs and with divorced/widowed/separated HHs (differences are not statistically significant at .05).

Employment:
- Have a larger percentage with dual income (37.3% buyer versus 28.4% non-buyer); have a HH who is self-employed (10.1% buyer versus 6.3% non-buyer); who is employed as a manger or professional (30.3% buyer versus 25.7% non-buyer).
- Have a smaller percentage of HHs who can’t find work (0.2% buyer versus 0.7% non-buyer); who are retired (18.6% buyer versus 21.9% non-buyer); are ill or disabled (2.6% buyer versus 6% non-buyer).
- Are similar to non-buyer households in the percentage with a HH in the military, in farming or in sales (differences are not statistically significant at .05).

Level and sources of personal income (loss) and wealth:
- Have higher after tax income than non-buyer households (about $73 K for buyers versus about 52 K for non-buyers); pay more in total taxes ($5,419 for buyers versus $2,525 for non-buyers); have homes with higher rental equivalence ($1,459 for buyers versus $1,357 for non-buyers).
- Have a higher percentage of households with income (or loss because the variable can be negative) earned from the sales of household goods (2.3% for buyers versus 0.9% for non-buyers); from a lump sum payment from a trust or estate (3.5% versus 1.7%); or from regular child support payments (4.4% vs. 2.3%).
- Have a higher percentage of households with wealth, represented by home ownership (86.6% buyers versus 71.9% non-buyers).
- Are similar to non-buyers in percentage of households with income from a lump sum payment for child support (0.3% versus 0.2%); from regular alimony payments (2.1% vs. 1.6%). Once again, the differences are not statistically significant.

Interpretation:
- Buyer households have greater resources than non-buyer households. They are more likely to have higher incomes and/or greater wealth:
  - because of their higher rate of home ownership and their homes higher rental equivalence; because of their more upscale and/or entrepreneurial occupations and higher after tax family incomes; because of their working spouses when married,
  - because of their relatively greater health (low percentage not working because of illness or disability); because of their relatively greater success in job hunting (low percentage not working because of inability to find work), and
  - because of “good” fortune (lump sum payments from trusts or estates) and/or hard work (income from sale of household goods).
• Buyer households may have a stronger motivation to use professional tax and accounting services to conserve these resources. This data set can only infer this, because the relevant variables are not in the set to test this. They may also have more complex tax reporting situations because of their different sources of income and higher earnings.

• Non-buyer households, although lower income, do not have as high a percentage of offsetting income or payments from alimony or child support and they do not appear to be as aggressive in growing family wealth through home ownership or sale of household goods. Although a slightly greater percentage of non-buyer households have HHs in the military and a slightly smaller percentage in sales; these HHs appear to be more likely to do their own taxes. Their lower levels of total taxes paid may be partly a reflection of their do-it-myself style.

BUYER SEGMENTATION AND PROFILING BY TIME

In exploring buyer segmentation by time, Table 2, “Timing and Amount of Accounting Fees in Year,” and Table 3, “Profiles of Buyers by Time,” show that, as conventional wisdom would have predicted, the majority of buyer households record an expenditure in the January to April time period (528 with fees in this period, 14 with fees in this period plus some other period, and only 46 households with no fees in this period). The May to June period has the next largest frequency of fees in that period (41 with another 8 having fees in at least one more period) with September to October and November to December time periods having the nine households with reported fees in this period plus another four or five in at least one more period. What is rather interesting, however, is that while mean fees over the year at $312.42 per household, the highest fees are recorded for the September to October and the November to December periods ($1,108.33 and $1,008.33, respectively). This further illustrates that people who likely have more complicated returns need the extra time for extensions. January to April mean fees ($267.26) and May to August mean fees ($351.17) are rather modest. Naturally in this chart all non-buyer households are excluded; therefore, there are no households with zero fees for the year included in the table. The ANOVA on amount spent by period results for the F test show that, indeed, there are statistically significant differences among the periods (Table 4, “Results of Hypothesis Tests”). The Post Hoc tests further reveal that not all periods are different from each other. January to April is like May to August. September to October and November to December differ from the two early periods but they do not differ from each other.

Table 3, “Profiles of Buyers by Time,” suggests that the buyer households:

Personal circumstances:
• although they appear to differ in marital status, race, ethnic origin, and gender for household head based on visual inspection of the percentages cannot be shown statistically to differ; with such a range in size of segment across the four time periods, such differences are not great enough to support an interpretation of difference.

Employment:
• do not differ by time segment on the employment variables.

Level and sources of personal income (loss) and wealth:
• do not differ by time segment on sources of income or on level of income (whether before tax or after tax) but do by level of total taxes paid and rental equivalence of owned home. Rental equivalence of owned home is greatest for the Sep – Oct time segment ($3,092.00 versus $1,891.63 for Nov – Dec, $1,595.21 for May – Aug, and $1,401.41 for Jan – Apr). Total taxes paid are highest for Sep – Oct ($30,239.00) versus Nov – Dec ($10,119.67), Jan – Apr ($5,164.04), and May-Aug ($2,219.00).

Interpretation:
• Personal circumstances: gender, race, ethnic origin and marital status are useful for profiling buyer/non-buyer segmentation, but not for buyer time segments.

• Employment: variables like, dual incomes, professional/managerial occupation, sales occupation, military occupation, self-employed occupation and reasons for not working are not useful for additional insight into buyer time segments over and above their contribution to understanding buyer/non-buyer segmentation.

• Level and sources of personal income (loss) and wealth: variables like sources of income or wealth (home ownership) are not useful for additional insight into buyer time segments over and above their contribution to understanding buyer/non-buyer segmentation. However, there is some additional utility in considering family after tax income, total taxes paid, and rental equivalence of owned home by time segment.

• Overall: Parts of both null hypotheses could be rejected. The subset of variables that is useful to distinguish between buyer and non-buyer households is not the same as the subset that is useful for buyer time segmentation.

DISCUSSION
There are a number of managerial implications stemming from this study that focus primarily on how to use the various segmentation categories to improve one’s accounting practice.

Segmentation is very useful in a number of marketing decisions such as: pricing of services, promoting of services, managing of services and managing of product offerings. Some of these suggestions are more applicable to an existing client base rather than marketing to new clients.

**Timing of Accounting Services:**
- Most accounting firms have their heaviest demand for services during the traditional tax season of January through April 15. Some clients utilize services later in the year for various reasons such as: estate planning, financial planning, and later tax filing. Identification of clients who need services throughout the year as well as those who could safely delay the bulk of their tax services with an automatic extension through October 15 would allow an accounting practice to shift clients to off peak demand times. Three challenges exist here. They are appropriate identification, creating awareness in the client that it is appropriate to delay tax services, and finally providing an incentive for the client to accept delay. Further study is needed on this.
- Benefit to the accounting firm would be lessening the time and resource pressures during tax season, as well as being able to provide more time to clients as per their needs.

**Personal Circumstances:**
- Advertising media decisions are more prudently made based on the media habits of market segments that are heavier purchasers of a given product. Media habits are often easy to determine based on demographic characteristics. This study shows the smaller but statistically significant percentage of households who are Hispanic or white and/or who are not now and never were married. Advertisements for accounting services should be placed in media that is used by potential clients that meet these descriptors.

**Employment:**
- The study has found a larger percentage of buyers with dual incomes. Due to the “category creep” of the alternative minimum tax (“AMT”--a tax regulation to ensure that upper income level households pay at least a minimum amount of tax in spite of tax loopholes), we find that dual income households are being swept into AMT liability at surprisingly lower income levels. It is a kind of encroachment on successively lower income levels. For example, married filing jointly could end up paying the AMT with an income level of roughly $70,000 and married filing separately at only half that. Clients need to become aware that the only way to determine if they are liable for AMT is to calculate their tax liability by completing both tax calculations. While the 1040 is complicated enough to complete on ones own, having to more forward to do forms 6251 could be more complicated than the average taxpayer wishes to undertake. Accountants can be useful in creating awareness in potential clients in coping with the AMT to make them realize that they may need professional tax advice. This is also found in our analysis of the segment of those having higher after tax income and those who pay more in total taxes.
- Buyer households have a larger percentage of those who are employed as a manager or a professional (30.3% buyer vs. 25.7% non-buyer). Marketing implications of this are two fold. First, it is standard advertising copy strategy to include actors who are observably similar to those of the prospects. Advertisements should depict actors who appear to be managers/professionals so that prospects can relate to the ad message. Likewise, managers and professionals may not balk at paying professional level accounting fees because they personally appreciate the value of expertise. This should be taken into consideration when developing your professional fee schedule.

**Level and Sources of Personal Income and Wealth**
- As stated above, buyers have higher after tax income than non-buyers and pay more in total taxes. Thus, they would have the incentive to reduce total taxes. Doing so requires a great deal of expertise. For example, deductions that are commonly known such as student loan interest and private mortgage insurance phase out as income increases. The phase out creep might catch potential clients unaware as their own income increases and the phase out erodes their own tax situation. Promotional materials that build awareness at people who had not previously sought out professional accounting services are now in a higher bracket necessitating professional accounting and tax planning services. This is consistent with the pattern shown with households with higher incomes buying more accounting services.
- Qualifying events necessitating expert advice include receipt of child support, and/or lump sum payments (through sales or inheritance), or status changes such as retirement or disability.
These events are related to the higher buying patterns of accounting services. The prudent accountant would build awareness in the client base that such events should precipitate seeking professional advice.

- Other complexities are related to the purchase of accounting services such as self-employment, receipt of rental income, sales of household goods. These complexities could be the subject of informative promotional materials and new complexities could be introduced such as changing and , often confusing, tax credits.

**LIMITATIONS OF THE STUDY**

The study has both clear limitations and clear benefits. The most important benefit, as mentioned earlier, is the background data in indentifying variables to be used to profile segments either by buyer/non-buyer status or by time segment. Although these variables will have to be validated in future studies, the insight provided in this exploration is invaluable in terms of savings on time and effort in identification. It also provides a baseline for a later multi-cross-sectional comparison of rates over time. It is, furthermore, the first of these data sets by the BLS that includes the critical fourth quarter of 2008 and provides from analysis of that time period. This series is also of excellent quality as a large, national probability sample with high quality methodology.

In terms of limitations, the study has the following problems:

- It uses a rough approximation for the time periods in the time segment analysis of buyers because the data set does not include the date of expenditure—only the month and year.

- It lacks variables that are important to understanding the motivation for using accounting and tax services.

- It lacks variables to explore the type of transactions and the benefits expected by the households for these transactions.

- It lacks marketing variables to select appropriate media, to set appropriate prices/fees, to decide on appropriate promotional tactics.

- It uses two series of four consecutive quarters in combination rather than splitting them apart for separate analysis because of the extremely small size of the later year time segments.

- The geographic variables in the data set cannot be used to refine the time segment profiles because some of them are already too small.

The primary sampling units focus on many major urban areas whose market structure may vary and may require adaptation of the service marketing mix for the area.

- The study does not attempt to look longitudinally at several cross sections in time before and after the critical 2008 year. Within two more years, this data will be available.

- The rather general nature of the expenditure category – accounting fees – does not permit distinctions among services.

The co-authors recognize these limitations but still wanted to explore what could be gleaned from a basic analysis. The results should be interpreted with care as exploratory only.

**SUGGESTIONS FOR FUTURE RESEARCH**

Clearly, a primary data collection study is needed to gather information on the missing variables that are important for improving the understanding of marketing for tax and accounting service professionals. In addition, comparison and contrast of stability or change in these personal characteristics, employment characteristics, and income and wealth characteristics for the segments identified can be accomplished in just a few years by analyzing three yearly cross-sections.

**CONCLUSION**

This exploratory study has identified some promising variables to profile buyer and non-buyer households. Although follow-up research is needed in order to incorporate other important variables not in this data set, it justifies the effort in looking into a new study. Such a study might be used to improve the marketing to accounting and tax professionals.

**REFERENCES**


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<tr>
<th>Variable</th>
<th>Buyers</th>
<th>Non-Buyers</th>
</tr>
</thead>
<tbody>
<tr>
<td>% HH Income from Sale Hsld Goods</td>
<td>2.3</td>
<td>0.9</td>
</tr>
<tr>
<td>% HH Lump Sum Trust or Estate</td>
<td>3.5</td>
<td>1.7</td>
</tr>
<tr>
<td>% HH Child Support Lump Sum</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>% HH Child Support Income</td>
<td>4.4</td>
<td>2.3</td>
</tr>
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<td>% HH Alimony Income</td>
<td>2.1</td>
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</tr>
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<td>% HH Can’t Find Work</td>
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<td>% HH Ill or Disabled</td>
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<td>% HH Retired</td>
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<td>% HH in Farming</td>
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<td>% HH Dual Income</td>
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<td>% HH Home Owner</td>
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<td>% HH Manager or Professional</td>
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<td>% HH Female</td>
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<td>Family Before Tax Income (000)</td>
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<td>Total Taxes Paid</td>
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<td>Rental Equivalent of Owned Home</td>
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<td>$1,357</td>
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Table 1 Profiles of Buyers versus Non-Buyers
### Table 2 Timing and Amount of Accounting Fees in Year

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<td>533</td>
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<td>Fees in This Period</td>
<td>528</td>
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<td>Fees in More than 1 Period</td>
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<td>Mean Fees in This Period--No Zero</td>
<td>$267.26</td>
<td>$351.17</td>
<td>$1,108.33</td>
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### Table 3 Profiles of Buyers by Time

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<td>$5,164</td>
<td>$2,219</td>
<td>$30,239</td>
<td>$10,120</td>
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<td>Mean Family Before Tax Income</td>
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<td>$67,685</td>
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<td>% HH Home Owner</td>
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<td>% HH White</td>
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<td>% HH Male</td>
<td>44.5</td>
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### Table 4 Results of Hypothesis Tests

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<th>Hypotheses</th>
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<tr>
<td>Amount Spent by Time</td>
<td>.000 overall</td>
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<tr>
<td>Sep.-Oct. different from Jan.-Apr.; from May-Aug.; from Nov.-Dec.; Jan.-Apr. from Nov.-Dec.</td>
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<tr>
<td>HH Never Married by Time</td>
<td>NS</td>
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<td>HH Divorced, Separated, Widowed by Time</td>
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<td>HH Manager/Professional by Time</td>
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<td>HH Military by Time</td>
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<td>HH with Lump Sum from Trust or Estate by Buyer Non-Buyer Status</td>
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STUDENT RESEARCH REVISION AS A TOOL FOR LEARNING STATISTICS

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ABSTRACT
The purpose of this paper is to show how revisions of statistical estimations demonstrate to the student the damage from statistical problems, the ability to improve estimation, and the process by which researchers arrive at a final result.

INTRODUCTION
A group of students during Spring, 2009 studied gasoline profits, the loss of U.S. manufacturing to other countries, the loss of jobs though foreign trade, and rising medical prices. Results were reported at the 2009 PEA in Sanders [5].

Students working on this project are sophomores taking their second course in Economic and Business Statistics at Clarion University, and chose the subjects as the topic of their course term project. The project is a multiple regression with at least three independents and thirty observations. After a first run, students meet with the instructor to identify a revision that would improve the estimation. Further revisions are not required, but some students taking part in this exercise worked through more revisions than usual, and on various functional forms for their equations.

The full project texts, a syllabus for the course and the text of this paper can be found at //jupiter.clarion.edu/~sanders/PEA2010 for a limited time. The equations below report the students’ results.

GASOLINE PRICES

Television news reports and newspaper articles emphasized the record profits of oil companies during the run up in gasoline prices. What actually determined the price of gasoline?

Student input: Gasoline prices were regressed with crude oil prices, profit rates, GDP, and stocks of gasoline, with the following early results:

\[
p = 19.926424 + 2.574072 \text{oilp} + 0.010830 \text{gdp} + 0.0773 \text{q}
\]

\[
(48.320) \quad (12.941) \quad (-1.277)
\]

\[
R^2 = .9805 \quad F = 2191.852 \quad DW = 1.158
\]

Revision: As indicated by the Durbin-Watson statistic and scatter plots associated with the regression, a linear form was not appropriate. For that reason, another functional form was tried, with the following results:

\[
p = -31.5 + 3.17 \text{oilp} - 0.06 \text{oilp}^2 + 0.01 \text{gdp} + 6458.25 \text{q}^{-1}
\]

\[
(24.3) \quad (-4.9) \quad (12.5) \quad (2.2)
\]

\[
R^2 = 0.9835 \quad F = 2191.852 \quad DW = 1.158
\]

As a result, the adjusted $R^2$ rose, and the Note that profit rates were dropped early for lack of explanatory power. An extremely high amount of explanation was achieved, and it reflects the results of professional studies. By using a more appropriate functional form, the student found that the explanatory power actually rose slightly, and the Durbin-Watson statistic moved toward 2. The source paper is Larson (3).

U.S. MANUFACTURING BASE

Another current topic was how to best stop the erosion of the U.S. manufacturing base. How much manufacturing have we lost?

