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**Editor: Larry R. Dale**  
*Arkansas State University*

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## LETTER FROM THE EDITOR

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

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

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

Dr. Larry R. Dale

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## **ECONOMICS EDUCATION ARTICLES**



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# BRINGING ECONOMIC DATA TO LIFE IN THE CLASSROOM

**Ryan T. Phelps, Stephen F. Austin State University**  
**Attila Cseh, Valdosta State University**

## ABSTRACT

*We detail several methods for improving economic instruction through the use of Gapminder World. Gapminder World is a free, simple and engaging internet-based resource for illustrating relationships between key global economic indicators. It presents data in a way that is in line with students' exposure to modern media and its dramatic visual content. The format instantly and intuitively conveys a great deal of information. Real world application and creative presentation are the keys to capturing the increasingly illusive attention and interest of today's student body. This tool can be readily used to energize students' natural curiosity, regarding world events, converting it into genuine motivation to understand economics.*

## INTRODUCTION

Interest in improving instructional methods in the post-secondary economics classroom has been growing lately. For example, one of the major goals of the Teaching Innovations Program sponsored by the Committee on Economic Education funded by a grant from the National Science Foundation was to promote more interactive learning materials. One reason for this increased interest may be that economics seems to be lagging behind other disciplines in applying non-lecture teaching methods. Economics classes are still primarily taught in the old-style "chalk-and-talk" approach (Watts and Becker, 2008). Since other disciplines have a head-start on economists in implementing more student-engaging instructional methods it is not surprising that one of the things that students mention, years after graduating, about their experience with their economics classes is that they are mostly taught in the old-fashioned way (Allgood et al., 2004).

There have also been recent calls toward making economics courses more rewarding (Hoyt, 2003). These efforts, Hoyt reports, carry benefits for both the instructor and the student. Rewards for the instructor include experiencing "genuine

student engagement” which the author describes as “intoxicating”. Students benefit from application to real world issues which she describes as “a life line to the real world”, and through the creation of “memory hooks” which facilitate in learning. The applications detailed here represent relatively costless methods for achieving these goals. “The cost of using conventional chalk and talk, rather than more contemporary outcome-based methods, may be significant in the long run as students choose to move away from economics and into more lively and interesting classes” (Becker and Watts, 2001).

Students have developed a taste for the internet as a medium of entertainment and education. Today’s college age students grew up with access to personal computers throughout their entire life. They also could easily have had access to the internet for most of their lives. Therefore, students are more willing to welcome multimedia/internet to their learning experience – as early as in the middle/high school years (Pew Internet & American Life Project, 2002a), and using the internet also has positive impacts on college learning (Pew Internet & American Life Project, 2002b). The recent popularity of tools such as Economics in the Movies, Movie Scenes for Economics and MusicForEcon, demonstrate educational gains through entertainment (Mateer, 2005; Movie Scenes for Economics; Music for Econ). For a more complete detailing of the work in this area see Mateer and Rice (2007). The widespread use of and students’ familiarity with the internet have created numerous opportunities to improve upon old methods of teaching economic concepts. “College students today clearly expect the computer to be an important learning tool” (Goffe and Sosin, 2005).

We understand that the use of technology in the classroom should not be a goal in and of it-self. We believe the methods presented here are more empowering to student learning than other available tools. Our beliefs in this regard are supported by our observations, statistical evidence, and student comments. The results suggest that this tool increases student interest in economic issues as well as in the course content and provides real world examples in order to expand their natural curiosity.

Student attitude towards economics has been shown to be a significant determinant of student performance (Karstensson and Vedder, 1974). Also, experiments used in economics courses have been shown to improve both student attitudes and student performance (Durham and Schulman, 2007). While we do not attempt to demonstrate a link between the tools detailed here and student performance, we do offer some limited evidence that they do improve student attitudes toward economics.

Gapminder World, the teaching tool discussed here, provides virtually painless synergy and empowers professors to overcome some troublesome hurdles.

We introduce Gapminder and establish some straightforward “best approach” applications of the tool for economics principles classes.

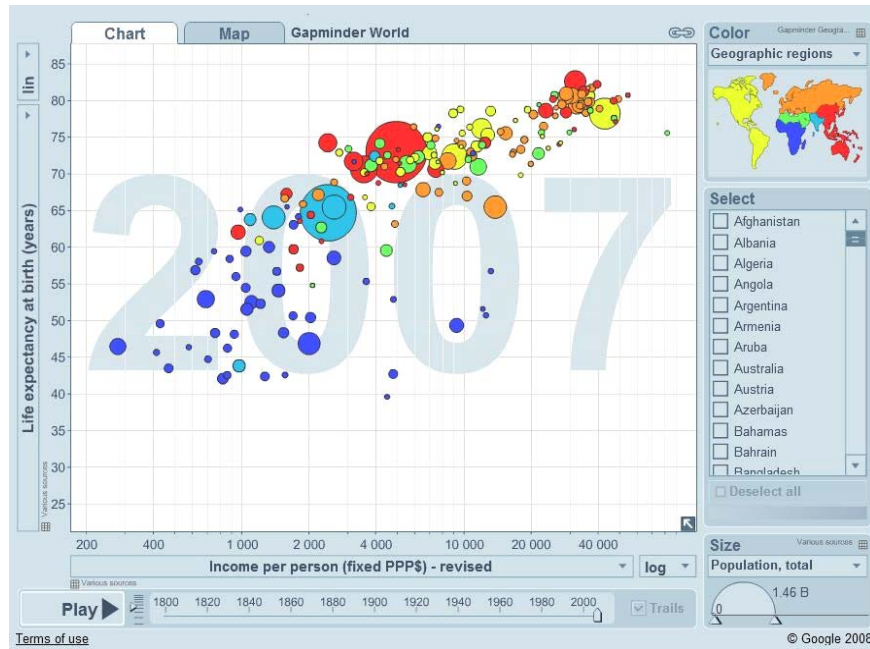
This paper presents non-lecture methods for capturing student attention and interest with economic data using a free internet tool, Gapminder World. We would like to emphasize that Gapminder World is a product developed by the Gapminder Foundation which was founded in Stockholm by Ola Rosling, Anna Rosling Rönnlund and Hans Rosling in 2005.

*“Gapminder is a non-profit venture promoting sustainable global development and achievement of the United Nations Millennium Development Goals by increased use and understanding of statistics and other information about social, economic and environmental development at local, national and global levels. We are a modern “museum” that helps making the world understandable, using the Internet.”*

Also, this tool was discussed at one of the Technology, Entertainment, Design (TED) conference sessions (For more information see [www.ted.com](http://www.ted.com)). Shortly after its introduction Gapminder became a hot topic in the blogosphere. We decided to write a paper on its applications in our classrooms when we realized through conversations with colleagues (at conferences and other forums) that it is not as widely known among instructors/educators as we had thought.

Gapminder World is a motion chart, which is a revolutionary way of portraying simple relationships between time series data ([www.gapminder.org](http://www.gapminder.org)). As illustrated in Figure 1, Gapminder World presents a scattergram which portrays four variables at once. The default setting portrays life expectancy at birth on the y-axis and income per person on the horizontal axis. Additionally, the size of the dots (indicating each nation) conveys population and the color of the dots indicates geographical region. The variable that drives each of these aspects can be set as desired (Choices include a wide range of key economic indicators). Per person income is Gross Domestic Product (GDP) per capita adjusted for purchasing power parity in 2005 dollar prices. A short description of each variable can be obtained by holding the cursor over the title on the chart. Also, supporting documentation is available through the website.