Student input: U.S. manufacturing was estimated as a time trend: the relation of U.S. manufacturing value to world manufacturing was estimated; and a time trend of a
The proportion of U.S. to world manufacturing were estimated in the equations [3] – [5].

\[
^\wedge
\text{USMFG} = 39312805 + .193626 \times \text{WMFG} \quad (5.487) \quad [3]
\]

\[
R^2 = .6984 \quad \text{Ra}^2 = .6752 \quad F = 30.1 \quad \text{DW} = .463
\]

where \( \text{USMFG} \equiv \text{U.S. Mfg. value added} \)
\( \text{WMFG} \equiv \text{world manufacturing} \)

As shown in equation [3], a linear relationship between U.S. and world manufacturing indicates that U.S. manufacturing is growing in value added terms. The ratio of the two is then estimated as a time trend.

\[
^\wedge
\text{USMFG} = -2906993154 + 1530534T \quad (5.473) \quad [4]
\]

\[
R^2 = .6379 \quad \text{Ra}^2 = .6166 \quad F = 29.951 \quad \text{DW} = .595
\]

where \( \text{USMFG} \equiv \text{U.S. Mfg. value added} \)
\( T \equiv \text{year} \)

The results showed substantial multicollinearity, modest increase or even fall of the adjusted \( R^2 \), and unresolved questions about functional form.

\[
^\wedge
\text{RATIO} = 3.077991 - .001409T \quad (5.487) \quad [5]
\]

\[
R^2 = .3803 \quad \text{Ra}^2 = .3327 \quad F = 7.979 \quad \text{DW} = .555
\]

where \( \text{RATIO} \equiv \text{U.S. Manufacturing to world mfg. ratio} \)
\( T \equiv \text{year} \)

Revision: The student added trade-related variables to see if they would provide additional explanation, as touted in the “manufacturing export” theory. The results as found below:

\[
^\wedge
\text{USMFG} = -15266E+6 + 7688936T + 4153.7X - 1255.7M \quad (2.342) \quad (1.766) \quad (-.879)
\]

\[
R^2 = .6471 \quad \text{Ra}^2 = .3825 \quad F = 2.445 \quad \text{DW} = 2.017
\]

where \( \text{USMFG} \equiv \text{U.S. Mfg. value added} \)
\( \text{WMFG} \equiv \text{world manufacturing, and} \)
\( T \equiv \text{year} \)

\[
^\wedge
\text{USMFG} = -145585929 + 7688936T + 4153.7X - 1255.7M \quad (2.342) \quad (1.766) \quad (-.879)
\]

\[
R^2 = .6471 \quad \text{Ra}^2 = .3825 \quad F = 2.445 \quad \text{DW} = 2.017
\]

where \( \text{USMFG} \equiv \text{U.S. Mfg. value added} \)
\( \text{WMFG} \equiv \text{world manufacturing, and} \)
\( T \equiv \text{year} \)

The roughly constant share reflected professional studies. The source paper is Lundgren (4)

In the ratio equation, a much higher explanation power and a better Durbin Watson were found, but at the cost of high multicollinearity. This student learned about the possible dangers while attempting improvements, as well as the problems of a model testing two separate theories.

**THE U.S. IS EXPORTING JOBS**

Another topic was the extent to which trade takes jobs from American workers.
Student input: Employment, unemployment and labor force participation were regressed with exports and/or imports, income and interest rates. In parentheses are t-values.

According to equations [9], [10] and [11], employment tends to rise with trade activity, as given by exports or imports. The balance of trade is indeterminate, however.

According to equations [9], [10] and [11], employment tends to rise with trade activity, as given by exports or imports. The balance of trade is indeterminate, however.

Refinements:

In the employment equations, the student wrestled with autocorrelation from a complex functional form. As can be seen, his successes were sometimes tradeoffs, and sometimes ineffective. Multicollinearity was eliminated, but autocorrelation was not. The case in which autocorrelation was solved had an insignificant term. In all cases, the interest rate was found to be causing trouble, but not providing explanatory power, and was dropped.

In the unemployment models, the student saw nonlinearities. To begin addressing this, he tried second-power terms.

Equations[12], [13] and [14] show the unemployment rate dropping with greater trade (shown by exports or imports), and an indeterminate effect of trade balance. The lack of evidence that increased trade causes U.S. unemployment is consistent with theory and professional findings. The source papers for these results are Cotherman (1) and Dunkin (2).
As is usual, he made some progress, such as in the explanatory power of the equations. He also saw that he had not solved all of the problems. While second-power term was closer to the correct functional form, it clearly needed additional tweaking to bring up the Durbin-Watson and adjusted $R^2$.

### CONCLUSION

Students found that statistical methods can be used to explore issues of the day. They learned that refinements in their models improved estimation. Students learned that research as a process, rather than an event. They also got a look into the work and timelines of researchers, and a deeper appreciation of the results.

### CITATIONS


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\[
^UR = 1.1 - 2E^{-6}X + 10E^{-12}X^2 - 0.69Y + 0.03Y^2 + 0.56I - 0.007P \\
\quad (-3.12) (.493) (-1.91) (1.93) (2.43) (-1.56) \\
R^2 = .371 \quad Ra^2 = .274 \quad F = 3.83 \quad DW = .523 \quad [12] \\
^\]

\[
UR = 1.5 - 1E^{-2}M + 2.6E^{-12}M^2 - 7Y + 0.03Y^2 - 0.001P \\
\quad (-1.18) (1.28) (-1.95) (2.0) (1.47) (-23) \\
R^2 = .395 \quad Ra^2 = .302 \quad F = 4.24 \quad DW = .424 \quad [13] \\
^\]

\[
UR = 3.7 + 1E^{-5}B + 9.6E^{-12}B^2 + 0.088Y + 0.06I \\
\quad (1.82) (1.35) (1.22) (1.85) \\
R^2 = .216 \quad Ra^2 = .140 \quad F = 2.83 \quad DW = .525 \quad [14] \\
\]

where

- $UR \equiv$ Unemployment Rate (%)
- $X \equiv$ Exports ($million)$
- $M \equiv$ Imports ($million)$
- $B \equiv$ Net Exports ($million)$
- $Y \equiv$ GDP ($million$ 2000=100)
- $I \equiv$ Interest Rates (% quarterly)
ABSTRACT

What delays primary school enrollment in Sub-Saharan Africa? This paper seeks to find answers to this including health, public expenditure on education, GDP, colonization, and corruption. The major findings within this paper are that through panel data all of these variables are economically significant.

INTRODUCTION

Primary school enrollment often determines whether or not an individual goes on to higher education followed by a career that will allow them to live a more productive life. An education not only boosts the living standards of the individual but of their family and the society as well. This study examines the different factors that influence primary school completion in Sub-Saharan Africa while controlling for GDP per capita, public education expenditure, health, years of independence, and corruption. Section two of this paper reviews existing literature on this topic. Section three details the data and methods used in this research. Section four covers the results found from running multiple regression estimation using panel data. The conclusions reached through the empirical results are covered in section five. In section six potential policy recommendations are made as an outcome of the empirical results.

LITERATURE REVIEW

Primary Education, the Primary Step in Human Capital

A primary education is important because all individuals are given a chance to maximize their potential. In developing countries, access and attainment of primary education is not always easy. Children are often enrolled late and drop out before completing their primary or secondary education. This leads to citizens who are not maximizing their human capital which keeps the country from developing further. Sub-Saharan Africa is a region that has been working on expanding and developing their primary education programs. They experienced quite an improvement throughout the 1960s and 1970s after gaining independence, but after facing a severe crisis in the 1980s, budgets were cut and education programs experienced drastic drops in attendance rates. (Bommier and Lambert 2000) Many research efforts have been conducted in order to find out what issues came from crisis that caused these attendance issues to occur. One suggestion for delayed enrollment and attendance is malnutrition which is proposed by Glewwe and Jacoby.

Delayed School Enrollment

Chronic child malnutrition is cited by Glewwe and Jacoby (1995) as being one of the main reasons that school enrollment is delayed in developing countries. Malnutrition affects child development by stunting growth, retarding mental development, and it can reduce motivation and energy levels. They found that children who are less ready for school, in this case they are malnourished, will delay enrollment longer at the age of six and will complete fewer years of school. Borrowing constraints for parents and the income variable of fixed school fees are other explanations for delayed enrollment. Supply constraints are also present as there are not enough primary school slots to meet the demand in certain areas. Slots can also be rationed so that older students get preference which causes six-year old students to delay enrollment until they are seven.

Glewwe and Jacoby used the Ghana Living Standards Survey (GLSS) 1988-1989 for the data they analyzed. They looked at height measurements of young children and their mothers. They found that children with stunted growth do in fact delay school enrollment longer. They conclude that their findings on undernourishment have the potential to impact policy.

The characteristics of a school can determine how well students do according to Glewwe and Jacoby (1994). Parents are able to choose the school that their child is going to attend and those in rural areas can even foster their children to relatives who live in urban areas in order to send them to better schools. (Ainsworth 1992) Glewwe and Jacoby state that any positive correlation found between school quality and cognitive skills may just suggest that more motivated students go to better schools. They try to control for this sorting of students by jointly analyzing the determinants of school choice and student achievement. Their data set gives information on the characteristics of schools actually attended as well as those of alternative local schools.

Glewwe and Jacoby conclude that it is important to improve schools in order to raise productivity and the standard of living in developing countries. In the process of choosing what to invest in, it is necessary to know their cost and impact on the students’ educational outcomes. They found that school improvements are often understated and, therefore, their effects on attainment are not accounted for.

School enrollment in Tanzania occurs about 2 to 3 years later than the legal enrollment age. Bommier and Lambert (2000) examined the reasons for this delay and found that girls and
boys follow different schooling patterns due to different return from pre-school training in the family’s economic activities or from wanting to have girls married off as early as possible. They found in their survey that girls start schooling earlier than boys, even though a larger percentage of girls do not attend school at all, and the number of years completed is lower for girls than it is for boys.

As was mentioned earlier, girls enter school earlier but stay in for a shorter amount of time than boys. Bommier and Lambert find that it is due to two reasons. The first reason is a lower return to pre-school experience for girls, relative to post-school experience. Boys have a higher return to economic activities because there is a wider range of occupations open to them. The second reason is linked to bride price. They find that when the bride price increases, female enrollment in school is earlier but they spend a short time in school. They then critique Glewwe and Jacoby by saying that girls would have to be better fed than boys in order for them to enter school earlier if malnutrition was in fact a reason for delayed enrollment. Present day factors such as malnutrition are not the only problems with enrollment so history needs to be examined through colonization.

Colonization Johnson (1987) cites a list of problems that Francophone countries in Africa are facing such as: colonial structures, methods, procedures, and curricula ill-suited to national needs. Also a lack of qualified teachers, shortage of facilities, high drop-out rates and failure rates, the issue of what is the national language, gender inequalities, a reliance on foreign powers and lack of financial resources are cited as problems.

He goes on to discuss the fact that education is related to other aspects of society and therefore Western education infiltrates the political, economic, and cultural aspects of Francophone Africa. The argument is most Africans did not and do not participate in this education system as it was set up to create westernized subjects, who were loyal to the colonists and Christianity. They were not set up to reflect African culture, politics, society, religion, or economics.

Johnson concludes that while Francophone countries in Africa have tried to implement educational reform, they have been limited by design, conceptualization, and a reluctance to break away from their French origins.

Schafer and Garnier’s article (2006) examines 28 countries in Sub-Saharan Africa and the effect that being colonized by the British versus the French had on their education systems after independence. They found two institutional arrangements, one being the structural arrangements and mandates of educational institutions within the state and the second being the relevant practices, procedures, and precedents that these institutions adopted.

Schafer and Garnier found that the Francophone nations that were centrally planned did not reach the same rapid increases in enrollments as the Anglophone countries did in the initial period following independence. Colonization effects the structure of education systems which effects the education of students and in turn human capital.

Human Capital “How is inequality generated? How does inequality evolve over time? How does inequality influence other variables such as economic growth?” These are questions asked by Castello and Domenech (2002). Throughout their article they provide new evidence and measures of human capital inequality. They used information from Barro and Lee’s (2001) data set about educational attainments and they calculated a human capital Gini coefficient. They conclude that most countries in the world have reduced inequality in human capital distribution. Also they find that human capital inequality measures provide more robust results than income inequality measures in the estimation of standard growth and investment equations. With the analysis of their data they find that education inequality is associated with lower investment rates and therefore lower income growth.

Godia (1987) writes about the high priority that many African countries have given to expanding formal education since their independence in the 1960s. That being said, education was considered to be an investment in human capital that would give way to economic growth. He mainly cites Kenya and the fact that its demand for education was much higher than the rate at which the government was able to expand the public school system. Formal education was expanding at a faster rate than both the economy and secondary education enrollment rose from 493,710 in 1983 to 498,146 in 1984. This excess supply of formally educated people has left many of those who have completed a formal education unable to find employment. Since the education system grew faster than the economy the minimum qualification for jobs increased leaving many of those who finished secondary school out looking for jobs. Godia states that Kenya needs to restructure their economic and political systems and move toward the idea of making new jobs.

Parents Lloyd and Blanc (1996) note that primary school completers have a competency in basic literacy and numeracy which not only benefits them, but their parents, other family members, and society as well. Children with a primary school education can benefit by knowing how to stay healthy, how to make a living, how to be an effective member of society, how to control fertility, and how to be mobile. Their parents can benefit from a higher family income, economic support during retirement, a better social status, and an improvement on the marriageability of their daughters. Society benefits from productivity and income along with reductions in population growth and healthier, more informed citizens.
Lloyd and Blanc found that a child’s biological parents play a less critical role in their education when comparing the outcomes of orphans versus children whose parents are still alive. Children in households headed by a female do better in school than those in male-headed households. They found that girls do better in female-headed households whereas boys do better in high-income households. It was also found that the survival rate of the parents does not drastically affect a child’s enrollment status. What is more important is their own abilities as well as their current living situation, which in some cases comes through strong family support networks, like fostering of children.

Fostering of children is quite common in developing countries, as many as twenty-five percent of children are fostered. Those who are fostered do not do worse in school than those who are not. In fact most students are fostered to homes that can more easily enroll them in school if they have difficulty enrolling in school near their current home. Zimmerman (2003) argues that fostering children for education provides an important means of improving human-capital investment.

Zimmerman concludes that households take advantage of fostering in order to improve the human capital of their children, gain better access to domestic jobs for themselves, and to create social ties with other households. Students who were fostered faced a 14%-22% risk of not attending school had they stayed at home. He notes that his research does not permit concrete conclusions about who incurs the cost of child-bearing and child-rearing as they do not occur in the same household for many children.

In conclusion, Glewwe and Jacoby have done a good bit of research in the area of primary education in Sub-Saharan Africa, including two articles cited above. They are even cited by Bommier and Lambert when discussing the reason for delayed enrollment. Overall the literature references different factors that relate to primary school attendance such as travel time, mental development, the parent’s decision to school, and the fostering of children to relatives which Zimmerman discusses in conjunction with increasing human capital. This review of literature led to the variables chosen for the data portion of this research.

DATA & METHODS

This research gathered data and used a cross section-time series data for the years 1960-2008 and 48 countries which are listed in Table 1.

The regression was estimated to see if primary completion rate is associated to GDP per capita PPP, life expectancy, public education expenditure as a percentage of GDP, length of independence, and corruption levels below the threshold of 5. The following is the regression model:

\[
\text{Prim. Compl. Rate (C)} = \beta_0 + \beta_1 (\text{GDP}) + \beta_2 (\text{Exp}) + \beta_3 (\text{Life}) + \beta_4 (\text{Ind60}) + \beta_5 (\text{Below5}) + \epsilon
\]

Where Y is defined as Primary completion rate, total (% of relevant age group). Refer to Table 2 for definitions of the explanatory variables.

Hypotheses The hypotheses explain each variable and how they are expected to move in relation to the constant variable, either positively or negatively. Table 3 shows an abbreviated form of these explanations with a positive or negative sign by each variable.

Hypothesis 1: GDP per capita, PPP (current international $): As GDP per capita increases, the primary education completion rate increases as well.

Hypothesis 2: Public education expenditure as % of GDP: As public education expenditure increases, the higher primary education completion rate increases as well.

Hypothesis 3: Life expectancy at birth, total (years): Better health should increase primary education completion rates.

Hypothesis 4: 1960 Independence Dummy Variable: The longer a country has been independent should increase the primary education completion rate. This is a colonization variable.

Hypothesis 5: Below 5 Threshold for Corruption: With a decrease in corruption there should be an increase in the primary education completion rate.

Table 3 shows that completion rates are highly correlated with GDP, health, and corruption. It also shows that GDP is highly correlated with health and corruption and health with corruption.

This matrix shows strong correlation between completion and GDP, completion and life expectancy, completion and corruption, GDP and life expectancy, and life expectancy and corruption.

EMPIRICAL RESULTS

The following results are from running a multiple regression estimation using panel data. Table 5 shows the results from three different models. The first model ran GDP, expenditure, and life expectancy against the primary completion rate. Model 2 added the dummy variable for independence and Model 3 added the dummy for corruption.

In Model 1, according to the p-value, all of these values are statistically significant because they are all less than .05.
There is economic significance since the coefficients for GDP, expenditure, and life expectancy increase. In Model 2, the dummy variable for independence, or colonization variable, is added and all of the results are statistically significant except for the independence variable at the .05 significance level. The coefficient is positive which shows countries that gained independence in the 1960s do better than those that became independent in the 1970s as far as primary education completion is concerned.

The last set of results includes all the independent variables and both dummy variables selected for this study. The results, except for independence, are statistically significant and all of them are economically significant. As GDP, expenditure, and life expectancy increase, so do primary completion rates. The longer a country has been independent also increases completion rates. The coefficient for corruption is negative suggesting a decrease in corruption increases completion rates.

**CONCLUSION**

This study shows robust results throughout all models and evidence in support of initial hypotheses for GDP, expenditure, life expectancy, colonization, and corruption. GDP, expenditure, and life expectancy were robust across all the models as they had the expected sign and were all statistically significant (all p-values were close to 0). The colonization variable was consistent although not statistically significant across models. More corrupt countries do worse with respect to primary education than the more corrupt countries do after controlling for GDP, life expectancy, expenditure, and colonization. All of the variables were economically significant across the models as they had the expected signs, positive for GDP, expenditure, life expectancy, and independence, while negative for corruption. This study fails to reject hypotheses 1, 2, 3, 4, and 5. That is, the empirical results show evidence in support of a positive association between GDP and primary education, expenditure and primary education, life expectancy and primary education, and independence and primary education. The empirical results also show support of a negative association between corruption and primary education.

The sample size was certainly large enough; it encompassed 48 countries in Sub-Saharan Africa and 48 years ranging from 1960 to 2008. The variables for GDP, expenditure, life expectancy, colonization, and corruption were all in support of existing literature. Not only did this study add a time dimension but also a set of 36 different countries. It also added a corruption variable to a panel data set along with a colonization aspect. A suggestion for improvement would be to get child labor data to strengthen this study.

**POLICY IMPLICATIONS/RECOMMENDATIONS**

One step that could be taken toward improving primary education completion rates would be to make attending school mandatory. A few major problems to be addressed with implementing such a policy would be child labor, time it takes to travel to the nearest school, and the availability of teachers and classrooms. Perhaps an increase in GDP and the percentage of it spent on education could help finance the expansion of the school systems in Sub-Saharan Africa along with cutting down on the need for child labor. The range of occupations open to men is wider than that for women and was mentioned in the research done by Bommier and Lambert. Simply expanding the occupations open to girls would expand the education that they can receive. Improvements made in health care and nutrition would also help to increase completion rates since students would be able to start school on time and have a higher attendance rates and therefore higher attainment at the primary level. Colonization issues could be tackled by assimilating schools in countries that gained independence in the 1970s with those who gained independence in the 1960s. Schools could also try to make the educational experience based more in African culture, politics, religion, society, and politics rather than those aspects of the country that previously colonized them. Completion rates would also increase if the government systems were void of corruption. Perhaps a reordering or change in governmental systems is needed, or even just replacing certain leaders and political parties. The higher the primary education completion rates are, then the more developed a country can become because education is one of the objectives of development.
Table 1.

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<td>GDP is a basic measure of a country’s overall output.</td>
<td>World Bank</td>
</tr>
<tr>
<td>Public education expenditure as % of GDP</td>
<td>This expenditure variable determines how much of GDP is spent on public education.</td>
<td>World Bank EdStats</td>
</tr>
<tr>
<td>Life expectancy at birth, total (years)</td>
<td>This variable is a measurement of health which along with education is a basic objective of development. They are both components of growth and development where an education makes one healthier and being healthy allows better attendance for more education.</td>
<td>World Bank</td>
</tr>
<tr>
<td>1960 Independence Dummy Variable</td>
<td>This variable tries to determine if countries who gained independence in the 1960s have a higher completion rate than those who became independent in the 1970s.</td>
<td>CIA Factbook</td>
</tr>
<tr>
<td>Below 5 Threshold for Corruption</td>
<td>This dummy variable accounts for countries that have below the CPI score of 5 which is considered to be the threshold for corruption.</td>
<td>CPI 2009 Score</td>
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</tbody>
</table>
Table 3.

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Expenditure</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Life Expectancy</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Colonization</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Corruption</td>
<td>-</td>
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Table 4.

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>GDP</th>
<th>EXP</th>
<th>LIFE</th>
<th>IND60</th>
<th>BELOW5</th>
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<tbody>
<tr>
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<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
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<tr>
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<td>0.011054</td>
<td></td>
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</tr>
<tr>
<td>LIFE</td>
<td>0.600286</td>
<td>0.447216</td>
<td>-0.03536</td>
<td>1.00</td>
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<td></td>
</tr>
<tr>
<td>IND60</td>
<td>-0.0183</td>
<td>-0.03456</td>
<td>-0.23572</td>
<td>-0.08714</td>
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<tr>
<td>BELOW5</td>
<td>-0.54409</td>
<td>-0.36161</td>
<td>-0.0346</td>
<td>-0.58892</td>
<td>-0.03748</td>
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</table>

Table 5.

<table>
<thead>
<tr>
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<th>Model 1</th>
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<th>Model 3</th>
</tr>
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<tbody>
<tr>
<td>Int</td>
<td>-27.81236 (0.0124)</td>
<td>-32.35991 (0.0066)</td>
<td>6.673872 (0.6860)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.003758 (0.0000)</td>
<td>0.003747 (0.0000)</td>
<td>0.003592 (0.0000)</td>
</tr>
<tr>
<td>EXP</td>
<td>0.730967 (0.0225)</td>
<td>0.817278 (0.0134)</td>
<td>0.718202 (0.0251)</td>
</tr>
<tr>
<td>LIFE</td>
<td>1.283747 (0.0000)</td>
<td>1.305490 (0.0000)</td>
<td>0.905939 (0.0002)</td>
</tr>
<tr>
<td>IND60</td>
<td>-</td>
<td>3.783802 (0.2754)</td>
<td>2.407866 (0.4762)</td>
</tr>
<tr>
<td>Below5</td>
<td>-</td>
<td>-</td>
<td>-17.12579 (0.0013)</td>
</tr>
<tr>
<td>Cross Sections</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Total Pool</td>
<td>148</td>
<td>148</td>
<td>148</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.585010</td>
<td>0.588461</td>
<td>0.617299</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.576365</td>
<td>0.576949</td>
<td>0.603823</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>0.118936</td>
<td>0.119899</td>
<td>0.125845</td>
</tr>
<tr>
<td>F-statistic</td>
<td>67.66557</td>
<td>51.11894</td>
<td>45.80930</td>
</tr>
<tr>
<td>Prob (F-statistic)</td>
<td>0.000000</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
</tbody>
</table>

Note: Variables have coefficients listed with p-values below in parenthesis.
REFERENCES


ETHNIC FRACTIONALIZATION AND ECONOMIC GROWTH IN ECUADOR

Katherine Cooper and Danielle Hughes
Clarion University of Pennsylvania
Clarion, PA 16214

ABSTRACT

Ethnic fractionalization is an indicator of economic growth. In the case of Ecuador, problems such as discrimination, poverty, and poor infrastructure lead to further division of Ecuadorian ethnic groups. Our paper’s contribution is a statistical analysis on provinces in Ecuador that has not been done before. This could be a first step towards further research on ethnic fractionalization in Ecuador. Furthermore, the data collected came from a source directly devoted to Ecuador. This type of data is not available through global institutions such as the World Fact Book and the United Nations.

INTRODUCTION

Ethnic fractionalization is evident in Ecuador due to the large indigenous population that still inhabits the country. The diverse population has led to problems such as unequal income distribution, discrimination, and social uprisings. This study links Ecuador’s ethnic diversity with its slow economic growth. In the second section, we review and summarize the literature available concerning these topics. This is followed by section three that sets up the data and explains the variables chosen to describe economic growth. The empirical results show the outcomes of the regression model run through SAS, which can be found in section five. Section six includes different policy recommendations to improve the problem of ethnic fractionalization in Ecuador.

LITERATURE REVIEW

Ecuador is a land of contrasts. There are vast differences in its geography and biodiversity in terms of mountains, lowlands, islands, and coasts. The inhabitants of Ecuador are equally as diverse; Cameron (2005) states that the population consists of varying social classes, ethnic groups, and nationalities. Furthermore, Ecuador’s political system has been anything but consistent in recent decades, which has not only been affected by these immense disparities, but it has also magnified the situation in many ways (Andolina 2003; Zamosc 1966). Ecuador has a history of instability. In fact, Zamosc (1966) states that Ecuador was the most unstable country in Latin America in 1966, and he adds later that political instability plays a role in the class struggle that is so evident in Ecuadorian culture.

Discrimination Discrimination is a major problem throughout the world. According to Chong & Ñopo (2008), countries that face a higher level of poverty tend to have higher levels of discrimination due to “unequal treatment for the same characteristics”. Income distribution, unemployment, level of education, and many other accounts could be considered determinants of unequal treatment throughout Latin America. During a survey entitled Latinobarómetro, Chong & Ñopo (2008) conclude that Latin Americans were said to believe that the central categories of people who face discrimination are the poor, indigenous, and Afro-descendents. Swanson (2007) supports that these people are encouraged to change their culture in order to “fit in” with the upper classes of Ecuadorian society. Chong & Ñopo (2008) state “[t]he perception of poverty as a key discriminatory problem is fairly low in countries that are relatively homogeneous in terms of race”. Sixty two percent of people who live in Ecuador feel that there is a problem with racial discrimination (Chong & Ñopo, 2008). The level of poverty and racial discrimination is a major problem for Ecuador. Discrimination often explains the organization of social class structures within a culture.

Social Class Structure There are many different social classes and ethnic groups throughout Ecuador. These groups shape both the culture and the economy of the country. The top levels of the social class are the elites and the middle class (Hanratty 1991; Whitten 1965). The elites attain their wealth through the accumulation of land (Hanratty 1991; Linke 1960). Hanratty (1991) states that these people consider themselves “la gente buena” and think that since they attained a higher level of education than most of Ecuador’s inhabitants they are more qualified to govern the country. Furthermore, Hanratty (1991) states that the middle class grew because of opportunities from economic expansion. Whites and Mestizos are considered to be the main ethnic groups in the upper classes (Hanratty 1991; Whitten 1965).

It is thought that the “whiter” a person is, the higher class standing they have (Hanratty 1991, Whitten 1965). Swanson (2007) also believes that this is true; while talking about economic equality she states, “[i]t is the basis for a social hierarchy that posits whites at the top and blacks and Indians at the bottom”.

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According to Hanratty, (1991) Peasants and the working class create the lowest levels of social class. Zamosc (1966) explicitly states that “Ecuadorian Indians are peasants”. Hanratty (1991) adds that blacks and indigenous people are typically artisans or laborers. Nett (2007) implies that many obtain jobs by becoming household servants who perform tasks throughout the household in order to be of assistance to the family. Other jobs that were typically attained are “shoeshine boys, carriers of heavy and light loads, well and ditch diggers, street vendors, and keepers of stalls in markets”. Swanson (2007) says that Indigenous people who used to tend to their own farms and land are now seen throughout the streets of Ecuador selling small goods to tourists and passer-bys in order to make money. According to Swanson (2007), “[c]hildren are ever visible on the streets as shoe shiners, candy vendors, flower sellers, entertainers, and beggars”.

Swanson (2007) concludes that the indigenous people have turned to tourism as part of their main way to make a living and the upper class does not like the indigenous people crowding the streets and presenting tourists the idea that Ecuador is not modernized. Beck & Mijeski (2000) state that laws are put into place in order to control the indigenous people. Because of this, Swanson (2007) confirms that only “formal” street vendors are allowed to be located in the streets and any “non-formal” vendor is forced into locations that are unseen by tourists. Swanson (2007) adds that many “non-formal” vendors are beaten and arrested for “crowding” and “dirtying” the streets of city centers and plazas (708-728).

A recent cultural movement, led by the indigenous population, in the past few decades has tried to change the social class structure in Ecuador.

The Indigenous Movement In recent decades, the Indigenous people of Ecuador have made one of the most influential uprisings (levantamiento) in all of Latin America (Andolina 2003; Brysk 2004). The revolution is rooted in conflict between social classes (Zamosc 1966; Linke 1960). Several sources support that one of the main bases for the movement is the creation of a “plurinational state” (Andolina 2003; and Zamosc 1966; Brysk 2004). Zamosc (1966) states that they are also fighting for protection of land, infrastructure development, education and health programs, representation in state institutions, officialization of native languages, and territorial autonomy. The main leader of this movement is CONAIE, or the Confederation of Indigenous Nationalities of Ecuador. For more than two decades, CONAIE has been organizing national uprisings mainly against the Ecuadorian government. However, Brysk (2004) states that the movement’s main target is religious institutions.

Ethnic Fractionalization According to Fedderke and Luiz (2007), ethnic fractionalization matters for economic growth, and “ethnic diversity is an important predictor of economic performance. Easterly, Ritzen, and Woolcock (2006) support this idea by stating, “…ethnic fractionalization endogenously determine[s] institutional quality, which in turn causally determines growth”. The main subject on which their article focuses is social cohesion; they express that economic growth depends on measures of social cohesion (one of which being ethnic fractionalization). The article continues to state, “…countries strongly divided along class and ethnic lines will place severe constraints on the attempts of even the boldest, civic-minded, and well-informed politician (or interest group) seeking to bring about policy reform”. Easterly, Ritzen, and Woolcock (2006) conclude that this in turn will establish poor social institutions, and retarded or stagnant economic growth. Furthermore, a study that Easterly and Levine (1997) conducted on Sub-Saharan Africa concluded that Africa’s ethnic fragmentation affects economic growth through factors such as low schooling, insufficient infrastructure, and political instability.

In conclusion, Ecuador is a country plagued with contrasts. Some of which, including social class and ethnic group disparities, are causing extreme conflict within the nation as well as slow economic growth. Discrimination, poverty, and education are all factors that contribute to the inequality that defines Ecuador. Despite recent efforts of the Indigenous population to rise up against oppression that they have been living in for decades, there is still much progress to make concerning social and ethnic issues in Ecuador.

DATA & METHODS

Table one displays the results of our regression model. In order to test our data, a multiple regression was completed through SAS.

Regression Equation

Multiple regression will be performed as given by:

\[ ^{\wedge} \text{INV} = \beta_0 + \beta_1 (\text{ED}) + \beta_2 (\text{INF}) + \beta_3 (\text{POV}) + \beta_4 (\text{ETH}) \] (1)

WHERE:

\( \text{INV} = \text{Investment measured through investment expenditure (MEF.gov Ministerio de Finanzas)} \)
\( \text{ED} = \text{Investment as our dependent variable because investment is an indicator of economic growth.} \)

\( \text{INF} = f (\text{ED, INF, POV, ETH}) \)
**ED** = Education is measured by the percent of the population who does not possess the knowledge to read or write (Ecuador en Cifras)

**INF** = Infrastructure is measured by the percent of the population whose infrastructure is considered poor (Ecuador en Cifras)

**POV** = Poverty is measured by the percent of the population who do not have access to electricity (Ecuador en Cifras)

**ETH** = Ethnicity is measured by the percent of the population who consider themselves indigenous (Ecuador en Cifras)

**Provinces in Ecuador** Table two shows the sample size (N) is 21, which represents 21 provinces in Ecuador. There are 23 total provinces in Ecuador, but the 21 provinces were chosen due to their availability of data.

**Hypotheses** For this study we stated the following hypotheses:

- Education: Due to the fact that education is measured as the percent of people who do not possess the ability to read and write, we expect that education will be negatively associated with investment expenditure because higher levels of education often lead to a higher income, which in turn leads to higher levels of investment probability.
- Infrastructure: We foresee infrastructure being negatively related to investment expenditure because poor housing structure conditions often implies lower levels of wealth and therefore lower levels of investment.
- Poverty: We imagine that poverty will be negatively connected with investment expenditure because high poverty signifies low levels of income. If a household lacks money for necessities such as electricity they will also lack money to invest.
- Ethnicity: We also suspect that ethnicity will be negatively correlated with investment expenditure because the majority indigenous population does not have high levels of income to invest.

**Correlation Matrix** In table 3, the correlation matrix for the variables determining their relationship to investment in Ecuador shows strong correlation. Ethnicity is highly correlated with poverty, in that provinces with higher indigenous populations have higher levels of poverty. This is shown by the p-value because .0098 < .05. Investment and ethnicity are highly correlated because provinces with high levels of ethnicity to not tend to invest as much. Additionally their p value is less than .05. To further analyze the relationship between the explanatory and the dependent variable, a multiple regression analysis is performed next.

**EMPIRICAL RESULTS**

Multiple regression results are shown in table four. P-vales are indicted in the parentheses and four models were estimated.

Table four shows the robustness of each variable across models. Education was negatively associated to investment expenditure throughout all four models. As far as infrastructure, it was positively related with investment expenditure, which shows economic significance. However, it did not prove to be statistically significant in any model. Poverty was negatively linked with investment expenditure in both models three and four, but it was not statistically significant. Finally, ethnicity was negatively associated with investment expenditure. Statistically speaking it was not significant.

Regression Equation Refer to section on Data and methods for a full description of the dependent and independent variables.

\[
^\text{INV} = 7.550766 - .036797 (\text{ED}) + .022355 (\text{INF}) - (.918) - (.786)
\]

\[
.003953 (\text{POV}) - .010613 (\text{ETH}) + (.036797 - .308) + (.308) - (.1.165)
\]

The signs of all variables turned out as expected except for infrastructure. One plausible explanation could be due to the fact that Ecuador consists of four different geographical areas; therefore, the materials available for construction of housing are diverse. The data used for infrastructure measured housing structure from poor to good. We believe that it would be impossible to sustain a constant measure of structure quality across the varying geographical areas.

The model shows no statistical significance because the p-values for the x variables are all greater than .05. One possible reason p-values are high is the small sample size of 21 provinces.

For instance the education, poverty, and ethnicity coefficients agreed with our hypothesized theory. However, this study fails to accept the hypothesis for infrastructure. Furthermore, results show evidence in favor of economic significance.

**CONCLUSION**

After reviewing the results of our regression we concluded that there are several ways to improve this study. In order to gain a more robust sample size, we could expand the area studied to include the neighboring countries of Peru and Colombia. It would also be useful to our study to
expand the observed period of time to fully understand changes over time. As with most studies, expanding the time we had to conduct research would be beneficial.

The model concludes that the most influential variables on investment are education, poverty, and ethnicity based mainly on economic significance. Each of these three variables is a product of ethnic fractionalization in Ecuador. Many of the sources used in the literature review, supported that ethnic fractionalization has a role in economic growth. The model designed above further explains this theory for the case of Ecuador. Furthermore, this study shows that using infrastructure is not conducive to determining factors that hinder economic growth, although it is associated with ethnic fractionalization.