**Figure 1: Gapminder Default Setting**



What makes the motion chart different and powerful is its animation of changes in the data over time. Before the historical data can be played forward, the starting point must be selected. The year 1970 is a good starting point due to some wild variations (and fragmented availability) in the data prior to this date. After selecting a starting year and clicking play, the static scattergram becomes animated as the sequential years of data play out the changes in the simple relationship over time.

This paper details four applications of Gapminder World toward improving economics courses. Each application is presented completely, so that each could be used separately as called for in a particular course. There is, however, overlap between the applications so that readers may wish to present several applications at once.

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## **APPLICATION 1: GRAPHS CORRELATION AND MODELS**

Even though economists frequently use graphs to teach economic concepts, graphs are not universally well understood by students (Hill and Stegner, 2003). In this application we detail a method for using Gapminder World to illustrate the efficiency of graphs as tools for conveying information. A quick review of basic graphing concepts should, in fact, be included in an explanation of what students are seeing in the static scattergram.

After a quick introduction, students are asked what the dots on Figure 1 and their locations represent. Alternatively, the professor could simply choose a few familiar countries and discuss the importance of both their vertical and horizontal location. Students quickly recognize the positive correlation between income per person and life expectancy. It is a simple extension to postulate that the apparent relationship between life expectancy and income per person could be modeled with a simple line. This illustration could be used to introduce other models such as supply and demand and to inform what their underlying data might look like.

After identifying the positive relationship between per capita income and life expectancy, we initiate a discussion regarding the differences between correlation and causation. Does economic growth improve health outcomes or does improved health facilitate economic growth, or is some other factor responsible for improvements in both? This discussion also easily transitions into what potential factors may be, in part, responsible for outliers and deviations from the trend.

## **APPLICATION 2: POPULATION VS. GDP VS. GDP PER CAPITA**

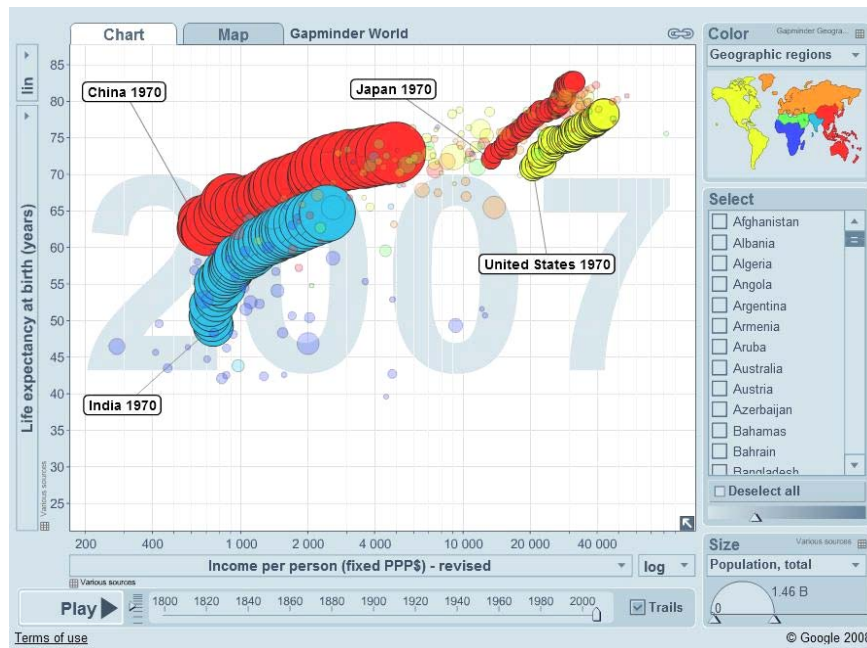
This tool also provides a fresh way of displaying the vast differences between the relevance of nations in terms of population, GDP and GDP per capita. Setting the x-axis to time and the y-axis to the log of total income (this is an option under “Economy” in the drag down menu) will provide a visual aid which can be used to contrast countries’ populations with their GDPs. We have found this discussion to be surprisingly eye-opening for our students.

Yet another contrast can be highlighted by altering the x-axis so that it indicates the log of income per person. Students are often surprised by the large number of countries with relatively small output but higher levels of income per person. The importance of GDP per capita can be underscored by asking students if they would rather live in a country with a high GDP or one with a high GDP per person. Contrasting total income and income per person for China is a nice example to highlight the importance of this difference.

### APPLICATION 3: GDP AND QUALITY OF LIFE

After students have a basic understanding of GDP and how it is measured, students are typically unable to expound on the importance of GDP per capita to individuals or to their own situations. We begin with a class inquiry regarding this topic. While students are mulling over the topic, we engage them in a discussion which relates personal outcomes such as life expectancy and infant mortality rates to GDP per capita. At the heart of this conversation is the powerful visual presentation of key global economic indicators that Gapminder World makes possible.

**Figure 2: Time paths for several indicated nations**



Once again, we begin with the motion chart in the default setting. After a quick introduction explaining the chart, students are able to notice the positive correlation between GDP per capita and life expectancy. Changes in countries positions and in this relationship over time can then be illustrated using Gapminder World's motion chart function. Repeated plays may be necessary for students to absorb what they are seeing. Selecting a few key nations such as China, India, Japan



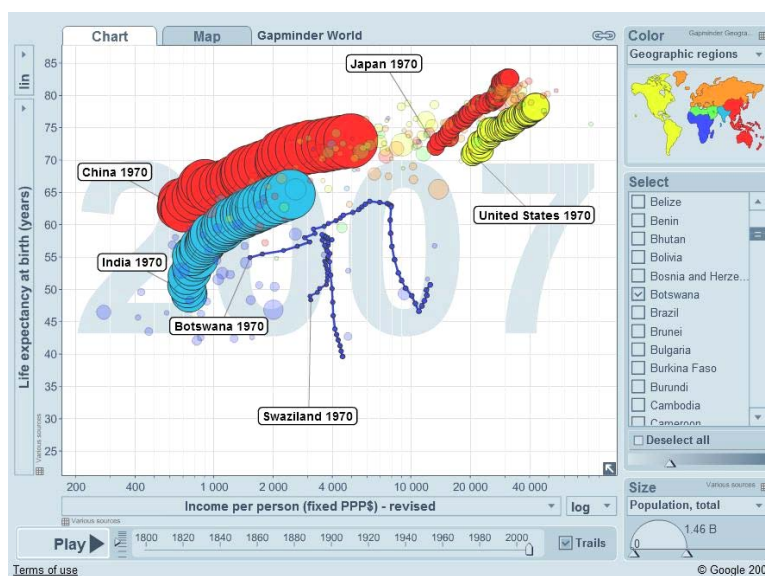
and the U.S. makes it easier to follow the changes. For an illustration see Figure 2. Comparing and contrasting the 1970 and 2007 life expectancies of the key nations highlights each nation's improvements. While the log of income per capita is being displayed, a popup box will indicate the actual income per capita. The popup box is revealed by holding the cursor over the coordinate of interest. At this point students have witnessed the link between GDP per capita and the age that they or their parents are likely to reach.

Changing the y-axis to "infant mortality rate" and repeating the process mentioned above allows an equally thought-provoking discussion on the relationship between infant mortality rates and income per capita.

#### APPLICATION 4: GDP VS. QUALITY OF LIFE

This tool is also very useful for discussing the shortfalls of GDP per capita as a measure of quality of life. We begin the illustration of this point again at the default setting. We then select several African nations, for example, Botswana, South Africa, Swaziland, and Zimbabwe which clearly weaken the apparent relationship between GDP per capita and life expectancy.

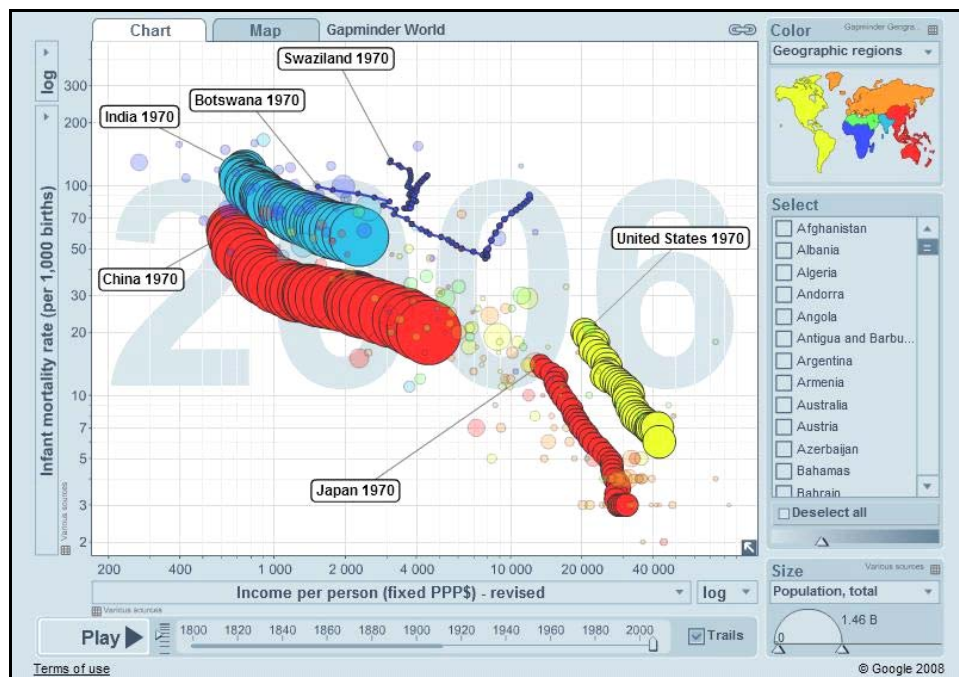
**Figure 3: Devastating reductions in life expectancy as revealed in the time paths of Botswana and Swaziland**



Tracking the changes in these nations since 1970 is guaranteed to shock most students as they will witness devastating reductions in life expectancy beginning in the early 90s as illustrated in Figure 3. We generally allow time and freedom for both student reflection and comments. The discussion often focuses on the cases of these reductions. The usual suspects are the AIDS epidemic, conflict and famine. All of which represent shortfalls of the ability of GDP per capita to capture quality of life. An inquiry regarding the actual underlying cause makes a rewarding student project.

Changing the Y-axis to indicate infant mortality rate in the same African countries and repeating the above process equally shocks students in our classes as it tells a similar story of hardship (Figure 4). If time allows we usually let students choose a few countries and watch their progress through time.

**Figure 4: Devastating increases in infant mortality rates as revealed in the time paths of Botswana and Swaziland**



### STUDENT RESPONSE - OBSERVATIONS

A key obstacle, when teaching principle level economics classes, is a general apathy toward the subject matter. GDP per capita is often looked at by students as a meaningless number or an abstract construct that must be memorized for an exam. For example, economists instantly identify with the powerful emotion in the following quote from Nobel Laureate Economist Robert Lucas:

“Is there some action a government of India could take that would lead the Indian economy to grow like Indonesia’s or Egypt’s? If so, what, exactly? If not, what is it about the ‘nature of India’ that makes it so? The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else.”

Students are often unequipped to identify with the speaker. The issue here is that economists have been informed of the link between economic growth and real-life individual outcomes through an understanding of economic principles and exposure to macroeconomic data. Bridging this conceptual gap is the key to capturing student’s interest and awakening their natural curiosity. Integrating Gapminder World into the presentation of GDP can empower students from all colleges to see GDP per capita through the eyes of an economist.

We have had success overcoming this hurdle by integrating a combination of the above applications into our principles of macroeconomics courses just after introducing the concept of GDP per capita. Spending around twenty minutes of class time on these examples will create a lasting impression. A brief classroom examination of Gapminder World will empower students to take hold of this passion for the economic problem and the class content surrounding it. We have found that, after presenting Gapminder World, students are better prepared to identify with the above quote.

We have also witnessed a great deal of student interest and participation during the presentations. We refer back to Gapminder World and “the moving dots” throughout the semester. The students have been eager to discuss the possible reasons for the changes in nation’s positions and the real world consequences that go along with them.

### STUDENT RESPONSE - DATA

To test student perception of Gapminder World one of the authors administered a short class survey. This survey was intended to gauge the value of the application of Gapminder World in the classroom. The survey also addresses shortfalls associated with the use of end-of-term student evaluations to assess teaching. For example, the relative lack of questions that ask about the use of new technology in the classroom (Becker and Watts, 1999). Also, concerning end-of-term student evaluations, “Little attention is given to students’ perception of what they believed they learned” (Becker, 2000). The survey asked questions about the impact of the presentation (for a sample of the questions, see Table 1). Several statements were presented and students had the following options to choose from: strongly agree, agree, no opinion, disagree, and strongly disagree. These responses were rescaled from 2 (strongly agree) to -2 (strongly disagree), no opinion being the middle ground with a value of 0.

<b>Table 1: Survey questions</b>
I enjoyed the presentation.
The presentation was related to the course material.
The presentation was a good use of class time.
The presentation caused me to think about things that I usually do not think about.
The presentation caused me to be more interested in economics and economic issues.
The presentation increased my interest in taking more economics courses.
I found the course content to be more interesting as a result of the presentation.
I found the course content to be more relevant to my life as a result of the presentation.
I recommend that the presentation be used in the future.
I think that the presentation could be improved.

Table 2 presents simple means, standard deviations along with Z-scores used in hypothesis testing. In all but one case the average student response was positive and statistically different than zero. The exception is the response to the

question about an increased interest in taking more economics classes where the average is neither positive nor significant. This result may be negatively biased due to the timing of the survey. The survey was administered immediately after the cumulative final exam (separately and anonymously); as a result any increase in interest may have been outweighed by that “I will never take another economics class again” feeling. Also, it is worth mentioning that 32.4% of the students surveyed agreed and 11.8% strongly agreed that the presentation had increased their interest in taking more economics classes.

Students reported having enjoyed the presentation and that they were spurred to think about issues that they do not regularly think about. Perhaps the most important results are those that point toward improved student attitudes toward economics. The results for both the question related to interest in economic issues and the question related to interest in course content were statistically positive. In fact, these results may have been driven by the self-reported increase in content relevance to their personal lives.