**POLICY IMPLICATIONS/RECOMMENDATIONS**

In order to boost economic growth, levels of investment must rise across all provinces. The consequences of Ecuador’s ethnic fractionalization must be handled. One of the first steps for dealing with this major problem would be progress towards a more consistent political system. Some of the topics that the government needs to address are discrimination, income distribution, unemployment, and education. Concerning these topics, social reforms should be put into place to minimize discrimination against the poor and indigenous population. One specific example is changes in legislation that single out the indigenous. Furthermore, the government needs to work towards changing the attitudes of the upper class, white and mestizos, to accept the indigenous population into urban areas and the urban workforce. A policy could be put into place to offer incentives to employers who hire indigenous people. This will work to not only change the attitudes of the upper class, but also to equalize income distribution throughout the country. Another policy that the government could impose would be similar to the program that Brazil uses entitled the “Bolsa Familia.” This program entices families to keep their children vaccinated and attending school. The Ecuadorian government could use this as a model to motivate the indigenous population to strive for higher levels of education which will in turn lead to higher levels of income in the future.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED</td>
<td>21</td>
<td>13.0038.10</td>
<td>3.021989</td>
<td>273.08</td>
<td>8.32</td>
<td>18.8</td>
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<td>4.880426</td>
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<td>16.56619</td>
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<td>347.89</td>
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<td>53872165</td>
<td>642607937</td>
<td>3062936</td>
<td>232252099</td>
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</table>

**Table 1. Regression Results**

**Table 2. Provinces in Ecuador**

<table>
<thead>
<tr>
<th>Provinces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azuay</td>
</tr>
<tr>
<td>Esmeraldas</td>
</tr>
<tr>
<td>Napo</td>
</tr>
<tr>
<td>Bolivar</td>
</tr>
<tr>
<td>Guayas</td>
</tr>
<tr>
<td>Orellana</td>
</tr>
<tr>
<td>Canar</td>
</tr>
<tr>
<td>Imbabura</td>
</tr>
<tr>
<td>Pastaza</td>
</tr>
<tr>
<td>Carchi</td>
</tr>
<tr>
<td>Loja</td>
</tr>
<tr>
<td>Pichincha</td>
</tr>
<tr>
<td>Cotopaxi</td>
</tr>
<tr>
<td>Los Ríos</td>
</tr>
<tr>
<td>Sucumbios</td>
</tr>
<tr>
<td>Chimborazo</td>
</tr>
<tr>
<td>Manabi</td>
</tr>
<tr>
<td>Tungurahua</td>
</tr>
<tr>
<td>El Oro</td>
</tr>
<tr>
<td>Morona Santiago</td>
</tr>
<tr>
<td>Zamora Chinchipe</td>
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**Table 3. Correlation Matrix**
<table>
<thead>
<tr>
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<th>Poverty</th>
<th>Ethnicity</th>
<th>Investment</th>
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</thead>
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<tr>
<td>Education</td>
<td>1.00000</td>
<td>0.10668</td>
<td>0.21612</td>
<td>0.48548</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0.0</td>
<td>0.6453</td>
<td>0.3467</td>
<td>0.0257</td>
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<tr>
<td>Poverty</td>
<td>0.10668</td>
<td>1.00000</td>
<td>0.60757</td>
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<td>Ethnicity</td>
<td>0.3467</td>
<td>0.0</td>
<td>0.0035</td>
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<td>0.08283</td>
<td>-0.20634</td>
<td>-0.47704</td>
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<tr>
<td></td>
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Table 4. Empirical Results

<table>
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<tr>
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<th>Model 2</th>
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<tr>
<td>β₀</td>
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<td></td>
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<td>(0.0001)</td>
<td>(0.0001)</td>
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<td>-0.066408</td>
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<tr>
<td></td>
<td></td>
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<td>(0.0793)</td>
<td>(0.1236)</td>
</tr>
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<td>β₂</td>
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<td>0.032330</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(0.5683)</td>
<td>(0.2541)</td>
</tr>
<tr>
<td>β₃</td>
<td>Poverty</td>
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<td>-</td>
<td>-0.012553</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.2539)</td>
</tr>
<tr>
<td>β₄</td>
<td>Ethnicity</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td>0.1067</td>
<td>0.0745</td>
<td>0.0943</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
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</table>

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Cameron, John. "Municipal Democritisation in Rural Latin America: Methodological Insights from Ecuador." Bulletin


ECONOMISTS IN CONGRESS: HOW ECONOMIC EDUCATION MOTIVATES VOTES ON FREE TRADE IN CONGRESS

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ABSTRACT

In 2005 the U.S. Congress passed the Central American Free Trade Agreement (CAFTA) causing the immediate elimination of tariffs on goods traded between the member nations. In the mold of the literature studying the pattern of voting in Congress, this paper attempts to understand why a Member of Congress would have supported the CAFTA legislation. We run a probit model of voting including a measure of the undergraduate college major in the analysis. The findings indicate that those who majored in economics are systematically more likely than any other college major classification to vote in favor of this free trade agreement.

INTRODUCTION

The substantive differences in worldview between economists and the general population on economic issues have been well documented. (Fuller, Alston, Vaughan, 1995; Blendon, et al., 1997; Walstad and Rebeck, 2002; Caplan, 2002; Miller, 2009). One of the consistent outcomes of this research is the general suspicion in which the lay-man, and some politicians, holds free trade agreements. This is thought to lead to the outsourcing of jobs, along with the belief that trade is not mutually beneficial. Caplan (2007) refers to this as the “anti-foreign bias” in which a predisposition exists against the economic benefits resulting from dealings with other countries. Since 2007 poll results have consistently shown support for Caplan’s anti-foreign bias. Some poll numbers are summarized in Table 1, with the tone being decidedly anti-trade.

Individual citizens however, do not write trade policy. While individuals can register their approval or disapproval with such policy, representatives are at liberty to follow the course they think is best for the country. Which means that poll-watching politicians are apt to be as divided about trade as the general population. Fuller, Alston, and Vaughan (1995) conduct a survey of delegates to the 1992 American political party conventions. When asked if tariffs and import quotas reduce the general well being of society, Republicans agreed at a rate of 62.4%, while Democrats agreed at a meager 25.7% clip, compared to economists who agreed at a rate of 71.3%. A more recent study by Fuller and Geide-Stevenson (2007) shows that for political party attendees in 2000, Republican support for free trade declined dramatically to only 31% from the Fuller, Alston, and Vaughan results accompanied by a slight decline for Democrats to 24.6%. The authors offer the explanation that a slight rewording of the question and an increase in the heightened perception of outsourcing led to the decline.

Interestingly, Miller (2009) notes that in terms of ideology and party, conservatives and Democrats are more likely than liberals or Republicans to support the notion of limiting imports to protect the domestic economy. Miller suggests that perhaps the framing of the question led to this peculiar result. The protection of domestic jobs could be considered a “valid” reason to conservatives for trade restrictions, as opposed to other reasons one might put forth for trade barriers. Read in this way, conservatives might agree with the statement while liberals would point to other “more valid” reasons such as social justice for such barriers.

Despite current public animosity toward trade, economists overwhelmingly support free trade. Fuller and Geide-Stevenson (2003) show that economists are galvanized on this issue. Between 1990 and 2000 agreement among members of the American Economic Association responding to a survey question asking if “tariffs and import quotas usually reduce general welfare of society” rose from 71.8% to 76.7%. This leaves us with one final group to consider: economists in Congress. Are they, as we might instinctively believe, the self-interested, re-election minded politician, or do they bring with them the economic beliefs they learned in their undergraduate education? This paper attempts to address that question by examining the votes of Members of
Congress in relation to the Central American Free Trade Agreement (CAFTA).

The undergraduate major of a Member of Congress should play a role in the decision making process of the member in some way. This adds to a theme of the voting literature known as background theory (Pjesky and Sutter, 2002; O’Roark and Wood, forthcoming). Rather than focus on the traditional composition of the constituency and political ideology, Pjesky and Sutter (2002) examine how life experiences of the members such as their involvement with the Chamber of Congress, and their educational attainment affect the votes of Members of Congress. The current study goes beyond Pjesky and Sutter by identifying the specific major of the members and whether, for instance, a political science or humanities major might vote differently than an economics major.

The paper proceeds as follows: a brief analysis of CAFTA is presented in Section 2, the model and data are addressed in Section 3, Section 4 presents the results of the model, and Section 5 concludes.

**CAFTA TRADE HISTORY**

A conscious effort to promote free trade between the United States and nations in the Caribbean was begun in 1983 with the Caribbean Basin Initiative (CBI). This agreement among 24 Latin American and Caribbean countries opened the U.S. to duty free importation of goods from its southern neighbors. The objective of the CBI was two fold. First, the initiative would encourage closer economic ties between the two segments of the western hemisphere along with promoting economic development. Secondly, the hope was that by fostering economic relations, the spread of communism in the western hemisphere would be curbed. One particularly political problem with the CBI was that it required continual re-approval by Congress. Since the expansion of the CBI in 2000, work has been undertaken to circumvent the approval process by replacing the CBI with direct bilateral trade agreements. CAFTA was proposed to reduce the transaction costs of multiple trade deals and to make permanent the zero tariff rates contained in the CBI. (Export)

Passed by Congress and signed by President George W. Bush in August 2005, H.R. 3045, the Dominican Republic-Central America-United States Free Trade Agreement Implementation Act, currently includes the United States, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua. This free trade zone created the second largest export region for the United States in Latin America behind only Mexico. Dramatic reductions in tariffs for textile, agricultural, and manufactured goods were accompanied by provisions to open doors for U.S. firms in the area of financial services and government procurement contracts. Additionally, laws regarding intellectual property rights were strengthened. The primary impact of CAFTA for U.S. producers was to eliminate the one-way tariffs against U.S. products into the nations who signed the agreement.

Provisions to address issues of corruption, labor rights, environmental concerns and dispute settlement proved the most contentious part of deliberations across all signing nations. Labor and environmental interests vehemently opposed the bill. Manufacturing and farming groups were in favor viewing the agreement as a way to expand markets and to gain an equal playing field. Not all nations signing the agreement were supportive. Strong opposition in Costa Rica by those who feared expanded U.S. influence almost scuttled the deal.

Passage of the bill in the United States was hard fought. The final vote was 217-215 and occurred only after Republican leaders held the vote open for nearly two extra hours to convince some members to vote for the measure.

**MODEL AND DATA**

The literature on voting behavior is vast. A long list of studies have examined what influences a Member of Congress as they vote for or against trade legislation. Virtually every trade bill over the past thirty years has been analyzed, from small bilateral trade bills, to large multination agreements like NAFTA, using a multitude of control variables (Nollen and Iglarsh, 1990; Marks, 1993; Boardu and Thompson, 1993; Moore, et al., 1995; Baldwin and Magee, 2000; Crichlow, 2002; Fordham and McKeown, 2003; Hasnat and Callahan, 2004; Bohara, et al., 2005; Gai, 2005; Weller, 2009). What these studies have not shown is whether a Member of Congress’ educational background affects their vote.

A natural first test of association is to conduct a simple cross-tabulation of members of Congress by free trade vote and undergraduate major. This test shows that economics majors were statistically more likely than any other major to support this free trade agreement, while no other major group displayed a statistically significant leaning. Among the economics majors, 72 percent were in favor compared with 50.2 percent of the overall congressional sample. These results are shown in Table 2, and indicate that there are systematic differences across undergraduate majors of members of Congress in their willingness to support free trade in the Caribbean.

This cross-tabulation test does not, however, exclude the possibility that the economics majors, or any other major for that matter, supported the free trade agreement because of some influence other than their educational background. Individuals who major in economics may be naturally more predisposed to favor free trade; that is, they may be
inherently more conservative. This selection effect could explain any bias in favor of free trade. Thus, we conduct a test of equality of means to determine if either the characteristics of the members or their constituents differ systematically for economics majors and non-economics majors. There is no statistically significant difference in the ADA scores or party affiliation, which indicates that economics majors are not markedly more conservative than non-majors. In fact, of all the control variables used in this study the only one that is statistically different for economics majors over non-econ majors is the percentage of campaign contributions from a labor union. Economics majors receive on average 5.6 percent of their contributions from labor unions while non-economics majors receive 8.8 percent of their contributions from labor unions.

Therefore, to better control for the labor contributions and other possible influence of on the CAFTA vote we construct a logit model using a representative’s vote on the CAFTA trade legislation presented in H.R. 3045 as the dependent variable. If the vote was “yea” in favor a value of one was assigned. If the vote was “nay” a value of zero was assigned. Our model is similar to that of Abetti (2008) who also focused on CAFTA.

Our sample examines only House members. A lack of variation in the Senate precludes a clean analysis. Combining the two chambers not only provides problems in comparison, but also is not a conventional method of analysis. Not all members of Congress voted on the bill leaving us with a sample of 432. 217 voted in favor of the bill, while 215 voted against it.

The model takes the following form:

\[ VOTE = aE + bM + fC + \mu \]  

(1)

where VOTE is a dummy variable equal to 1 if a representative voted yes on the CAFTA bill and zero otherwise. E is a vector of dummies for the college majors of members of Congress. M is a vector of personal characteristics of the members, and C is a vector of constituent characteristics. \( \mu \) is an error term.

Data points for our analysis come from a variety of sources. Demographic characteristics for each state and congressional district come from the Census bureau. The district data is based on the 2000 Census. Information about individual members of Congress is drawn from their personal websites and from the Congressional Staff Directory issued by Congressional Quarterly. (Congressional Staff Directory)

We use the Americans for Democratic Action (ADA) ideology score to control for the ideological priors of members of Congress. ADA is a commonly used measure of ideology (see Groseclose, Levitt and Snyder, 1999; Bohara et al., 2005; Lopez and Ramirez, 2008; and O’Roark and Wood, forthcoming). We also run versions of the model including a control for party. Part of the reason for this is to identify if, as in Kahn (2005), there might be some impact of party loyalty inherent in the vote. Additionally, Nolan and Iglarsh (1990), Marks (1993), Baldwin and McGee (2000), Dennis, Bishin and Niccolu (2000), and Hasnat and Callahan (2004) include party as a control for trade votes. A natural concern is whether this might interact with the ideology variable causing spurious results. Thus, we run versions of the model including party and ideology separately, as well as one in which party and ideology are included together.

The percentage of the work force represented by unions as well as the percentage of the workforce in the textile and agriculture industries is only available at the state level. We nevertheless use this as a proxy for the congressional district. Spillover effects would inevitably make this a difficult value to quantify, as it is not uncommon for individuals to live and work across congressional district lines. Campaign contribution data comes from opensource.com.

**Characteristics of Members of Congress**

The primary variable of interest is the educational background of the Members of Congress. We grouped members into educational major categories based on the definitions shown in Table 3. Table 2 provides a breakdown of the percentage of Congressional members in our major classifications. In all specifications of the model, we include eight major classifications leaving out the “no major” category to avoid a near singular matrix problem. A positive sign on a major category, as we would expect to see for the economics major, would be consistent with support for free trade.

In testing for the influence of ideology, we expect the ADA measure to possess a negative sign. This would mean that more conservative members of Congress are likely to vote in favor of free trade. The party variable is a dummy equal to one if a member is a Republican. Since this policy was raised during the Bush administration, the sign on party should be positive. This would indicate at the very least that Members of Congress held the party line, although it could indicate that Republicans are more in favor of free trade than Democrats.

Similar to Kahn (2005), we control for whether a member is a freshman to indicate the mood of the nation toward the administration. This variable is coded as a one if a member is in their first term and zero otherwise. Newly elected Members of Congress might have run on a pro-trade basis hoping for coattails from President Bush. Contrariwise, they might have run on an anti-trade message to counter what some Democrats considered an illegitimate president. Thus, the sign on freshman could be positive or negative.

The percentage of PAC money from business and labor groups as a share of money raised is also expected to impact
the vote of the Congressmen. Since business generally favors the opening of markets, it is expected that the sign on business PAC contributions will be positive. As labor unions tend to be against free trade the sign on labor PAC donations should be negative.

**Constituent Characteristics** The second list of control variables in Table 3 focuses specifically on the characteristics of constituents. The percentage of the population who are Hispanic should be positively correlated with the vote on CAFTA. Prior research (Boadu and Thompson 1993; Baldwin and Magee, 2000; Hasnat and Callahan, 2004; and Abetti, 2008;) found the Hispanic population to be an indicator of a positive vote on trade issues dealing with Latin American countries. By supporting CAFTA a Member of Congress may be placating the Hispanic portion of their constituency.

Turning to the educational attainment of the population, those with less than a high school education are likely to be opposed to free trade either because they do not understand the benefits of it, or more likely, because this will create competition for low skilled jobs. Thus, the sign on the percentage of the population with less than a high school diploma should be negative. Those with a college degree are more likely to favor free trade and the sign on this variable is expected to be positive.

Finally we include controls for labor force traits. Here we include a variable for the percentage of the population who are represented by a union as well as certain sector specific controls. The percentage of the population represented by a union is expected to be negatively related to the CAFTA vote as unions are traditionally opposed to opening borders, and in this case opposition by labor union leaders was intense. Unemployment is expected to be negative as those out of work sometime use free trade agreements as a straw man for their ills.

Two specific sectors of the workforce, textiles and agriculture, were expected to be directly affected by CAFTA. Generally, textile workers viewed CAFTA negatively as it was believed to intensify competition and possibly outsource jobs. Those in the agricultural sector, on the other hand, saw this as an opportunity to expand their markets. Thus, the sign on the control for the percentage of the workforce in textile production is expected to be negative, while that for the percentage of the work force in agriculture is expected to be positive. Summary statistics are presented for these control variables in Table 4.

**RESULTS**

The results of the model are shown in Table 5. The variables all have the expected sign except for the unemployment rate and in some cases the percentage of the population represented by a labor union. Neither of these variables displays a level of statistical significance.

The unemployment rate in 2005 was 5.1% and falling. In such an economic environment, the reaction to a free trade bill should be supportive, thus, the number of unemployed may not have the impact on voting that would be expected. Similarly, not all union members were opposed to CAFTA despite the vocal outcry. Agricultural unions were in favor of the program thus, union representation may not be as important in a Member of Congress’ decision.

In all versions of the model reported, being an economics major has the expected positive sign and is statistically significant. Interpreting the coefficients in a logit model can be difficult, so we present the marginal effects. Being an economics major makes the Member of Congress between 30.49 and 39.26 percent more likely than another major to vote in favor of free trade. The only other major that holds any level of significance is the human services majors, the majority of who majored in education. The negative sign on the coefficient as seen in Columns 2, 3, 4, and 6 indicates that these majors are 33 to 35.78 percent more likely to vote against CAFTA than other majors. This raises an interesting question of whether a dearth of economics in the undergraduate education curriculum is leading not only to poor decisions in personal finance but also corresponds to poor policy decisions when it comes to economic issues.

The ADA, party of the member, Hispanic population and percentage of the labor force in the textile industry are all consistently statistically significant. Those Members of Congress who are either more conservative as indicated by a low ADA score, or who are Republicans are more likely to vote in favor of CAFTA. An increase of a member’s ADA score by one point increased the probability of voting in favor of CAFTA by 1.48% across the samples. Interaction effects do appear to be a concern in the final two columns of Table 5 as the party variable is insignificant in both columns and the sign switches to negative in Column 5. In the two samples where only party is included, the Republican members are 76.3 percent more likely than the other Democratic colleagues to vote for CAFTA. The strength of the party variable suggests that Republicans are more supportive of trade and perhaps, at least for CAFTA, there is a degree of party loyalty playing out.