<b>Table 2: Results of the survey</b>			
Survey questions	Mean	Std.Dev.	Z-score
I enjoyed the presentation	1.294	0.871	8.659
The presentation was related to the course material	1.706	0.524	18.985
The presentation was a good use of class time	1.588	0.609	15.209
Think about things that I usually do not think about	1.029	0.969	6.196
More interested in economics and economic issues	0.765	1.130	3.947
Increased my interest in taking more economics courses	-0.029	1.218	-0.141
I found the course content to be more interesting	0.647	1.098	3.437
I found the course content to be more relevant to my life	0.500	0.992	2.938
I recommend that the presentation be used in the future	1.441	0.705	11.927
I think that the presentation could be improved	-0.265	0.790	-1.953

Interestingly, students responded more intensely to the appropriateness and efficiency of the presentation than to their enjoyment of the presentation. Students also overwhelmingly supported the continued use of this presentation in the class.

In addition to the above questions, students were also asked questions related to the way that the presentation affected their lives outside of the classroom. We found that 58.8% of the students said that they had accessed Gapminder World outside of the classroom at least once. We also found that, based on student reports, 50% had brought up Gapminder World or its content during a conversation outside of the classroom, and 29.4% had mentioned the Gapminder World website or its content during conversations with their parents. We view these results as suggestive of a success in awakening student interest and we wish that all of our discussions could have this level of impact.

### **STUDENT RESPONSE - COMMENTS**

We have selected the following responses to the survey item “Please take the time to write any comments that you have in regard to the use of this website and its content in the classroom”. The responses have been altered only to correct format and simple errors in spelling or grammar. Student comments were anonymous. All respondents are assumed to be female for convenience.

- 1        “I thought the presentation was amazing. It really opened my eyes to things I had not previously had any interest in...”
- 2        “The website was really interesting in regard to the fact that it was very thought provoking and made you think about the world wide implications of the economy. It also proved the point very well that the economy is an indicator and a part of living conditions along with other social aspects of life. I think it would be interesting to use it more in the class in connection with other lessons since it gives the material learned substance and tangible evidence.”
- 3        “It should be used early in the class maybe the first week to show how this class overall relates to solving global problems and how it is relevant to all 6.5 billion of us

whether we realize it or not. It shows how you have a vested interest in the class/study.”

4 “This presentation I found to be very eye-opening. I know I had never thought about the other countries and how their lives are compared to ours here in the U.S.”

5 “Not bad, I would use it if I taught an economics class.”

Comment 1 supports our classroom observations that this tool is helping students reach the point where they can become interested in economic issues. Comment 2 also uses the word interesting. Out of fifteen comments a form of the word “interest” appears in six. Using the above applications of Gapminder World also helped student 2 to comprehend that much of the material in the course is interrelated. Comment 3 also reveals the overarching relevance of our utilization of Gapminder World in this principles of macroeconomics course and to students’ lives in general.

We believe that it is much easier for students to learn about GDP once they care about its implications. These comments provide evidence that this tool can be used to generate interest and to provide a vivid illustration of complex concepts. It is rewarding to see that students are widening their horizons as a result of a fifteen to twenty minute presentation.

It is often difficult for students to see that our relative wealth in the U.S. alters our views on many issues. The student that provided comment 4 has learned that her perspective shapes the way that she sees the world. It is also interesting that this student chose to use the words “eye-opening”. For visual learners a reference picture can carry a lot of weight when it comes time for recollection or comprehension of abstract concepts. Out of fifteen comments three contained signals of visual learning.

Comment 5 really gets to the main purposes of this paper; which are to inform other college level instructors that this tool exists and of the benefits that it affords. This comment suggests that students recognize and appreciate efforts toward making the material relevant and interesting.

## CONCLUSION

One concern of introducing novel techniques in the classroom is the fixed cost (the additional preparation time required from the instructor). Gapminder World

is a tool which has a minimal cost of utilization and great potential reward. Gapminder World's presentation of the data leaves a lasting impression that can be utilized throughout the semester. Our results suggest that many students will share and discuss the website with their family and friends and that this tool increases student interest in economic issues and principles course content. Our results also suggest that students value the appropriateness and efficiency of this teaching tool. Finally the results suggest that students enjoy the presentation and are stretched by the implications of its content.

Gapminder World contains a host of data with teaching applications for both microeconomic and macroeconomic subject matter. The applications detailed here only scratch the surface of what is available for today's economics professor. Upper level economics classes, such as health economics, public economics, economic growth and development, environmental economics as well as statistics classes (to discuss correlation) could all benefit from simple applications of this free tool. Furthermore, the simple examples mentioned in this paper could be utilized in economics classes at the high school level.

We also present some statistical evidence that presentations using Gapminder generate student interest. The results presented here have some weaknesses though and should be interpreted carefully. One serious weakness is that we only collected responses from a single Principles of Macroeconomics class, which resulted in only 34 responses. Still, the sample was large enough to establish statistical significance in most of the hypotheses.

In closing, this paper's goal is to inform our peers of the potential for student inspiration that this free website contains. It is also our hope that readers will both explore what Gapminder World can add to their courses and continue to spread the word about this innovative presentation tool.

#### **AUTHORS' NOTE**

The authors would like to thank the people at the Gapminder Foundation for their accomplishments and generosity. While Gapminder World was not costless to develop, it has been made available free of charge. We would also like to thank two anonymous referees for their helpful comments. Finally, Cseh gratefully acknowledges financial support from the Rea and Lillian Steele Summer Grant.



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# WHAT INFLUENCE DOES MATHEMATICS PREPARATION AND PERFORMANCE HAVE ON PERFORMANCE IN FIRST ECONOMICS CLASSES? <sup>1</sup>

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## ABSTRACT

*Using data from a Midwestern university, the authors examine whether math preparation, as measured by the ACT special mathematics score and the math placement from a preparation entrance exam for freshmen students, is associated with performance in one's first economics course. The results indicate that the level of math skills one brings to college has a statistically and economically significant effect on the performance in the economics course. This result is persistent, even when controlling for college math courses taken prior to the economics course. The authors conclude that mathematical maturity may be the relevant causal factor in one's first economic course performance, since higher level math placements tend to result in higher probabilities of As and Bs in one's economic class. In addition, it appears as though the first college algebra course, the business calculus course, and the mathematics courses for math majors or those planning to teach mathematics are the classes associated with higher economics grades. On the other hand, the elementary and intermediate algebra course are not helpful, and in fact, those students who did not take a math class prior to their economics courses performed better on average than those who took the basic algebra classes. These results suggest that at the least, some college algebra would benefit a student in the first economics course.*

## INTRODUCTION

Educators have long held the belief that successful learning relies on a series of building blocks. Students often begin with an introductory course that overviews

the general concepts of a subject, and additional courses sequentially cultivate the students' expertise in that discipline. As with many other disciplines, economics students sequence from principles level courses, which typically require algebra level mathematical skills, to intermediate courses that focus on advanced technical skill development, and finally to higher level courses that develop increasingly complex applications of economic theory. Critical thinking skills are also developed (hopefully) in a sequential pattern, as students learn to apply normative analyses to ever more intricate questioning.

Despite this "building block" mentality, students often begin the economics principles courses with a wide degree of mathematical preparation. In the case of Bowling Green State University, students can take a principles level economics course with only a background in high school level algebra. However, students from different colleges and in different stages of their academic career will vary in their math preparation. For example, the College of Business (CBA) students must complete five to six credit hours in calculus in order to attain the Bachelor of Science in Business Administration (BSBA) degree.<sup>2</sup> Because calculus is not required for the principles of economics courses, sophomores typically begin such a course with algebra, while juniors and seniors are more likely to have completed a calculus class. Education majors specializing in Integrated Social Studies must take one math course that includes basic statistics and college algebra. Students from the College of Arts and Sciences and the College of Technology also have a low math requirement prior to taking an economics principles course. And, finally, students are often placed in a mathematics course in their first year at the university, so that those students with better high school preparation may begin their college mathematics courses at a higher level compared to those lacking such preparation.

Because economics educators face a diversity of mathematics preparation, because of the reliance on mathematical devices such as graphs in economics, and because economics courses are typically difficult for the average student,<sup>3</sup> we investigate whether the level of math preparation prior to college has an impact on the final grade in introductory and principles level economic courses. Using data provided from the authors' university, this paper analyzes whether the economics course grade is related to two different mathematics placement tests taken by students before they begin college classes. Because these tests have several versions and include questions related to different math skills, it allows us to more closely examine the effect of math preparation on performance, as compared to a more generic control for math skills, such as the overall ACT mathematics score. With our data, we can examine how basic, intermediate, college algebra, and trigonometry skills brought to college are related to final grades in first level economics courses.

As noted earlier, calculus is not required for any of the first level economics classes. But what mathematics usually occurs in these classes? These three courses are taught by both tenure track faculty and instructors (both full time and part time). Each instructor does something a little different, but the mathematics requirements are fairly standard. The primary tools are using and reading graphs, performing algebra and finding areas using very basic geometry rules. These are skills most students will have been exposed to in high school. How well they remember them is an issue. Further, the level of mathematics tools applied to the economics material is fairly even across instructors. One or two may use Aplia, but most simply rely on what students bring to the class. The level of mathematics used seems to be in line with the standard textbooks used, including Mankiw, Frank and Bernanke, and Case and Fair. Because the faculty do not rely on calculus for understanding the economics material, and there is no reason to think that calculus or any higher level mathematical skill would be especially useful at this particular institution in one's first economics course.

#### **PREVIOUS RESEARCH ON MATHEMATICS ABILITY AND SUCCESS IN ECONOMICS**

One goal of higher education is to prepare young adults for the intricacies of everyday decision-making. Students will face many situations that are rich in complexity, with no easy solutions. Such ill-defined problems are used to build the critical thinking skills faculty often include as part of the classroom experience. Mathematics is an important element of such development because solving mathematical problems helps students with transitional ability, the ability to take what they know and apply that to what they do not know. Experiments involving middle and high school students indicate that students who have practiced certain rudimentary algebra (Leader, 2004) or calculus skills (Walter, 2005) can apply those skills to advanced mathematical problems that the students previously did not experience. This idea of becoming a transitional problem-solver is directly related to mathematics education, where one becomes comfortable presenting the same information across verbal, graphical, and algebraic symbols (Gagatsis and Shiakalli, 2004). Mathematical maturity also matters. Researchers in the mathematics education field find that college preparatory mathematics leads to higher test scores in high school students' subsequent academic careers (e.g., Gamoran and Hannigan, 2000). The general conclusion is that mathematics maturity and understanding help students become better overall learners.

In addition, a number of studies find that there are links between mathematical ability and performance in college or in life decision-making. Mathematical ability is highly associated with achievement in the sciences, engineering, business, and technology fields, where mathematical language and visual-spatial intelligence is foundational (e.g., Stavridou and Kakana, 2008). Applying mathematics to problems in physics can improve both the mathematical abilities and the comprehension of the physics (Giannetto and Vincent, 2002). The level of mathematics is also used to explain gender differences in achievement in the sciences and in gender choices of science occupations (Bolli, et. al, 1985). Researchers also find that numeracy ability is important for introduction to statistics courses in psychology (Gnaldi, 2006) and in making health and medical decisions (Raina and Brainerd, 2007). Thus, mathematical comprehension, even when it is as simple as understanding fractions, provides long term benefits for individuals.

The relationship between mathematics ability and subsequent performance in economics courses has also been investigated. However, the results are inconsistent across studies and do not provide economics departments with strong directions regarding the type and sequence of mathematics and economics courses. A detailed review of the major studies about mathematics and economics performance follows.

Brasfield et al. (1992) argue that students taking the calculus course have a stronger grade in both the micro and the macro principles of economics. The college algebra course does not improve performance at statistically significant levels. The analysis involved a regression (one for micro and one for macro) including GPA, class standing (hours completed), ACT, average grade in the course, the number of hours the student planned to study, and binary variables for whether the student completed each of college algebra and business calculus. This research suggests that if we wished to improve performance in the principles, we should require business calculus.

Milkman et al. (1995) completed a similar study. However, in this study, the students were given a pre-test (Test of Understanding College Economics, III, called TUCE) and a post test (the same one). As with the Brasfield study, the Milkman study used a similar list of independent variables. The study examines both the absolute level of performance and the change in performance between tests.

In this case, college algebra was a statistically significant factor in the absolute performance level on the micro TUCE, but not for macro, and neither algebra nor calculus was a statistically significant factor on the difference between the post-test and the pre-test performance. This result is in stark contrast to the previous study. In addition, the authors suggest that the form of the dependent variable appears to

be a significant issue. What it is we are trying to measure in the scope of learning is central to whether we want to require more mathematics or not.

Two additional studies are the primary literature on this topic. Siegfried et al. (1996) report that about half of the students taking principles of economics have had a college level calculus course before they took economics. It is clear that success in economics can be achieved without calculus, but that calculus is widely seen as a valuable tool for many economics students. Anderson et al. (1994) examine the predictors of academic success in principles of economics in a class that was essentially a yearlong principles class. The dependent variable is the final grade. The independent variables include how the student performed in various high school classes (this is a Canadian study, so the authors create an index using data on the best six classes in the students' 13<sup>th</sup> year of school). This high school grade index was statistically significant and positive. The subject areas were represented by binary variables indicating if the student took the class in their final year of high school and a second variable representing their grade in that class. The authors control for three different math classes: algebra, functions, and calculus. These math variables have a negative coefficient, but were not statistically significant. The math grade had a positive coefficient, but was not statistically significant. However, joint tests on the dummy variable and grade for each math class indicated that neither algebra nor functions has an impact, but that calculus does.

Ballard and Johnson (2004) report on their examination of the relationship between mathematics skills and performance in principles of microeconomics. The relationship was generated by an ordinary least squares regression where the dependent variables included both measures of mathematics skills and other control variables. The measures of mathematics skills included whether the student took a remedial mathematics course, whether the student took calculus, whether the student took remedial math and their score on a 10 question mathematics quiz. The dependent variable was percentage of correct answers on three multiple choice tests given during the semester (the same exams were administered in all sections). Whether the student had taken calculus and whether the student had taken a remedial math course were statistically significant, with the remedial course having a negative sign. The score on the math quiz was also statistically significant. If the four measures of quantitative ability are combined, a substantial effect is generated. The authors argue that the regression analysis indicates that mathematics skills involve several different facets. To focus only the math ACT or the math course taken will miss some parts of the mathematics skills that may support success in economics. Better algebra skills may be more important than more calculus

concepts for success in economics. Finally, they conclude that quantitative skills are important for success in economics.