The Hispanic population affects Members of Congress leading them to vote in favor of free trade with Caribbean nations. If the Hispanic percentage of the population in a district increases by 1%, the likelihood of a positive vote for CAFTA increases by 0.74%.

The textile industry appears to have a strong pull, more significant at least than union membership as a whole, within
a congressional district. The marginal effects indicate that increasing the percentage of the work force in the textile industry by 1% decreases the probability of a yes vote on CAFTA by 1.79%.

Interestingly, the percent of the labor force in a union does not appear to affect the votes of Members of Congress. However, the percent of a candidate’s contributions coming from a labor union does impact the vote rather significantly. Increasing the percentage of campaign contributions coming from a labor PAC by 1% decreases the likelihood of voting for CAFTA by 4.13% on average. This leaves the impression that special interest money means more than special interest numbers. These two variables, percent of the workforce represented by a labor union, and the amount of labor PAC contributions are run in separate versions of the model due to heterogeneity.

**CONCLUSION**

An economically literate population is a vital component of a well informed society. Understanding how the economy functions, the fundamental role free markets play and the importance of private property are the foundation of a society whose economy is strong and vibrant. No less important is the understanding of such economic institutions for those who write policy.

This paper has shown that when it comes to voting on a free trade bill, those who understand economics, the economics majors, vote consistently as we expect them to. Over a number of specifications, controlling for ideology, party, labor influences among other factors, the results are robust. Economics majors support free trade. Unfortunately they do not appear to be having success articulating the benefits of free trade to their colleagues. In particular, human services majors are consistently at odds with the CAFTA bill.

Caplan’s notion of an anti-foreign bias is a real concern for economic development. While economists understand this, apparently Members of Congress as a whole do not. More work lies ahead for economic educators who want to see their work come to fruition. As is often the case, we see that the Halls of Congress are the place where the work needs to begin.

**TABLE 1: Poll results for free trade**

<table>
<thead>
<tr>
<th>Date</th>
<th>Question</th>
<th>Response</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2008 -</td>
<td>Has free international trade helped or hurt the economy?</td>
<td>50% - Hurt</td>
<td>LA Times / Bloomberg Poll</td>
</tr>
<tr>
<td>April 2008</td>
<td>Do you think that free trade agreements have been a good thing or a bad</td>
<td>48% - Bad</td>
<td>Pew Research Center / Council on Foreign</td>
</tr>
<tr>
<td></td>
<td>thing for the United States?</td>
<td>35% - Good</td>
<td>Relations</td>
</tr>
<tr>
<td>Dec 2007 /</td>
<td>Do you think the fact that the American economy has become increasingly</td>
<td>Dec: 58% - Bad</td>
<td>NBC News / Wall Street Journal Poll</td>
</tr>
<tr>
<td>March 2008</td>
<td>global is good or bad.</td>
<td>March: 58% - Bad</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dec: 28% - Good</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>March 25% - Good</td>
<td></td>
</tr>
<tr>
<td>March 2007</td>
<td>Do you believe that the United States is benefiting from or being</td>
<td>25% - Benefiting</td>
<td>NBC News / Wall Street Journal Poll</td>
</tr>
<tr>
<td></td>
<td>harmed by the global economy</td>
<td>48% - Harmed</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 2: Percentage Positive Vote on the CAFTA free trade bill by Undergraduate Major

<table>
<thead>
<tr>
<th>Major</th>
<th>Proportion Positive Vote</th>
<th>t-statistic</th>
<th>Percentage of majors in Congress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics</td>
<td>0.720</td>
<td>2.434**</td>
<td>5.75%</td>
</tr>
<tr>
<td>Business and accounting</td>
<td>0.553</td>
<td>0.645</td>
<td>8.74%</td>
</tr>
<tr>
<td>Government, political science and related fields</td>
<td>0.436</td>
<td>-1.842*</td>
<td>45.52%</td>
</tr>
<tr>
<td>Humanities</td>
<td>0.548</td>
<td>0.854</td>
<td>16.78%</td>
</tr>
<tr>
<td>Vocational</td>
<td>0.600</td>
<td>0.758</td>
<td>3.45%</td>
</tr>
<tr>
<td>Human service, including education and medical</td>
<td>0.375</td>
<td>-1.297</td>
<td>5.52%</td>
</tr>
<tr>
<td>Science and technology</td>
<td>0.516</td>
<td>0.157</td>
<td>7.13%</td>
</tr>
<tr>
<td>Other, including no college degree</td>
<td></td>
<td></td>
<td>21.61%</td>
</tr>
<tr>
<td>ENTIRE SAMPLE</td>
<td>0.502</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\chi^2 = 10.239$

** indicates statistical significance at 1 percent level.
* indicates statistical significance at 5 percent level.
Statistics are from t-test of difference of means tests assuming unequal variances between each major and the rest of the sample; $\chi^2$ test of statistical independence for entire sample.

Table 3: Definitions of Variables

<table>
<thead>
<tr>
<th>Member Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUSACCO</td>
<td>first or second major provided was in business or accounting</td>
</tr>
<tr>
<td>ECONMAJ</td>
<td>first or second major provided was in economics</td>
</tr>
<tr>
<td>GOVETC</td>
<td>major in government, political science, foreign affairs, international affairs, public administration, pre-law or urban studies</td>
</tr>
<tr>
<td>HUMANITIES</td>
<td>major in American studies, art history, religion, communication, English, French, general studies, history, journalism, philosophy, Spanish, speech, Far Eastern languages, music education or social studies.</td>
</tr>
<tr>
<td>HUMANSERVICE</td>
<td>major in education, nursing, pharmacy, pre-dental, pre-med or social services</td>
</tr>
<tr>
<td>SCITECH</td>
<td>major in a science or technical field</td>
</tr>
<tr>
<td>VOCATIONAL</td>
<td>major in agriculture, home economics, mortuary science or criminal justice</td>
</tr>
<tr>
<td>ADA</td>
<td>ideology score based on the voting records tabulated by American's for Democratic Action</td>
</tr>
<tr>
<td>FRESHMAN</td>
<td>dummy equal to 1 if a Member of Congress is in their first term</td>
</tr>
<tr>
<td>PACBUS</td>
<td>percentage of total campaign contributions from business PAC</td>
</tr>
<tr>
<td>PACLAB</td>
<td>percentage of total campaign contributions from labor PAC</td>
</tr>
<tr>
<td>PARTY</td>
<td>dummy equal to 1 if a Member of Congress is a Republican</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>District and State Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG</td>
<td>percent of labor force in agriculture industry by state</td>
</tr>
<tr>
<td>BA</td>
<td>percent of population with a bachelor’s degree</td>
</tr>
<tr>
<td>HISPANIC</td>
<td>percent of the population who are Hispanic</td>
</tr>
<tr>
<td>HS</td>
<td>percent of population with less than a high school education</td>
</tr>
<tr>
<td>TEXTILE</td>
<td>percent of labor force in textile industry by state</td>
</tr>
<tr>
<td>UNEMP</td>
<td>unemployment rate</td>
</tr>
<tr>
<td>UNIONREP</td>
<td>labor force represented by a union percent of state (district data not available)</td>
</tr>
</tbody>
</table>
Table 4: Selected Variables’ Means (Standard Deviation Listed Below Means)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Economics n=25</th>
<th>Non-Economics n=410</th>
<th>Full Sample n=435</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Characteristics of Members of Congress</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADA</td>
<td>38.333</td>
<td>47.176</td>
<td>46.686</td>
</tr>
<tr>
<td></td>
<td>41.117</td>
<td>42.974</td>
<td>42.874</td>
</tr>
<tr>
<td>FRESHMAN</td>
<td>0.08</td>
<td>0.093</td>
<td>0.092</td>
</tr>
<tr>
<td></td>
<td>0.279</td>
<td>0.290</td>
<td>0.289</td>
</tr>
<tr>
<td>PACBUS</td>
<td>0.344</td>
<td>0.349</td>
<td>0.348</td>
</tr>
<tr>
<td></td>
<td>0.162</td>
<td>0.384</td>
<td>0.374</td>
</tr>
<tr>
<td>PACLAB</td>
<td>0.056</td>
<td>0.088</td>
<td>0.086</td>
</tr>
<tr>
<td></td>
<td>0.067</td>
<td>0.092</td>
<td>0.091</td>
</tr>
<tr>
<td>PARTY</td>
<td>0.64</td>
<td>0.527</td>
<td>0.533</td>
</tr>
<tr>
<td></td>
<td>0.489</td>
<td>0.500</td>
<td>0.499</td>
</tr>
<tr>
<td><strong>District and State Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AG</td>
<td>0.013</td>
<td>0.015</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>0.021</td>
<td>0.021</td>
<td>0.021</td>
</tr>
<tr>
<td>BA</td>
<td>0.102</td>
<td>0.113</td>
<td>0.112</td>
</tr>
<tr>
<td></td>
<td>0.035</td>
<td>0.040</td>
<td>0.040</td>
</tr>
<tr>
<td>HISPANIC</td>
<td>0.157</td>
<td>0.146</td>
<td>0.147</td>
</tr>
<tr>
<td></td>
<td>0.201</td>
<td>0.173</td>
<td>0.174</td>
</tr>
<tr>
<td>HS</td>
<td>0.203</td>
<td>0.194</td>
<td>0.195</td>
</tr>
<tr>
<td></td>
<td>0.056</td>
<td>0.045</td>
<td>0.046</td>
</tr>
<tr>
<td>TEXTILE</td>
<td>0.077</td>
<td>0.095</td>
<td>0.094</td>
</tr>
<tr>
<td></td>
<td>0.119</td>
<td>0.116</td>
<td>0.116</td>
</tr>
<tr>
<td>UNEMP</td>
<td>0.068</td>
<td>0.070</td>
<td>0.070</td>
</tr>
<tr>
<td></td>
<td>0.015</td>
<td>0.021</td>
<td>0.021</td>
</tr>
<tr>
<td>UNIONREP</td>
<td>0.112</td>
<td>0.126</td>
<td>0.125</td>
</tr>
<tr>
<td></td>
<td>0.050</td>
<td>0.066</td>
<td>0.065</td>
</tr>
</tbody>
</table>

* Values are missing for some variables, making n < 535 total in those cases.

Table 5: Regression results
Dependent Variable: Vote on CAFTA bill equal to 1 if Member of Congress voted yes
z-stat in parentheses

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*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

REFERENCES


DEFORESTATION IN BRAZIL AND ECONOMIC DEVELOPMENT

Travis Schill
Clarion University
Clarion, PA 16214

ABSTRACT

The problem of tropical deforestation is one of the most profound environmental and economic problems in the world today, and nowhere is the problem bigger or more important than in the Brazilian Amazon. The forests are cleared for myriad reasons, usually with economic incentives of one form or another driving the trend. However, though the problem has been heavily studied and researched, little consensus has been reached as to which forces in particular are responsible. The purpose of this study is to primarily observe the influence of various macro economic variables as well as some non economic variables on the process of Amazonian deforestation.

INTRODUCTION

The loss of rain forest land worldwide is an ecological catastrophe that affects us all. These unique biomes serve vital purposes, the destruction of which has repercussions that reverberate around the world. The Amazon rain forest is one of the most important examples, the Brazilian portion, the largest portion, being especially vital. Deforestation in Brazil has been a controversial issue for decades and the trend is only accelerating. There are myriad reasons, both economic and otherwise, that contribute to the trend. The purpose of this paper is to discover what is the relationship between deforestation and economic development in Brazil.

This study takes a unique look at the problem and makes a couple of original contributions to supplement and expand upon the work available in the existing literature. All of the studies that were reviewed either used agricultural land added as a proxy for deforestation or CO2 emissions per capita. This study uses them both so as to see which one reflects deforestation better and to see which one is more strongly correlated to the variables. Also, though the literature discussed the potential impact of individual agricultural products, all the ones reviewed looked predominantly at agricultural production as a whole, while this study does both this and includes beef and soy as specific agricultural products.

LITERATURE REVIEW

Deforestation in the tropical regions of the world, particularly, the Brazilian Amazon, has received much attention and research. Therefore, any look into the issue requires a look into the work of previous researchers, thus, the purpose of this section, will be to identify many of the findings that have been postulated on the subject in previous literature.

The Defining of Deforestation Deforestation, particularly in tropical regions is a particularly vital issue that needs to be observed. However, finding a good, empirical measure of a trend that is so observable is complicated. Caldas et. Al. (2002) used a rather complicated model wherein an INCRA map with property boundaries was digitized and laid over a GIS data base. Much of this was based upon images provided via satellite imagery from NASA. However, while seemingly the most sound way to observe a trend is to empirically observe it in such a way, an attempted look at deforestation from a satellite can be problematic. One reason being, images can be obtained and interpreted in various ways as discussed by Eduardo (2009). Distinguishing that which counts as land conversion and that which represents the deforestation arc have been discussed and debated by numerous parties Eduardo (2009) continued. Another reason is that such images are only limitedly available and do not exist prior to 1980, with the exception of one from 1978. Therefore, a direct, objective look at the trend in this way proves problematic for any attempting a statistical look into the problem Eduardo (2009) concluded.

On the other hand, a simpler and possibly more reliable measure of deforestation lies in a method used by Eduardo (2009) wherein a look at agricultural density, agricultural area divided by the total state area. However, this too poses problems as it is looking at agricultural density, so it is including land that has been converted from the savannah regions, or the otherwise non Amazonian regions. The data could also be seen as being skewed by the fact that areas can be ceased to be used and would thus not be reported as being agricultural. Instead, this study uses the agricultural area alone. Because most of the land deforested is converted to agricultural land, this will serve as an accurate proxy.

Land as a Commodity and Factor of Production This is a huge issue with myriad factors and variables affecting it, many in such complicated ways that the actual effect is often difficult to deduce. Morton et. Al. (2006) stated that the Brazilian Amazon was the single most active land use frontier in the world. Brazil is what is known as a land abundant nation, in a world with a shortage of arable land.

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Macro economically, there are many rationales for the phenomena of deforestation within the Brazilian Amazon. Land is a commodity, the usage, or allocation, of which is dictated by price factors just like any other commodity (Morton et. Al., 2006, Cattaneo, 2001). The deforesters, who Cattaneo (2001) called the suppliers are driven by the market incentives provided by the demand for arable land. This demand for arable land changes as an economy develops. As a country reaches higher levels of development, the need for deforestation for the generation of new capital begins to wane. Therefore, deforestation can also be said to be linked to the Environmental Kuznets curve.

Environmental Kuznets Curve Barbier and Burgess (2001) looked into the potential effects of the Environmental Kuznets Curve, EKC, on Brazilian deforestation. Barbier and Burgess (2001) noted that as income increases, deforestation would consequently decrease. Also, they looked into the opposite effect of population growth, as they speculated and discussed how dense populations and a rising population would increase the pressures on the land and would thus perpetuate ever higher rates of deforestation. They claimed, in yet another contradiction, that the EKC seemed to have an effect, and other data showed no effect. Barbier and Burgess (2001) continued by saying that the projected potential turning point of income for a reversal of environmental degradation via deforestation is roughly one third above their current rate of income per capita, for all of Latin America. However, this turning point is closer than in other parts of the world, so we may see it occur in Latin America first.

The turning point is likely caused by a change in the marginal costs and benefits of deforesting land, as the economy develops, more work outside of the agricultural sector becomes available, and the cost of land will decrease. Thus, reducing or even eventually eliminating the incentives that drive land conversion.

Importance of Land Costs The returns on converted land are, like with any commodity, driven by cost as well as demand factors. One key cost factor that is instrumental in the driving of deforestation is transportation cost. One obvious factor of deforestation for any given region is the location of the forest and its proximity to settled areas according to Babier & Burgess (2001). This is why the literature discusses the deforestation arc of the Amazon, the majority of land conversion occurs along the periphery between the already converted land and the untouched forest. As roads and infrastructure are constructed to make the Brazilian hinterland accessible to the global markets, the goods produced on the cleared lands can be more easily marketed, therefore increasing the demand, the price, and ultimately, the incentive to supply new converted land (Branstrom, 2000, Babier & Burgess, 2001). An example of this is the trans-Amazonian highway. Another, as discussed by Nepstad et. Al. (2006) is the small barge system developed along the Madeira river in conjunction with the development of a deep water port at Itacatiara to facilitate easier transport of goods from the region. These aquatic improvements, though not as famous as the trans-Amazonian highway did facilitate the acceleration of an already exponentially growing economic industry, soy production.

Another cost that affects the rate of deforestation is a set of costs discussed as institutional costs. These include taxes, trade policy, stability, corruption, bureaucratic efficiency, etc. Babier and Burgess (2001) went on to say that, ideally; political stability, control of crime and corruption, bureaucratic efficiency, and strong individual property rights would serve to limit and slow deforestation. However, in a demonstration of the complexity of the issue, they went on, in virtually the next sentence to refute themselves by saying that the above situations could potentially merely streamline the process and help to fuel the problem of deforestation as stated by Babier & Burgess (2001). While cost factors can drive people to the forest lands, potential profits through commercial agriculture also play a role, as can be seen through a look at the importance of exports.

The Importance of Exports The economy of the Amazon has traditionally been viewed as being one that largely exists for the satiation of foreign demand for primary goods, and that was a major aspect of economic growth and policy decisions pursued by the Brazilian government Eduardo (2009) stated. Therefore, when the government looked to increase revenues and economic activity, they would often pursue export promotion policies Eduardo (2009) continued. This included the expansion and modernization of large scale agriculture. This large scale modernization reduced the labor intensification of the agricultural process and thus further heightened the plight of agricultural workers.

Additionally, the issue can be viewed from the stance of economies of scale. For a given region, as the amount of cleared land increases, then the amount of infrastructure and labor available similarly increase. This in turn lowers the prices of these in agricultural inputs, thus increasing the potential return on new agricultural land, and finally raising the price to a sufficient level to spur further deforestation Cattaneo (2001) stated.