Other studies also provide some insight into the relationship between math preparation and performance in economics principles classes. Roger Reid (1993) demonstrates that the grade students earn in a college principles course is affected in a statistically significant and positive way by having taking a mathematics class in their senior year in high school. The mathematics variable is a dummy representing the taking of some math class, without indicating the level of the math class taken. Myatt and Waddell (1990) test whether a high school economics course improves performance in college economics. As part of this study, the authors include a dummy variable for whether math was taken in the senior year of high school or not and a variable for the grade in the highest level math class taken. Taking math and the grade were statistically significant factors in predicting the final grade (in percentages). When the sample included only those who had economics in high school, the math grade had a statistically significant positive coefficient, and the dummy for having taken math as a senior was positive but not statistically significant. Kassens Uhl and Fleming (2007) use a sample of Roanoke College students and examine whether student performance is associated with human capital variables, time variables, indicating how the individual spent time studying or doing other activities, a math score from a quiz taken during the first week of class, and the number of prior mathematics courses taken. The results of an ordered probit indicate that students with better mathematics skills performed better in their economics classes. Finally, in two different but related studies, Cohn et. al use data gathered from experiments and find that graphs may not contribute to short-term performance in principles courses (2001), but that because a later statistical analysis indicates a positive but statistically insignificant association between a measure of performance and the student belief that graphs were helpful in learning economics (2004), the authors conclude that they cannot argue against the use of graphs. Instead, they argue for better student preparation and a better combination of verbal and graphical representation of economic concepts on the part of the instructor.

These studies on the effect of mathematics on economics performance suggest that mathematics may play a role in performance in the principles of economics. However, the impact may depend on the output measure used. Further, it is not clear whether the impact comes from the taking of the math course, the performance in the math course, or the skills one brings to the college arena.



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## DATA DESCRIPTION

Our analysis employs observations from the fall semester economics courses between 2002 and 2006. We elected a dataset with only fall semesters because students taking the standard principles sequence were required to take microeconomics before macroeconomics and we would therefore be more likely to get those students in their first economics course. In addition to the two principles level courses, we also offer an introduction to economics course. Students required to take one economics course could take either the introduction or the micro principles. Deletions occurred if a student recently transferred to BGSU and therefore did not have a math placement code or a previous semester's GPA, or if they were missing some other control variable, such as ACT scores. These deletions resulted in a sample size of 2,823.<sup>4</sup>

For the estimation of math preparation and final grade, we use an ordered probit model. Grades are arranged from 0 to 4, with 0 associated with the lowest grade of F and 4 associated with the highest grade of A. We estimate the probability of receiving a grade with the independent variables that have been used in many studies of economic performance. These variables include measures of academic achievement, including high school GPA and college GPA in the previous semester, gender, whether the individual was situated in the College of Business, whether the student has a proclivity for economics, mathematics or technical problem solving, either as an economics or finance major, as a mathematics or actuarial science major, or a computer science major,<sup>5</sup> and binary controls for type of economics course taken, including the micro and macro course.

Several variables represent math preparation. We normally see the ACT mathematics score employed as a control for mathematics preparation (Ballard and Johnson, 2004) and we do the same. However, we believe that the overall ACT math score only tells us that “more math preparation is better for economics” and not “which math skills are better for economics?” Therefore, we include two other sets of variables.

First, we substitute the ACT mathematics subscores for the overall ACT math score. These subscores present information about the individual's preparation in elementary algebra, college algebra, and trigonometry and geometry and these scores are aggregated up to the ACT Math section score (See Table 1A).

<b>Table 1A. ACT Subtest Content</b>		
Test	Broad Content	Material Covered
ACTSEA	Elementary algebra	Basic operations, factoring, linear equations
ACTSAG	Algebra and coordinate geometry	Functions, exponents, arithmetic and geometric series, matrices, complex numbers
ACTSGT	Plane geometry and trigonometry	Circles, rectangles, area, triangles, trig equations
Source: ACT Compass <a href="http://www.act.org/compass/">http://www.act.org/compass/</a>		

The second set of control for mathematics preparation comes from the math preparation test provided by the authors' institution. Freshmen entering the university are required to take placement tests in mathematics. Until recently, the test was administered when the student came to campus in the summer for registration and orientation. Based primarily on the placement score and the overall ACT math score, a placement for the student in a college math class was determined.

The mathematics department uses a set of tests developed by the American Mathematical Association. Each student selects one of three tests, based on their preparation. Table 1 shows the expected preparation for each test. Test A examines arithmetic, number sense, and pre-algebra. Test B predominantly tests algebra skills with some arithmetic skills. This test overlaps with both Test A and Test C. Test C examines for readiness in calculus, graphing, algebra, and trigonometry. Depending on the score on the test and the Math ACT, the student would be placed as shown in Table 1B. We are not given the score of the placement exam, but we are provided with the code that associates a student with the highest possible mathematics course s/he could first take at the university. Thus, we know something about how well prepared the student is for different types of mathematics.

A set of binary variables indicate at which mathematics level students could begin their mathematics course of study, including college algebra I and II, precalculus, basic calculus (which is required for business students), a higher level of precalculus, required for those student taking higher level math courses in the future, and a calculus course that includes trigonometry and analytical geometry. Apriori, we are not sure which of the math skills will be associated with success in one's economics course. Perhaps it is less about calculus and more about intermediate algebra, since introductory and principles courses do not use calculus, but do present graphs and simple equations.

<b>Table 1B. Math Placement Rules &amp; Skills Tested Bowling Green State University</b>				
<i>Minimum High School Background</i>	<i>Test</i>	<i>Sub-sections</i>	<i>Possible placements</i>	
Less than two years of high school algebra or two years with less than C	A	Prealgebra Elementary algebra Intermediate algebra	MATH 095 MATH 112 MATH 122	Intermediate Algebra College Algebra I College Algebra II
Two years of high school algebra with a C or better, but no trigonometry	B	Intermediate algebra College algebra	MATH 112 MATH 122 MATH 126 MATH 128 Mathematics MATH 129	College Algebra I College Algebra II Basic Calculus Precalculus Trigonometry
Some trigonometry	C	College algebra Advanced algebra Trigonometry	MATH 128 Mathematics MATH 130 Mathematics MATH 126 MATH 131 Analytical	Precalculus Precalculus Basic Calculus Calculus and Geometry
Source: University X Mathematics Department.				

Table 2 presents the descriptive statistics for the sample. The average economics grade for all students was a 2.19, which is typical for the department in any given year. The students who elected to take economics had an average grade point average in the previous semester of 2.92. Only 43% were females, a percentage not reflective of the gender composition of the university, but is in line with the typical class in economics at this university. Further, the majority of students take principles of microeconomics course as their first economics course.<sup>6</sup> Twenty-four percent of the students scored their highest placement in the required business calculus course, while another 34% placed either into college algebra I (21%) or II (13%). This distribution is typical of the students who end up in economics, where a majority of the students in principles levels courses tend to be business majors who have had some mathematics preparation in high school but

fewer place into the calc/trig course (11%) or the higher level precalculus course (8%). Note also that the ACT subscore averages are not very different from one another.