Corruption According to Eduardo (2009) vast stretches of the Amazon are already set aside as reserves and parks, in fact, including indigenous reservations, they stretch over 1.1 million square kilometers. However, the government doesn’t allocate adequate resources for proper enforcement.
of its conservation policies Eduardo (2009) continued. Government spending has led to drastic cutbacks in the funding for the agencies charged with the maintenance and protection of these areas in an effort to cut the deficit and get the debt under control during the past decades of budgetary problems experienced by Brazil (Eduardo, 5). In 2005, the government arrested dozens of environmental officials for corruption stated Nepstad et. Al. (2006). Lack of law enforcement is a chronic problem in the Amazon, for example, there was only one guard available for approximately 6,161 square kilometers according to the 1990’s estimates Eduardo (2009). This lack of oversight combined with the lucrative nature of land conversion and resource exploitation led to low risk and high profit potential for authority abuse and corruption. Thus the incentives were in place to fuel the process of deforestation.

**Macro – Economic Policies** Cattaneo (2001) discussed a plethora of additional macro economic factors as well, including, credit, interest rates, fiscal subsidies on agriculture, technological change, colonization policies, industrialization policies, etc (Cattaneo, 2001, Babier & Burgess, 201).

Fiscal subsidies on agriculture help in particular as they increase the prospective returns on land clearing; therefore, they directly help to increase the incentive for further deforestation. Contrastingly, the more conservative economic policy environment that has arisen recently in Brazil has led to a tightening of Brazil’s monetary policy Eduardo (2009). This in turn led to the withdrawal of subsidized credit to agricultural endeavors, leaving farmers without the necessary capital to improve the land they had and continue to function. Credit allows factors of production exogenous of labor, i.e. capital, to complement the abundant labor and to thus facilitate more effective and efficient agricultural production stated Caldas et. Al. (2002). Therefore, many farmers sold their farms and moved to regions where they could start anew Eduardo (2009) stated. “Given their lower opportunity costs, subsistence farmers were willing to sell their plots of land to the newcomers and move into the Amazon,” Eduardo (2009).

Trade liberalization and better collaboration with global norms and trade requirements are also helping the booming Brazilian agricultural sector to compete abroad, thus increasing deforestation Nepstad et. Al. (2006) postulated. This opens an interesting contradiction, as elsewhere in the literature, such as the discussion of the EKC, economic growth served to help mitigate deforestation, whereas here, economic growth is seen as fueling deforestation.

The demand and supply for property rights is also very important claimed Eduardo (2009). The demand was driven largely by the prospective capital gains of selling ‘improved’ converted land. Also, the very act of deforesting and converting land is a traditional way of securing and enforcing land claims and thus right to ownership continued Eduardo (2009). Strong and easily obtained property rights has been a key corner stone of colonization on the Amazonian frontier throughout the history of Brazil, much as it was in our country and other regions with areas of unutilized potential agricultural land.

**Exchange Rates**

An example of the complexity of the issue is that of the effect of the exchange rates. Nepstad et. Al. (2006) postulated that the 2002-2004 spike in deforestation was the result of a teleconnection, which he defined as two distant climatic phenomena occurring simultaneously in two different areas, as the Real devaluated substantially against foreign currencies Nepstad et. Al. (2006) continued. This devaluation is commonly good for the agricultural sector as it lowers the price of the country’s goods, in this case Brazil’s, on the world market concluded Nepstad et. Al. (2006).

However, in direct contrast to this, Cattaneo (2001) claimed that the devaluation hurt the agricultural sector and consequently hindered deforestation. She claimed that the export sector is a small and insignificant part of the agricultural market targeted in Brazil. Instead, she argued that the reduced consumption of the Brazilian public transferred into a diminished market for goods, thus lowering the return on farm land and lowering the demand for converted forest land Cattaneo (2001) continued. The reduced buying power of the Brazilian population would lead to reduced consumption possibilities across the board and lead to a depressed demand for locally produced agricultural products. Additionally, the reduced buying power of the Brazilian currency would consequently increase the price of imported capital goods used for agriculture and land clearing, tractors, saws, tools, fertilizers, etc. These two potential outcomes would combine to reduce the price of agricultural products, and, therefore, the rate of return on investments into agricultural production, i.e. land conversion.

**Agriculture – General**

Thus far, I have discussed deforestation and the factors contributing to this, just mentioning agriculture. Throughout the literature, agricultural expansion is often used interchangeably with deforestation, as the two are often directly linked Barbier & Burgess (2001) contended. Agricultural conversion is directly related to price of agricultural staples, thus, they looked into such factors as population growth, agricultural exports, agricultural yields, land constraints, etc.

Brannstrom (2000) gave an effective account of the historical pattern of deforestation within the Brazilian
Amazon. The coffee growers during Brazil’s height of dominance over the industry lowered costs via labor relations and governmental subsidies, both of which helped to fuel the beginnings of the trend of deforestation in the country Brannstrom (2005) continued. He looked heavily into the Transactions Costs Theory and its potential application into the issue as he looked into the issues of labor relations in the time period and how these efforts to drop costs helped to facilitate the massive deforestation steps that followed concluded Brannstrom (2005).

Because the government actively helped and allowed the growers to keep labor costs down, and they even subsidized and encouraged agricultural land conversion, the growers opted not to reinvest in declining coffee groves, opting rather to pursue new groves out of ‘fresh land’ according to Brannstrom (2005). Coffee added value to farms and capital was accumulated via deforestation and expansion. This provided the all important incentives that would fuel and facilitate the process of deforestation and launch a trend that would continue into today.

Eduardo looked into the significance of government policy in the process of Brazilian Amazonian deforestation. The government was interested in policies that would lead to deforestation for a couple of reasons that involved national security, particularly during the time of military dictatorship regimes. First, was to assert Brazilian sovereignty over the Amazon stated Eduardo (2009). Second, was to reduce the frequency and intensity of political instability that occurred over land conflict throughout the nation. The colonization of the Amazon was seen as a ‘safety valve’ for the disenfranchised in the country Eduardo(2009) continued. This was seen as the strategy of “peoples land and landless people,” Eduardo (2009) said, as it was seen as a fortuitous coincidence of needs and resources to be utilized.

Agricultural land is a major source of wealth in the nation, thus the mass production of it is a fast way for them to generate wealth. However, this quantitative growth has largely come at the cost of qualitative growth as farmers have adopted poor agricultural techniques, a problem they are only just recently trying to remedy Barbier (2004) stated. This poor agricultural intensification includes such issues as practices, fertilizer use, technology adoption, crop rotation, etc. Barbier (2004) contended. In sum, land depreciates with long term negative consequences to its productivity and agricultural value. Additionally, this reduced quality can lead to erosion and numerous other environmental issues, like health problems and ecological disruption that can translate into poor economic development, despite the growth.

Agriculture – Beef and Soy Though coffee carried the torch for the first half of the last century, beef and soy are the contemporary drivers of deforestation Nepstad et. Al. (2006) claimed. One reason is the liberalization of trade and adoption of global trade practices and regulations to enable competition on the global market Nepstad et. Al. (2006) concluded. Beef for example has taken off due to the industry’s adoption of better genetic lines of cattle, better technology, better pasture management, etc. So, as prices of these two commodities change so do the rates of deforestation. Basic technological improvements could do more than any amount of public policy.

For example, a more efficient method of raising livestock would lessen the amount of arable land used for pasture, which would free it up for farming, which would, in turn, finally decrease demand and price and incentive for the production of converted forest land stated Cattaneo (2001). Traditionally, forests in Brazil were largely cleared for use as pasture, until recently. The rise of soy has led to a rising importance of cultivation land ( Nepstad et. Al., 2006, Morton et. Al., 2006). In fact, agribusiness, large scale farming, now accounts for roughly 1/3 of Brazil’s GNP and may account for the largest portion of new deforestation (Morton et. Al., 2006, Barbier, 2004). The two are actually directly related as well, Barbier (2004) observed. As the price of soy goes up, the amount of land deforested for cattle seems to go up.

This is a contradiction to another old pattern of this kind of deforestation, as it is large areas being taken by the rich instead of small ones being taken by the desperate and disenfranchised poor. Fearnsdie (2005) showed that only 25% of the deforested land was in sections of 25 hectares or less, thus showing that it is mostly large land owners taking the land. Therefore, we cannot blame poverty for the environmental problems Fearnsdie (2005) stated. This insinuates that the social cost of reducing deforestation would be dramatically less than originally thought, in fact, it would probably help. It would be a situation of hurting growth but helping development as people would have a healthier environment and more efficient agricultural practices claimed Fearnsdie (2005).

Conclusion A look at the specific factors driving the deforestation may seem superfluous and unnecessary. In particular, one could ponder, “the rain forest is disappearing, what does it matter if it is for soy or cattle, or the rich or the poor?” Knowledge of who is responsible and what factors are involved is crucial to the eventual resolution of the issue.

DATA & METHODS
Deforestation, though obviously a serious problem, is a difficult one to quantify. All the attempts at quantification have been based upon satellite imagery to reveal the true acreage cleared. However, such images are open to
subjective interpretation and can be misread or blatantly skewed in an effort to make the data fit the agenda of the interpreter. Also, the images to be reviewed are not available from every year and only go back a few years. Therefore, a look at the problem would require the utilization of proxy measures for deforestation so as to accommodate empirical observation. It is almost universally acknowledged that the predominant share of the land that has been cleared in Brazil over the last several decades has been converted into agricultural land. So, for this study’s first regression, the study decided to look at agricultural land as a percentage of the total. Throughout the literature, this has been used as an indicator of deforestation in Brazil, so this study has chosen it to be the first ‘y’ variable.

However, to complement this study’s statistical observations, a second ‘y’ variable was used as well. Deforestation accounts for a major share of the CO2 emissions in every country that faces the problem. Brazil is no exception, in fact, it has been postulated that deforestation could count for as much as 70 percent of CO2 emissions in that country. The study decided to look into this in an effort to establish a check against the uncertainties of the first dependant variable.

A summary of the variables as well as the descriptive statistics for the study can be seen in Tables I and II at the end of the paper. The literature placed heavy emphasis upon the impact of agricultural factors as being major dictators of the deforestation problem. Just as the expansion of agricultural area can be attributed to deforestation, so this study hypothesizes that the expansion of agricultural production will be significantly correlated. This study intends to see if the expansion of agriculture is purely quantitative, thus decreasing the rain forest, or qualitative, and making better use of the land available. Beef and soy are the two largest agricultural products produced by Brazil; therefore, this paper looks at them and sees if their statistical importance matches the emphasis given to them in the literature. This study hypothesizes that there will be a positive correlation between these two variables and deforestation.

In relation to the above stated reasons for agricultural production, this study looks into agricultural value added as a variable as well. As land is deforested, it is converted into agricultural land, and, therefore, the level of agricultural value added as a percentage to the GDP should also increase. Agricultural value added was included in an effort to capture the effects of other agricultural goods as well, coffee, sugar, and others that are important to Brazil. If the correlation of this variable is more significant than those for beef or soy, then it will be shown that the literature’s overwhelming presumption of the importance of those two products was inaccurate. Therefore, this study hypothesizes the correlation to be positive between agricultural value added and deforestation. Interest rates should also prove to have some correlation to the rate of deforestation. Deforestation is the economic act of converting land from one use to another in response to profit and cost incentives. If interest rates are high and land is consequently difficult to be purchased in the already agriculturally productive regions, then people, rich and poor included, will likely pursue the course of land conversion in the Amazon to supply their land demand. Or, contrastingly, if interest rates are high, then money will be invested in other activities outside of the primary sector and the rate of deforestation will decrease. Therefore, the literature provides rationales for hypothesizing both a negative and a positive correlation between interest rates and deforestation.

Brazil, like most LDCs, relies heavily upon the production of primary goods for the world market. In Brazil, these exports are highly influenced and even dominated by the products responsible for Amazonian deforestation, such as timber, agricultural goods, and minerals derived from mines. One debate expressed in the literature centered around the impact of the export rate of the country on the deforestation rate. Therefore, this study looks into the correlation of the export rate of goods and services and deforestation, and it is hypothesized that correlation to be positive.

A contention posited by the literature that this study intends to look into is the effect of external debt shock on the rate of deforestation in the Amazonian regions of Brazil. This study hypothesizes that the rate of deforestation will decrease as the external debt shock rises, and will increase as it diminishes. This study suggests this because, as the debt of the country increases, there is less capital available to be utilized in the clearing of the forests. Rising debt typically coincides with a slump in economic activity as well as a devaluation of the currency, both of which would lead to a decreasing of the incentives to convert land from rain forest to other uses. Again there is a controversy as rising debt could lead to restricted funds for enforcement of environmental laws and desperation for increased tax revenue, both of which could precipitate higher rates of deforestation. Therefore, this study also hypothesizes that the correlation could be positive.

The next variable this study will examine is population growth; population growth is seemingly the most obvious variable to be factored into any form of environmental degradation, much less one such as deforestation. Throughout the literature, population was presumed to be a driving factor in the acceleration of deforestation. However, this study wishes to see to what degree the two variables are correlated, and this study would like to see how the other variables that the study has included will
compare to population growth in terms of statistical significance. Additionally, there were instances within the literature wherein population growth was given marginal significance. This study hypothesizes a positive correlation, though with reason to suspect a negative one as well.

Foreign direct investment is another interesting variable to look into so as to discern correlation between it and deforestation. This study hypothesizes a negative correlation to exist between FDI and deforestation. According to much theory, deforestation is largely driven by foreign direct investment as large swaths of land are cleared for farmland and thus converted from rain forest. Contrastingly, however, some other scholars contend that deforestation is a function of a lack of opportunity. As people are perpetually impoverished and locked in the dreaded poverty trap that so plagues the developing world, the incentive to degrade the environment and thus deforest land, even marginal land, can become sufficient to perpetuate a catastrophic trend. Foreign direct investment is seen as a catalyst to inject new capital and thus economic activity into the nation and thus lead to the rectification of the development problems that facilitate deforestation. Therefore, a look into the statistical backing of each of the above arguments will be interesting and informative.

Finally, the growth of GNI per capita is a vital variable to include in any study on economic development. Deforestation, particularly land conversion to agricultural practices, is an economic process, wherein the incentives to convert land arise with the appropriate levels of marginal cost and marginal benefit. Thus, the literature gives this paper reason to hypothesize that as GNI goes up, then the rate of deforestation will go down. This is because, as people are poor, they have fewer options and have more to gain by establishing new farms on the frontier. However, if the economy is strong and GNI is increasing, then it could be speculated that the people will have less incentive to deforest land and thus the rate of the trend could potentially slow deforestation. Contrastingly, others suggest that as the economy booms, so too does demand for all forms of commodities, those produced at the expense of the forest being included. Therefore, as GNI increases, it could lead to heightened demand for goods and thus increase the incentive to convert land from the natural state of rain forest into some other, more monetarily beneficial and more marketable use.

A number of the variables are correlated with interesting trends being thus revealed, the correlation matrix can be seen in Table III at the end of the paper. Both of the dependent variables, Agricultural land as a percentage of the total and CO2 emissions per capita, are highly correlated to all of the variables that were observed. This is good as it verifies that which was hypothesized, all the variables that were have chosen to be x variables have proven to be significant factors that determine deforestation. However, it was disappointing, but not astonishing to see a high rate of correlation between the ‘x’ variables as well.

Beef and soy production was a surprising pair of variables to be as highly correlated as shown by the analysis. Soy being a major food staple for cattle, as it is high in protein, is likely responsible for the existence for this correlation. The original hypothesis was that the cattle raising industry in Brazil was largely ranch based with heavy emphasis upon pasture, thus making soy less important to cattle production. This is also why the study chose to use beef production instead of dairy production, protein is vital for dairy and the cows can’t be left to pasture for as long of times as beef cattle can. This study also theorized that the prominence of bio diesel in the Brazilian economy, derived from both sugar and soy, would separate the two items into differing categories. It was hypothesized that the correlation could possibly be negative; more beef with less soy and vice versa, thus making the inclusion of both a good reflection of agricultural deforestation. Also interesting is the low rate of correlation between soy and beef production and interest rates. This is good as it proves that the production of these agricultural products is not affected by credit and the interest rates, as it had been theorized. Also important is the lack of correlation between the interest rate and the rate of exports, GNI, and external debt shock. This suggests that the Brazilian economy as a whole isn’t very sensitive to the monetary implications of interest rates. Additionally, the interest rate is moderately correlated to both FDI and population growth, so more data will be needed to run and see how closely these items truly do affect one another.

Finally, and most significantly, the interest rate is the only one of the independent variables to not be heavily correlated to either of the dependant variables. This could be due to the fact that the interest rate depicts the price of money and thus of capital. The price of capital would not have a heavy impact upon a labor intensive industry like agriculture. This thus partially vindicates the argument posited in the literature regarding large areas of land being cleared, obviously by larger entities that would have the lines of credit or capital on hand to be affected by interest rates.

Empirical Results. To analyze the variables that were outlined and discussed above, the study used an estimation of two regressions. One used the agricultural land as a percentage of the total land of the nation as the dependant variable, and the other using the CO2 emissions per capita value as the dependant variable.

The empirical results showed some interesting trends in the data and yield some intriguing results, see table IV at the
end of the paper. First, the beef production variable proved to fit into this study's original expectations. Beef production proved to be both statistically and economically significant to the rate of deforestation in the Amazon in both regressions that were run for the two proxies for deforestation.

Soy proved to be economically significant in both models but not statistically significant in either of them, though it was marginally close in the agricultural land model, as would be expected. This is interesting as it was presumed that soy production is highly correlated to deforestation in the Amazon, as soy production is a well known commercial crop in the area, thus the study theorized that soy would have a direct, positive correlation with deforestation. However, in the agricultural land model, soy actually had a negative relationship with deforestation. This is quite puzzling as soy production should be contingent upon the availability of fertile land. One possible explanation for this is that perhaps soy is not as easily grown able in the regions being deforested, as soy requires quality soil and deforestation depletes this resource. Also, soy may be planted in areas already deforested due to the fact that soy serves to replenish nitrogen in the soil. The relationship is economically significant and positive in the CO2 emissions model, which is also interesting. This reveals a key difference in the two proxies and thus the reason for the inclusion of both, as by one measure of deforestation, soy production is negatively related to deforestation, it is positively correlated by the other.