<b>Table 2. Descriptive Statistics of the Variables</b>			
<i>Variable</i>	<i>Description</i>	<i>Mean</i>	<i>Std. Dev.</i>
Grade	0 if F, 1 if D, 2 if C, 3 if B, 4 if A	2.19	1.04
GPA	College GPA in previous semester	2.92	0.61
High School GPA	High School GPA	3.17	0.66
College of Business	1 if from College of Business	0.44	0.50
Econ/Finance Major	1 if an economics or finance major	0.05	0.21
Math/Actuarial Science Major	1 if a math or actuarial science major	0.02	0.13
Computer Major	1 if a computer science major	0.01	0.10
Female	1 if female	0.43	0.49
White	1 if white	0.88	0.32
Introductory Economics	1 if course is Introductory Economics	0.24	0.42
Principles of Micro	1 if course is Principles of Microeconomics	0.58	0.49
Principles of Macro	1 if course is Principles of Macroeconomics	0.19	0.39
ACT Math	Overall ACT Math Score	22.10	4.05
<i>ACT untimed placement tests for mathematics</i>			
ACTSEA	ACT Elementary Algebra Score	11.95	2.77
ACTSAG	ACT Algebra Score	10.98	2.29
ACTSGT	ACT Geometry and Trigonometry Score	11.24	2.37
<i>University mathematics placements</i>			
College Algebra I	1 if highest placement was in College Algebra	0.21	0.41
College Algebra II	1 if highest placement was in Intermediate Alg.	0.13	0.34
Pre-Calculus	1 if highest placement was in Pre-	0.17	0.38

**Table 2. Descriptive Statistics of the Variables**

<i>Variable</i>	<i>Description</i>	<i>Mean</i>	<i>Std. Dev.</i>
	Calculus		
Basic Calculus (Business)	1 if highest placement was in Basic Calculus	0.24	0.43
Precalculus for Higher Level Math	1 if highest placement was in a precalculus course	0.08	0.27
Calculus or Trig	1 if highest placement was in calculus/trig	0.11	0.31
<b><i>Highest Mathematics Course in College Prior to Economics</i></b>			
No College Math	1 if no college math before first economics course.	0.13	0.34
Elementary & Intermediate Algebra	1 if the student took a beginning math class.	0.23	0.42
College Algebra I	1 if College Algebra .	0.05	0.22
College Algebra II	1 if College Algebra II.	0.08	0.26
Basic Calculus (Business Students)	1 if Business Calculus.	0.36	0.48
Precalculus or Trig. For Math	1 if Precalculus or Trigonometry for Mathematics.	0.04	0.15
Calculus & Analytical Geometry	1 if Calc. with Anal. Geom.	0.05	0.22
Advanced Calc. & Anal. Geometry	1 if Advanced Calc. with Geometry.	0.01	0.17
Math for Math Majors/Educators	1 if math for math majors or educators taken.	0.04	0.19
Higher Level Mathematics (Discrete Analysis, Linear Algebra)	1 if higher level mathematics.	0.003	0.06
Data source: Authors' university. SAS statistical software used to develop the statistics.			

### EMPIRICAL ESTIMATION OF PERFORMANCE

Table 3 presents the results from the ordered probit regressions; Table 3A presents the marginal effects for the relevant variables. We estimate the base probability at the means of all continuous variables and assume the base case includes the economics/finance major, the business student, and the microeconomics course (Recall, over 58% of the sample takes principles of microeconomics). All other binary variables are set to zero. Except for the ACT Math variable, the coefficients in Column 4 of Table 3 are used in the calculations. Column 2 results are used to estimate the ACT Math effect. Marginal effects are calculated by increasing the continuous variables by one unit. Binary variables are “turned on” by setting them to one.

The regressions present reasonably consistent results, as noted by the statistically significant likelihood ratio statistics that test the overall fit of the models and by the consistency of the coefficient estimates across different specifications of the independent variable set.

The controls for demographic characteristics are in the direction expected. Compared to their male counterparts, females have a higher probability of receiving a D or F (by about 3 percentage points) and a lower probability of receiving an A or B grade (by almost 5 percentage points). The signs of these coefficients are consistent with other papers that control for gender (Anderson, Benjamin, and Fuss, 1994; Benedict and Hoag, 2002).

<b>Table 3. Ordered Probit Results</b>					
<b>Dependent Variable: Grade in Economics</b>					
<i>Variable</i>	<i>(1) Basic</i>	<i>(2) ACT Math</i>	<i>(3) ACT Special Math</i>	<i>(4) Freshma n Placemen t Score</i>	<i>(5) College Math</i>
Intercept	-2.311*** (0.141)	-3.333*** (0.160)	-3.277*** (0.160)	-2.740*** (0.207)	-2.798*** (0.209)
GPA	1.179*** (0.040)	1.093*** (0.040)	1.094*** (0.040)	1.088*** (0.040)	1.097*** (0.014)
High School GPA	0.288*** (0.034)	0.160*** (0.036)	0.168*** (0.036)	0.135*** (0.036)	0.140*** (0.036)

<b>Table 3. Ordered Probit Results</b>					
<b>Dependent Variable: Grade in Economics</b>					
<i>Variable</i>	<i>(1) Basic</i>	<i>(2) ACT Math</i>	<i>(3) ACT Special Math</i>	<i>(4) Freshma n Placemen t Score</i>	<i>(5) College Math</i>
College of Business	0.315*** (0.048)	0.257*** (0.049)	0.259*** (0.049)	0.246*** (0.049)	0.189*** (0.061)
Econ/Finance Major	0.182* (0.098)	0.176* (0.098)	0.182* (0.098)	0.168* (0.098)	0.170* (0.099)
Math/Actuarial Science Major	0.571*** (0.163)	0.335** (0.165)	0.338** (0.165)	0.302* (0.166)	0.137 (0.180)
Computer Major	0.678*** (0.205)	0.461** (0.208)	0.460** (0.208)	0.404* (0.209)	0.196 (229)
Female	-0.255*** (0.042)	-0.143*** (0.043)	-0.142*** (0.043)	-0.145*** (0.043)	-0.146*** (0.064)
White	0.167*** (0.062)	0.085 (0.063)	0.080 (0.063)	0.093 (0.063)	0.087 (0.064)
Principles of Micro	-0.273*** (0.054)	-0.319*** (0.055)	-0.315*** (0.055)	-0.325*** (0.055)	-0.306*** (0.056)
Principles of Macro	-0.453*** (0.070)	-0.561*** (0.071)	-0.552*** (0.071)	-0.566*** (0.071)	-0.562*** (0.073)
ACTMATH		0.083*** (0.005)			
<b><i>ACT math subscores (untimed test results used for informational purposes)</i></b>					
ACTSEA			0.044*** (0.010)	0.026** (0.011)	0.024** (0.012)
ACTSAG			0.040*** (0.012)	0.016 (0.013)	0.017 (0.013)
ACTSGT			0.069*** (0.011)	0.051*** (0.012)	0.051** (0.013)
<b><i>Highest Level of Mathematics Placement from University Placement Exam</i></b>					
College Algebra I				0.082 (0.094)	0.082 (0.096)

<b>Table 3. Ordered Probit Results</b>					
<b>Dependent Variable: Grade in Economics</b>					
<i>Variable</i>	<i>(1) Basic</i>	<i>(2) ACT Math</i>	<i>(3) ACT Special Math</i>	<i>(4) Freshma n Placemen t Score</i>	<i>(5) College Math</i>
College Algebra II				0.203* (0.105)	0.171 (0.108)
Pre-Calculus				0.268*** (0.106)	0.209* (0.110)
Basic Calculus (Business)				0.360*** (0.113)	0.300** (0.118)
Precalculus for Higher Level Math				0.400*** (0.144)	0.342** (0.149)
Calculus or Trig				0.679*** (0.150)	0.637*** (0.158)
<i>Highest Level of Mathematics Taken Prior to First Economics Class</i>					
No College Math Prior to Econ					0.163** (0.072)
College Algebra I					0.209** (0.102)
College Algebra II					-0.056 (0.090)
Basic Calculus (Business Students)					0.188** (0.075)
Precalculus or Trigonometry for Mathematics					0.162 (0.115)
Calculus & Analytical Geometry					0.049 (0.113)
Advanced Calculus & Analytical Geometry					0.096 (0.194)
Math for Math Majors/Educators					0.416*** (0.136)
Higher Level Mathematics					0.528