The influence of the interest rate was shown to be highly economically significant in both models. It is a negative correlation, suggesting that the higher the interest rate, the lower the deforestation rate. This suggests that people will only turn to forest conversion if there is no other, more prudent ways to invest their time and money. Or, contrastingly, as loans get more expensive, there is less investment in agriculture and thus less of the large parcels of land discussed will be deforested.

Agricultural value added was shown to be highly significant economically in both models. It was also nearly highly significant statistically in the CO2 model and was not statistically highly significant in the agricultural land model. Particularly with the agricultural land model, agricultural value added is largely a one to one relationship, thus robbing it of its statistical significance. However, this does reveal an overall relationship between the expansion of agriculture and the deforestation of the Amazon, particularly in the CO2 emissions model.

The export of goods and services was shown to be highly economically significant and highly statistically significant, though it was marginal in the agricultural model. The negative correlation with the coefficients indicates that as the exports increase, deforestation will decrease. This is very interesting and serves to solve a major debate and controversy in the literature. Some of the authors contended that the agricultural export sector was of vital importance in driving the deforestation trend. However, others postulated that the agricultural sector of the Brazilian economy was aimed primarily at domestic consumption. Taking the correlation between agricultural production and deforestation into account, the latter of the above positions seems to be accurate. One possible explanation for this could be that as exports increase in the country, economic opportunities arise elsewhere and people turn away from forest conversion and pursue easier lifestyles than tropical agriculture.

External debt shocks were economically significant in both models, and were statistically significant in the agricultural land model, but were not significant in the CO2 model. The literature suggested that much of the problem was not a lack of conservation policy, but of a lack of enforcement. External debt could be an indicator of restricted government funds, thus leading to cuts or simple lack of expansion of conservation spending, thus leading to deforestation. Also, external debt could lead the government to become anxious in increase tax revenue in any way it can, with an expansion of agriculture into deforested lands being a natural and easy possibility.

Population growth has long been believed to be heavily correlated to deforestation, as the increasing pressure of over population increases the demand for arable land to sustain it. However, here the population growth is only statistically significant in the CO2 model, and all else is insignificant. This surprisingly vindicated an argument posited in some of the literature disregarding the old paradigm of population growth driving deforestation. They based their arguments on the satellite images offered by NASA showing the deforestation in the Amazon. These images show the deforestation, and they suggest that most of the land conversion is done in large plots of land by large entities. This refutes the theory of population pressure as if population pressure were responsible, small chunks of land would be deforested at a time as poor people struggled to carve out a small piece of land to subsistence farm and support themselves.

Foreign direct investment is also highly correlated economically. Statistically, it is highly significant in the agricultural land model, but is not in the CO2 model. Interestingly, FDI is highly correlated in a negative relationship to the agricultural measure of deforestation. One potential explanation for this is that as FDI enters the country, then opportunities for economic advancement arise elsewhere. In essence, the opening of the country to the world economy allows would be farmers a choice other
than land conversion for prosperity. In the CO2 emissions model, FDI was positively correlated. This likely suggests that the investments come with new activities that produce CO2.

Finally, GNI per capita was highly economically significant. In the agricultural land model, it was statistically significant, though it wasn’t in the CO2 emissions model. The agricultural model correlating coefficient indicates that growth is highly correlated to deforestation rates. This could either mean that increased economic prosperity leads to a higher demand for forest goods and converted land, or it could mean that the deforestation leads to increased income that spurs the GNI per capita value to increase.

**POLICY IMPLICATIONS AND CONCLUSIONS**

Given the empirical findings of the regressions, there are several potential policy implications and suggestions that could be recommended. The first of which is the promotion of better and more efficient agricultural techniques. Brazil is similar to many different land abundant countries in that the incentives for qualitative land improvement and sustainable agricultural practices do not outweigh the cost and the potential for the simple low cost alternative of clearing new land from the rain forest. However, the findings of the empirical analysis have shown that agricultural factors are highly correlated to the rate of deforestation. Therefore, improved crop rotation, fertilizer usage, and pasture maintenance strategies should be employed so as to ensure the optimum use of the land that is currently available for cultivation.

The government should advocate the expansion of more qualitative agricultural growth so as to gain the needed increased levels of output as opposed to the purely quantitative expansion that has been seen traditionally. For this to occur, the government would need to help to create incentives to make the marginal revenue of qualitative improvements compare with the marginal revenue of quantitative improvements per cost. This is a hard feat as the land that is being deforested is largely free, with the only real cost being labor. Brazil is a labor abundant country, thus making the labor intensive clearing of land seem more prudent than the often capital intensive land improvement. Therefore, government is needed to help to manipulate the incentives and make the environmentally sound choice parallel the economically prudent choice.

Next is the promotion of export industries. The empirical evidence showed that the expansion of the export sector of the economy is positively correlated to reductions in the deforestation rate. This could potentially be interpreted as creating incentive to leave the agricultural sector and enter other fields.

In connection to the promotion of export industries, the promotion of FDI would also seem to be a prudent course of action. The negative correlation between the FDI and deforestation suggests that an increase in FDI would slow the deforestation trend. As FDI pours into the economy, the surplus labor that would otherwise likely find them on the frontier carving a living from converting forests to fields is put to work providing goods for the global market. Yet again, trade liberalization and increased economic opportunity reveals another example of using incentives to move policy in the direction that we want society to go.

So, after reviewing the empirical analysis and the regressions, this study has failed to reject the hypothesis. Agricultural production does indeed seem to be highly related to the deforestation trend in the Amazon, and economic development is key to the resolution of the problem.

**REFERENCES**


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<td>Good proxy</td>
<td>World Bank</td>
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Table I: Data Summarization

Table II: Descriptive Statistics
Table III: Correlation Matrix
Table IV: Empirical Results

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A STRATEGY TO STRENGTHEN THE US ECONOMY

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ABSTRACT

For decades the United States’ competitive position in global manufacturing has steadily declined. Analysts point to increasingly automated manufacturing processes, changing domestic demand factors, outsourcing, and overconfidence in service export surpluses. However, Asian and European competitors, undergoing the same pressures, have been able to maintain a healthy percentage of their GDP’s in manufacturing by growing high tech jobs while the United States continues to fall behind. Perhaps the most fundamental and overlooked contribution to this decline is the lackluster performance of the United States education system. After comparing the performance of US students to that of the other G-8 nations in the critical disciplines of math and science literacy, US students rank last. Furthermore, the most recent PISA test results show US students rank in the bottom half of 30 participating nations in the ability to apply math and science concepts to real world problems. This is particularly troubling when one considers that among the compared nations the US spends the most on math and science teacher compensation.

If the US intends to successfully compete in the global manufacturing arena, significant changes to the education system must be enacted. A new strategy aligning the system with real world demands should begin with a national initiative to increase Pre-K enrollments, a paradigm shift from liberal arts to math, science, problem solving and critical thinking, standardized policies aligning high school graduation requirements with college and workplace expectations, and standardized college and career readiness assessment programs. These steps combined with more rigorous secondary education teacher certifications, continued education and involvement with universities and manufacturing firms within the community, should more adequately prepare high school students for further study or to enter the skilled workforce. At the post secondary level federal and state funding should be targeted to R&D programs specific to industrial design, engineering, and alternative energy. Industry investment in such programs should be federally incentivized to foster cooperative relationships between business and academia. Such relationships will ensure faculty spend time focusing on how their discipline relates to manufacturing and install the necessary skill sets, knowledge and abilities graduates will need to compete in the global market. Such a revised system will position the US to create and keep high paying manufacturing positions on its way to sustainable economic growth.

OBJECTIVE

The events of the last two years have proven to be a powerful reminder of the potential danger of reliance on a predominantly service based economy to provide sustainable economic growth. The stark reality of our economy’s fragile state, while frightening, may allow for a more open discussion on how to best restore the United States’ position as the global manufacturing leader after decades of decline. It is no coincidence that as our competitive position in global manufacturing has declined, so too has the United States’ performance in math, technology and science education; disciplines integral to maintaining a competitive edge in manufacturing. Deliberate funding in these critical disciplines, in conjunction with targeted private sector investment designed to create well paying jobs, are the first steps towards increasing the US GDP attributed to manufacturing from an anemic 12.7% to a level on par with European and Asian competitors enjoying ranges above 20% (Raveche, 2009). However, these steps alone cannot be successful without a renewed commitment across educational institutions to focus their programs around product innovation and bringing American goods to the global market.

EXISTING SITUATION

In the period following World War II more than one third of jobs in America were in manufacturing, by 1970 this number dropped to 25%. In the ten year period from 1998 to 2008 more than 5 million jobs were lost, and since President Barack Obama took office in 2009 and additional 1.1 million jobs have been shed (Bornemann, 2009). Today just roughly 9 percent of all American jobs are in this sector (Kanell, 2009). Perhaps a further 4% of those employed in manufacturing are employed in service oriented jobs such as financial services, logistics or design leaving just 5% of manufacturing jobs dedicated to actually producing a tangible good for export (The Economist, 2005). This steady decline can in part be attributed to an increase in productive output as manufacturing processes are increasingly automated, as well as the possibility of changing domestic demand factors. However, millions of those lost have been due to cost reducing measures that sent American manufacturing jobs overseas where the cost of labor was substantially lower. In addition, many
millions more were lost as a result of a growing manufacturing trade deficit spurred by short sighted economic policies and an over confidence in service export surpluses. In fact, growing net manufacturing imports accounts for some 59% of manufacturing job loss since 1998 and 34% since 2000 (Bivens, 2004).

The United States’ faith in the service industry’s “trade-off” power, while possible in theory, has been misplaced as it has ignored the reality that the service export surplus represents a small percentage of the manufacturing trade deficit. Furthermore, its rate of growth is nominal in proportion to that of the growth rate of the manufacturing trade deficit (Bivens, 2004). Simply put, the last 50 years of decline in US manufacturing and faith in the service industry has seen the US purchasing more than it produces. Further compounding the economic impact of this imbalance, consider that the average manufacturing job pays nearly $25,000 more per year on average over service sector positions while, in many cases, also providing health and pension benefits. Clearly, the loss of a wages and benefits that previously afforded a middle class lifestyle is difficult to replace through service sector employment (Alliance for American Manufacturing, 2010). Another key concept not to be overlooked is the “multiplier effect”, which in short provides that investing in a sector fuels regional or national economic development through additional job creation. For instance, it is estimated that every direct manufacturing job in the United States supports 2.9 indirect positions in associated activities such as finance, logistics or transportation (Apollo Alliance, 2009). In contrast, estimations for each service sector position range from .9 to 1.5 supported jobs (Alliance for American Manufacturing, 2010). Clearly the net impact of lost manufacturing jobs in the United States has far reaching implications.

The United States is not alone in experiencing a long range decline in manufacturing jobs, as major competitors in Europe and Asia have undergone the same. However, these countries have kept a more healthy percentage of their GDP in manufacturing by growing high tech manufacturing jobs, even while continuing to outsource commodity manufacturing to leverage lower costs (Raveche, 2009). Our competitors have been successful in this strategy, in large part, due to a more robust respect for the limits of the service industry. However, an acute awareness of the need for an educational system designed to support the future of competing in the global manufacturing arena is more likely a better explanation. As it turns out, America has been sleeping while the world has been studying.

**CURRENT PROBLEMS**

In order to be successful in the new manufacturing reality, the United States must strive for significant improvements in our performance in the fields of mathematics, science and technology education. A 2007 study commissioned by the US Department of Education and conducted by the National Center for Educational Statistics, found that in mathematics US 4th grade students lagged behind the UK, Japan and Russia by 7%, 14% and 4% respectively when measured against the advanced international benchmark. The same study showed that US 4th grade science students fared slightly better being edged out by UK students by a 2% margin while barely surpassing Japan and Russia by a margin of 1% and 2% respectively (Miller, 2007). The same study measured 15 year old students’ combined math and science literacy at the most advanced level and found that the United States ranked last, tied with Italy and Russia, among the G-8 nations trailing Japan, Canada, France and Germany by 6%, 3%, 1% and 2% respectively (Miller, 2007).

Looking further into the global competitive picture, scores from the 2006 Program for International Student Assessment (PISA), an exam administered once every three years to test students ability to apply math and science concepts to real world problems, showed that US High School students scored 24th and 17th respectively of 30 countries (Glod, 2007). When these facts are combined with the knowledge that the United States spent the highest percentage of GDP of the compared countries, at 7%, on education at the combined levels, it becomes clear that something in the educational system is broken. In particular, when one considers that the United States ranks first and second in math and science teachers’ average first year compensation respectively (Miller, 2007). While the United States spends significantly more as a percentage of GDP on post secondary education than any of the compared nations, it is too little and too late to make an impact on math and sciences. Just 17% of post secondary degrees awarded in the United States, in the years covered, were in the fields of math, science or engineering, a number 13% behind manufacturing competitor Germany and 4% behind Japan (Miller, 2007). It is little wonder that these two competitors have been able to keep more than one third more of their GDP in manufacturing than the United States.

**CURRENT NEEDS AND STRATEGIES**

Today, only 21 States have policies in place aligning high school graduation requirements with college and workplace expectations. Furthermore, just 10 States have developed college and career readiness assessment systems integral to identifying strengths and weaknesses in both students and the system in which they are educated (Institute of Education Sciences, 2009). These findings, coupled with US students’ below average test scores, despite higher teacher compensation in math and science, and our nations continued manufacturing decline clearly indicates the United States needs a new strategy to align its education system with real world demands.

The first step towards a new strategy will be to foster a sense of national purpose focused on achieving the goal of economic recovery through education reform. Such reform
must address the disconnect between what is being taught in our schools and what the world requires of its skilled workforce. Most importantly, this reform should be designed specifically to position the United States for successful creation of well paying and high economic value manufacturing jobs.

First, many of our European and Asian competitors enjoy enrollment rates for Pre K programs of more then 50%, while only 23% of US student begin their career at this level. Essentially, our competitors have a significant “head start” in the race for academic excellence. One of our national goals should be to make Pre-K enrollment accessible and affordable to families by greatly expanding the involvement of public school districts in these programs. At the K-7 level there must be a paradigm shift away from focusing on liberal arts and humanities to a heavier emphasis on math, science and technology. The certification process for teachers at this level needs to become more rigorous, requiring a greater amount of college course work in math and science and scoring standards more heavily weighted toward these academic areas. From an administrative stand point, curriculum must focus much more heavily upon critical thinking and problem solving skills, two areas US high school students struggle tremendously. Specifically targeted funding is required to accomplish this necessary curriculum overhaul, as well as to provide for the continued education of our nations teachers. Educators at this level must be required to complete scheduled training to continually update their skill sets, effectiveness, evaluation techniques, planning abilities and keep in touch with the real world applications of math and science in industry. Once these steps are accomplished our nation’s high school students will have been provided with a solid foundation from which to build upon at the next level of education.

It should be completely unacceptable to every American that less than one fifth of States have policies in place establishing college and career readiness assessment programs in their high schools. Additional funding to bring every state up to speed within the next 2 years should be a high priority and every effort should be made by the federal government to compel compliance. Funding should also be allotted for secondary school math and science teachers to receive mandatory continued education tailored in a similar way as that suggested for primary school teachers, but a heavier emphasis should be placed on cooperation with universities and employers to gain insight into what will be asked of students at the next level. Time spent in manufacturing facilities observing the day to day application of disciplines such as algebra, calculus, geometry, physics, chemistry and biology will enhance an educator’s ability to formulate lesson plans that value practice as much as theory. Furthermore, increased cooperation between high school and university faculty will foster a sense of cooperation giving high school students access to up to date information and an opportunity to refine their career interests. In addition, it may be helpful to consider the possibility of providing additional incentives to secondary school teachers whose students consistently score above established international benchmarks in literacy in math, science and technology. This type of program would provide for healthy competition between districts and States that will serve to maximize the return on the nations increased investment in education, while providing an outstanding example to students seeking to excel at the next level.

Finally, reform at the post secondary level should involve increased state and federal funding for programs specifically designed to perform research and development in the fields of industrial design, engineering, materials, energy distribution and alternative energy (Raveche, 2009). These are the areas in which the United States has the opportunity to excel and they represent the future of high value manufacturing jobs. Grants should be awarded strictly on a competitive basis, again to foster the competitive spirit necessary for success in the global market. Awarding funds this way will inevitably foster greater opportunity for community involvement, secondary school-university cooperation, and attract the attention of businesses seeking new innovations and a skilled workforce.

In fact, the involvement of business in the rejuvenation of math, science and technology education should be deliberately grown and facilitated through Federal incentives. Industry investment in joint research and development projects with our nation’s universities can provide a number of invaluable benefits. First, this type of joint venture will facilitate a program design that allows for faculty to spend time working in the field focused specifically on how their discipline relates to manufacturing. By virtue of this practical experience, educators will have a more balanced perspective from which to present information and additional tools at their disposal for educating students. Second, this cooperative relationship between industry and universities will give the industry significant input into the skill sets, knowledge and abilities to be developed and mastered for success in a given field of study. The net effect of which will allow for new innovations without losing sight of manufacturing excellence and the competitive “here and now” (Raveche, 2009). Finally, as these cooperative relationships begin to flourish and provide real world results with real world profits, it has the potential to create a cycle of reinvestment in our nation’s university students. As the innovations born of these partnerships become patents and new products to bring to the global market, valuable high tech manufacturing jobs are created. With each one moving us one step closer to a stronger sustainable economy.
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DISCUSSANT COMMENTS
AN APPLICATION OF THE SOCIALIZED CONCEPTION OF PEOPLE TO ACCOUNTANTS' ETHICS

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The paper presents a plan for a study of ethical decision-making among students majoring in accounting. The author proposes a process where students would be presented with a series of hypothetical scenarios showcasing various ethical dilemmas that may be faced by a practicing accountant.

This discussant found the present paper to be lacking in detail regarding both the theoretical underpinnings for the study and the study design. The following comments address issues or questions that arose in review of the paper that should be addressed prior to full design of the study and its implementation.

The author references work by Wrong (1961) regarding the oversocialized conception of man as a foundation for the analysis, noting that a well-socialized individual would follow society’s mores and rules. This raises the question as to whether the author is assuming that accounting students are “well-socialized.” There is no evidence provided by the author regarding this issue, which is critical given that this concept is presented as a foundation for the study. It is also recommended that the author strengthen the link between the “oversocialized” concept and the design of the proposed experiment.

In the theoretical development section of the paper, the author principally discusses deterrence theory, but does not provide a strong link between it and the design of the study. The theory is briefly introduced but needs further discussion and development to show its relevance to the present study. The paper would benefit by the presentation of other theories that may also be relevant to describing ethical decision-making. In addition, the reader is left with the impression that ethical decisions are only made due to deterrence effects. This raises the question as to whether accountants, or others, make a decision because it is the “right thing to do” or to avoid deterrents (e.g., feelings of guilt or remorse, punishment, fines, social stigma). This section would be greatly improved through a discussion of other studies of ethical behavior that have been performed based on deterrence theory, or others, especially related to accountant decision-making. This would better position the proposed analysis in the context of the literature.

In terms of the research design, the previous ethical education of the student is not discussed. Have all students participating in the study been subject to like ethical training? For example, have all students taken a formal business ethics or accounting ethics course, or has ethical instruction been consistently provided through general education courses or other advanced accounting courses? Irrespective of formal ethical training, will the study control for this background, and how? This ethical training background and the importance of other demographic variables (e.g., professional status of parents, family income) is not addressed by the author and is critical for a properly designed study.

The present paper ends without a firm conclusion. It is understood that the purpose of the paper was to present an outline for a future study, but questions remain regarding the place of such a study in the literature, planned methods for assessing the validity of the designed scenarios and follow-up questions, and methods for statistically analyzing the results. For example, the author indicates that regression analysis will be used to evaluate the results, but the dependent and independent variables are not identified.

Lastly, there exists some literature showing that students may be able to identify the appropriate ethical decision based on a scenario, for instance, based on formal ethics training. However, students’ actual ethical behavior may differ markedly from these decisions. It may be useful in the present proposed study to try to separate or compare students’ perception of the proper ethical decision from their likely actual behavior.
PANEL DISCUSSION
CLICKING ON IMMEDIATE LEARNING AND TEACHING ASSESSMENT
IN THE PRINCIPLES OF ECONOMICS CLASS

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ABSTRACT
The Student Performance System (SPS) can be very useful in engaging students in critical thinking right after a concept has been taught in the Principles of Economics classroom. The students use a device called clicker to submit instantaneous answers to a question presented in a slide. Being able to see the proportion of students who choose each one of the multiple-choice questions allows the instructor to determine teaching and learning effectiveness. Although there are some challenges involved with adopting a new technology in the classroom, it is definitely a valuable approach if you want every student to be actively involved in the classroom while collecting real time data on their learning performance.

RATIONALE FOR THE USE OF SPS
Why should we use SPS?
The SPS allows instructors to obtain immediate feedback on students’ learning. The reason why a teacher would be interested in using the clickers in the classroom is based on the idea that she or he would never account for every student’s understanding of a concept just explained in such an inclusive way otherwise. The SPS makes it possible to ask a question and get the percentage of the total amount of students that choose every one of the possible different choices.

Why Should I Use SPS?
There are several reasons why a teacher would like to use the SPS in the classroom. A list of reasons is listed next:
• Transform large group instruction into an active learning experience.
• Provide a "safe" way for shy students to participate in classroom discussion.
• Allow anonymous, simultaneous, and fast response to instructor questions on class material or learning preferences.
• Add a little fun to the classroom.
(Source: http://telr.osu.edu/clickers/)

In my experience with the SPS I can honestly say these reasons were proven true.

Why do I use SPS?
More specifically, I have used SPS for the following more specific reasons:
1. Learning/Teaching assessment tool. The SPS has allowed me to get an immediate idea about my students understanding of concepts I explain during a given session. After explaining several concepts and ideas, I would be able to pose questions and determine the choice distribution for the different answers possible related to a question presented in the screen. If the proportion of students who select the right answer is high, I move on and commend his understanding of the ideas. Students who are part of the small percentage who answered incorrectly do seem to realize they need to make an extra effort to improve their performance; it may almost be embarrassing to be part of the 3 percent of students who got the answer wrong. If there is a high percentage of students who choose the wrong answers, I may take time to explain the misperception of concepts and its application. Once students see the evidence that proves low performance, they pay even closer attention to make sure they understand why their choice may be right or wrong.

2. Classroom-based research. I have intended to use the reports from the software to do classroom based research. It would be interesting to determine how SPS performance relates to overall academic performance in the class per student.

3. Not for tests/quizzes yet. I do not use the SPS to test students, but to use questions to practice in a very inclusive manner. This approach may have advantages and disadvantages as it may deter students from trying their very best since they do not get a heavily weighted grade for correct answers. I have considered given an additional point to their participation if students answer correctly. However, I talk to them enough to
make them realize that if we want to maximize the experience they ought to use their best thinking. Also, they seem to take pride in getting the right answers.

4. **Stimulate critical thinking.** The key to a successful session using the SPS is the design of challenging, critical-thinking questions. The questions should not be too obvious or easy, I think, because the exercise may be pointless. The idea is to prove that the students are, indeed, getting the economic way of thinking.

5. **Accommodate the mix of learning styles.** Based on previous research, a typical classroom has a mix of learning styles. By using the SPS, I am able to accommodate another teaching method that targets hands-on and interactive learners.

Once the investment in a SPS system has taken place, it can be used for any project that requires people's feedback such as classes with prospective students, faculty meetings, or games.

**SAMPLE EXERCISES USED IN THE CLASSROOM**

I am listing in this section, a few of the examples I have used in the classroom.

**Example #1:**
Your car needs to be repaired. You have already paid $500 for the transmission fixed, but it still doesn't work properly. You can sell your car “as is” for $2000. If your car were fixed, you could sell it for $2500. Your car can be fixed with a guarantee for another $300. Should you repair your car?
   a. Yes
   b. No

**Example #2:**
Marijuana is an illegal good and broccoli is a legal good. Which of the following statements are true?
   a. Darin grows and sells marijuana to Anne. When Darin and Anne get married, GDP falls.
   b. Darin grows and sells marijuana to Anne. When Darin and Anne get married, GDP rises.
   c. Darin grows and sells broccoli to Anne. When Darin and Anne get married, GDP falls.
   d. Darin grows and sells broccoli to Anne. When Darin and Anne get married, GDP rises.

**Example #3:**
Quality Motors is a Japanese–owned company that produces automobiles; all of its automobiles are produced in American plants. In 2007, Quality Motors produced $20 million worth of automobiles, with $12 million in sales to Americans, $6 million in sales to Canadians, and $2 million worth of automobiles added to Quality Motors' inventory. The transactions just described contribute how much to U.S. GDP for 2007.
   a. $12 million
   b. $14 million
   c. $18 million
   d. $20 million

**Example #4:**
In countries where pollution levels are relatively higher, the quality of life is overstated by GDP.
   a. Yes
   b. No

**Example #5:**
If the value of the consumer price index is 110 in year 1 and 121 in year 2, then the inflation rate is 11 percent for year 2.
   a. True
   b. False

**Example #6:**
The fixed basket for this economy consists of 2 cell phones and 20 ham sandwiches.
   c. 100 in 2006, 125 in 2007, and 131.25 in 2008
   d. 40 in 2006, 100 in 2007, and 110 in 2008

**Example #7:**
If the base year is 2006, then the economy’s inflation rate in 2007 is
   a. 1.25 percent
   b. 25 percent
   c. 40 percent
   d. 125 percent

**Example #8:**
If an instructor is curious about his or her class profile, he or she may ask about political preferences or any other demographic characteristic interesting for class discussion. For instance, you can let them reveal their preferences for presidential candidates.
I will vote for …
   a. Obama
   b. McCain

Example #9:
I have used the SPS for the College of Business Day when I interact with prospective students. Some of the questions I have asked are:
   How are you doing?
   a. Very well
   b. Not well at all
   c. Not too bad
   d. Ok
I have taken Economics in high school
   a. Yes
   b. No
I am interested in Economics
   a. Yes
   b. No
I know about Genocide in Sudan
   a. Yes
   b. No
Genocide relates to the PPF in the following manner…
   a. …the PPF stays unchanged
   b. …the PPF shifts outwards
   c. …the PPF shifts inwards
   d. …there is a movement along the PPF.
This last question is asked after I explain what a production possibilities frontier is and after showing a video link on genocide in Sudan.

My Challenges with the SPS
Some of the challenges I experienced with the adoption of the SPS had to do with costs, not only the financial costs for the students, but also my opportunity cost of learning to use the software and making sure it worked properly. A teacher necessarily has to be a risk-lover as we say in Economics, and an innovator to want to use the SPS. I am listing the challenging factors next:
   • Cost of the clicker
   • Learning curve for the faculty
   • Lack of institutional adoption of clickers
   • Technological and technical risks involved

My Overall Experience
Following, I list factors that made the use of SPS a successful approach in my Principles of economics classes.
   • Students appreciated the use of clickers because they realized they were meant to improve the teaching and learning environment.
   • Students actively participated and definitely felt challenged to respond correctly. They would not like to be part of the small percentage of the class answering incorrectly.
   • Students experienced a more engaging discussion of problems.
   • Students were even more attentive.
   • I had better teaching evaluations when I used the clickers in the classroom.

REFERENCES


AN APPLICATION OF THE OVERSOCIALIZED CONCEPTION OF PEOPLE TO ACCOUNTANTS’ ETHICS

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ABSTRACT

This paper is a proposal for a study that will address accounting majors’ reactions to ethical dilemmas. The study will entail an experimental questionnaire which will ask college students majoring in accounting to evaluate hypothetical scenarios in which subjects would face ethical dilemmas while employed as accountants. The results may contribute to an understanding of circumstances that may result in accountants violating a code of ethics.

INTRODUCTION

In “The Oversocialized Conception of Man in Modern Society” (Wrong, 1961), Dennis Wrong noted that, at the time, sociological theories suggested that a well-socialized person could be expected to not commit crime. A well-socialized person would have internalized society’s mores. Such a person, driven by conscience and great desire to maintain the esteem of others, would refrain from breaking society’s rules. However some people who might be expected to be well-socialized nevertheless do break laws. It can be inferred that while most people in most circumstances do follow the rules, people with moral values and consciences may break laws if they face temptation that overwhelms their moral principles.

The phenomenon of law breaking by people who should be expected to be well-socialized may be comparable to the current issue of the breaching of accountants’ ethics. If accountants have internalized a code of ethics, they would be expected to behave ethically. The accounting scandals of Enron (Duska and Duska, 2003; Toffler and Reingold, 2003; McLean and Elkind, 2004), WorldCom, Tyco, Adelphia and others suggest that some accountants do not adhere to a code of ethics. The more recent financial institution scandals suggest that ethical lapses persist.

Violations of accountants’ ethics raises questions such as: Do accountants internalize a code of ethics? Do accounting majors graduate from college in possession of a well-developed sense of ethics? Would accountants who generally follow a code of ethics break that code if their motivation were sufficiently great?

THEORY DEVELOPMENT

Questions regarding an accountant’s decision to violate ethical rules can be related to deterrence theory (Silberman, 1976; Grasmick and McLaughlin, 1978; Grasmick and Green, 1980; Grasmick and Scott, 1982). Deterrence theory posits that when a person is tempted to break a rule, a number of factors may give rise to expectations of undesirable consequences. Such expectations tend to inhibit prohibited behavior.

Deterrence factors generally fall into three major categories: (1) formal punishment, such as fines and imprisonment; (2) informal punishment, such as embarrassment, humiliation and social stigma; and (3) internalized norms or moral commitment, which give rise to feelings of guilt and remorse. The greater the magnitude of deterrence factors, the greater the degree of inhibition.

The concept of accountant ethics can be related to the deterrence factor of internalized norms or moral commitment. An accountant who considers a behavior to be unethical may also consider the behavior to be morally wrong. The accountant may anticipate that unethical behavior would result in feelings of guilt and remorse.

An implication of deterrence theory is that if magnitude of deterrence factors varies, whether or not an individual is deterred depends on whether or not the magnitude is sufficient. If a person is highly motivated to violate a rule, that person may break the rule despite the risk of punishment and expectations of feelings of guilt.

The concept of motivation can be related to the economic concept of expected utility (Von Neumann and Morgenstern, 1947; Marschak, 1950; Savage, 1954; Pratt, Raiffa and Schlaifer, 1964). Expected utility theory suggests that decision makers are rational utility maximizers who perceive value or utility to be associated with various potential consequences. The greater the expected utility of a behavior, the greater the inclination to choose the behavior.

If a behavior has the potential to result in both favorable and unfavorable consequences, the undesirable consequences might be characterized as giving rise to
negative utility or disutility. Expected utility could be viewed as the expected net utility that arises from the combination of positive and negative utility. Greater positive utility would give rise to greater net utility. Greater disutility would give rise to less net utility. Although a person may perceive that a particular behavior would be a breach of ethics, strong motivation may overwhelm a person’s reluctance to violate ethical rules. The result may be choice to breach ethics even though the person may feel guilt and remorse.

**HYPOTHESES**

Applying deterrence theory and expected utility theory to accountants’ ethics, an accountant’s decision to violate a code of ethics can be viewed as a function of motivation and expected undesirable consequences. It can be hypothesized that greater motivation is associated with greater inclination to violate a code of ethics. Conversely, greater expectation of undesirable consequences is associated with less inclination to violate a code of ethics.

For an accountant facing an ethical dilemma, motivation may be related to foregone opportunities that would arise from adherence to ethical principles. For example, if an auditor were to identify a misrepresentation in a client corporation’s financial statements, and if the corporate management were to refuse to correct the misrepresentation, the auditor could face a dilemma. The auditor could face the choice of participation in the misrepresentation of financial statements or resignation from the audit. Resignation would mean the foregoing of future audit fees from the client. For an auditor who is an employee of a prestigious CPA firm, resignation from the firm would mean the forgoing of future salary, as well as the loss of power and prestige associated with the firm.

For an employee of a prestigious CPA firm, resignation would result in unemployment and zero earnings. Participation in the misrepresentation would result in continued employment. Motivation to violate ethics could be expressed in terms of the magnitudes of income and prestige that an auditor wishes to preserve.

Resignation from a job might alternately be viewed in terms of negative utility that would result from forgone income and prestige. If an auditor were to consider forgone income as a loss, the perceptions of net utility might be described in terms of magnitude of negative utility. An auditor may view the decision as a choice between two sources of disutility. An auditor might seek to minimize disutility.

If an auditor faced a decision between two sources of disutility, the auditor could be viewed as making a decision in the domain of losses. The proposed study may consider whether prospect theory (Kahneman and Tversky, 1979) would affect decisions. For example, if decision makers in the domain of losses tend to be risk seeking, the study may consider how risk seekers may react to ethical dilemmas.

Regardless of whether auditors view a foregone job in terms of positive or negative utility, the following can be hypothesized:

**H1:** The greater the magnitude of forgone income and prestige that would result from resignation, the lesser an auditor’s inclination to resign.

**H2:** The greater the perception that participation in a fraudulent audit is morally wrong, the lesser a person’s inclination to participate in the audit.

**RESEARCH DESIGN**

This study will entail a questionnaire survey of accountants. Since one of the questions to be addressed in this study is whether new accountants possess well-developed senses of ethics, it seems appropriate for the subjects to be college students majoring in accounting.

The survey will ask subjects to evaluate hypothetical scenarios entailing ethical dilemmas that arise in the course of auditing a client’s financial statements. To provide for variation in the magnitude of forgone income, different scenarios will entail different amounts. For example, in one scenario, a subject may be asked to imagine that he or she is a recently hired staff accountant with a salary of $50,000 per year. Another scenario might describe a more experienced, higher ranking employee with a salary of $100,000. Other scenarios may describe a self-employed CPA auditing a client’s records. The amount of the audit fee (and accordingly the foregone audit fee) would be varied.

A sample scenario is as follows:

Imagine that you are a recently hired staff accountant for a prestigious national CPA firm. Your salary is $50,000 per year. Further imagine that during the audit of a client’s financial statements you discover that inventory is overstated by several million dollars, which would result in the overstatement of assets, the understatement of expenses, the overstatement of income and the overstatement of equity. Assume that the misstatement is a material amount. You discuss your discovery with your superior in the CPA firm. Your superior states that the client does not want to correct the misstatement and that it is the position of the CPA firm to allow the financial statements to remain unchanged.

*Proceedings of the Pennsylvania Economic Association 2010 Conference*
Your concerns lead you to consult a lawyer. The lawyer tells you that because of confidentiality responsibilities, you would not be permitted to disclose the misrepresentation. Your alternatives would be to continue to participate in the audit, aware of the misrepresentation, or to resign your job. If you were to resign, your employer would not provide a good reference and it would be unlikely that you would find a new job with similar pay or prestige.

The survey will ask a number of questions, including the subject’s perceptions of expected consequences such as formal punishment, informal punishment and feeling of guilt, as well as the subject’s degree of inclination to accommodate the client.

Examples of questions may include:

If you were the accountant described in the scenario, to what extent would you be inclined to either participate in the audit or to resign your job?

<table>
<thead>
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<th>Definitely would resign</th>
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If you were the accountant described in the scenario, and if you were to participate in the audit, to what extent would you consider your participation to be unethical?

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<tr>
<th>Perfectly Ethical</th>
<th>Extremely Unethical</th>
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If you were the accountant described in the scenario, and if you were to participate in the audit, to what extent would you expect to experience feelings of guilt?

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<th>No feelings of guilt</th>
<th>Great feelings of guilt</th>
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ANALYSIS OF RESULTS

Analysis of results will entail statistical tests such as Analysis of Variance (ANOVA), regression analysis and other tests to determine if relationships between variables are significant.

POTENTIAL IMPLICATIONS

The results may contribute to an understanding of circumstances that may result in accountants violating a code of ethics.

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