<b>Table 3. Ordered Probit Results</b>					
<b>Dependent Variable: Grade in Economics</b>					
<i>Variable</i>	<i>(1) Basic</i>	<i>(2) ACT Math</i>	<i>(3) ACT Special Math</i>	<i>(4) Freshma n Placemen t Score</i>	<i>(5) College Math</i>
(Discrete Analysis, Linear Algebra)					(0.389)
$\mu_1$	1.060*** (0.042)	1.079*** (0.043)	1.080*** (0.043)	1.081*** (0.043)	1.086*** (0.043)
$\mu_2$	2.407*** (0.050)	2.474*** (0.052)	2.475*** (0.052)	2.483*** (0.052)	2.494*** (0.052)
$\mu_3$	3.623*** (0.061)	3.766*** (0.064)	3.764*** (0.064)	3.783*** (0.064)	2.494*** (0.052)
Log-L	1372.90* **	1570.10* **	1567.70* **	1594.00* **	1616.4***
Data Source: Authors' university. SAS statistical software is employed in the analysis. Statistical significance as follows: *** $\rightarrow \alpha = .01$ , ** $\rightarrow \alpha = .05$ , * $\rightarrow \alpha = .10$ . Standard errors in parentheses.					

The college grade point average in the previous semester is an important determinant of the economics grade. A 0.10 point increase in the college GPA increases the probability of receiving an A by 1.7 percentage points and the probability of receiving a B by 2.6 percentage points. The probability of receiving a D or F falls by 2.6 percentage points. This result is also consistent with previous work on performance in economics courses (Park and Kerr, 1990; Anderson, Benjamin, and Fuss, 1994). As discussed earlier, it is likely that GPA represents several characteristics of the individual, including ability and work ethic, and we would expect that those students with higher GPAs would perform better in their economics classes. Likewise, the high school GPA is positively associated with higher grades in a student's first economics course, although the marginal effect is small.

**Table 3A: Marginal Effects of Major Factors**

<i>Grade</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>F</i>
Base Probability	0.078	0.375	0.447	0.091	0.009
<i>Percentage Point Changes in the Base Probability</i>					
Female	-0.019	-0.038	0.029	0.024	0.004
GPA	0.017	0.026	-0.026	-0.015	-0.002
High School GPA	0.004	0.007	-0.006	-0.004	-0.001
ACT Math	0.018	0.014	-0.023	-0.008	-0.001
ACTSEA	0.004	0.007	-0.006	-0.004	-0.001
ACTSAG	0.002	0.004	-0.004	-0.003	0.000
ACTSGT	0.008	0.013	-0.012	-0.008	-0.001
College Algebra I	0.013	0.020	-0.019	-0.012	-0.002
College Algebra II	0.034	0.047	-0.050	-0.027	-0.004
Precalculus	0.047	0.060	-0.067	-0.035	-0.005
Basic Calculus (Business)	0.067	0.076	-0.093	-0.044	-0.006
HiPrep Pre Calc	0.076	0.082	-0.105	-0.0473	-0.006
Calc& Trig	0.152	0.108	-0.185	-0.067	-0.008

The authors estimate the base probabilities at the means of all continuous variables, for those who are business students, and economics/finance majors, and for those in the microeconomics course (micro is set to 1) because the student sample is primarily associated with this course (Recall, over 58% of the sample takes principles of microeconomics). All other binary variables are set to zero. Except for the ACT Math variable, the coefficients in Column 4 of Table 3 are used in the calculations, as are base probabilities. Column 2 results are used to estimate the ACT Math effect and base probabilities are not reported in this table, but are available from the authors. Marginal effects are calculated by increasing the continuous variables by one unit. Binary variables are “turned on” by setting them to one.

Our primary interest is how mathematics preparation is associated with performance in the class. Before we review these results, note that when the ACT mathematics score is included instead of the math preparation examination, a marginal increase in the ACT Math score increases the probability that an individual will receive an A or B and reduce the probability of receiving a lower grade. When we substitute the ACT subscores for the overall ACT math score, all three

coefficients related to these scores are statistically significant and positive, but the impact of each score on the economics grade is very small, from 0.2 to 0.8 of a percentage point. However, when we include the math placement level for the incoming freshman at the university, the placement reveals a strong, positive impact. One can see that as a student's mathematical skill reaches high levels, from the first level of college algebra to the highest level of calculus course, the probability of receiving an A or B grade increases as well, compared to the benchmark case of elementary algebra. For example, those who place into the required business calculus class have a 6.7 percentage point higher average probability of an A and a 7.6 percentage point higher average probability of a B compared to those whose highest placement is elementary algebra. For those who place into the highest level of mathematics, the average probability of receiving an A is 15.2 percentage points and a B is 10.8 percentage points higher than those who place into elementary algebra. Note that in these cases much of the movement to the highest grades comes from the C grade, suggesting that higher math ability does not particularly prevent individuals from flunking their economics courses, although the average probability of receiving a D does fall anywhere from 1.2 to 6.7 percentage points.

Are these results indicative of particular or specific mathematics skills or general mathematics ability? This is a difficult question to answer. However, we suggest that the math placement results represent something more than natural ability for several reasons. First, when we control for ability through the two GPA variables, the math placement variables are also statistically and economically significant in the regression. Second, when the model includes the ACT subscores and the math placement variables, all but one of the subscore coefficients remain statistically significant. The impact of the subscores is reduced, however, when the placement variables are included, due to some collinearity among the variables,<sup>7</sup> suggesting that there is some overlapping effect among the variables, but not entirely.

We next test whether math skills developed in college have an effect on the performance in the first economics course. Column (5) of Table 3 presents the model that includes all of the previous variables, plus controls for the highest mathematics course taken by the student prior to the economics class. The benchmark case is elementary and intermediate algebra. Table 3B presents the marginal effects of these courses. We find that except for College Algebra II and the benchmark case, some college math prior to economics helps the student better perform in the class, although a number of courses are associated with statistically insignificant coefficients. However, business calculus and mathematics for math majors and future educators seem to have a substantial impact, both statistically and

economically. Those students who have completed a mathematics class for majors/educators have a higher average probability of receiving an A of 12.6 percentage points, and a 12.2 higher average probability of receiving a B, compared to those in elementary and intermediate algebra (the benchmark case). Likewise, students completing a business calculus class have a higher average probability of receiving an A of 7 percentage points and a B of 9.1 percentage points, compared to the benchmark case. Note that when these math courses are included in the model, most of the ACT subscores and math placement variables are still statistically significant, with little change in size, suggesting that the math skills brought to college are important for the student when taking economics.

**Table 3B. Marginal Effects of College Math Courses on Economics Grades**

<i>Economics Grade</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>F</i>
<i>Base Probability</i>	0.065	0.352	0.468	0.104	0.011
No College Math Prior to Econ	0.026	0.043	-0.039	-0.026	-0.004
College Algebra I	0.034	0.053	-0.051	-0.032	-0.005
College Algebra II	-0.005	-0.013	0.007	0.009	0.002
Basic Calculus (Business)	0.070	0.091	-0.101	-0.053	-0.008
Precalculus or Trigonometry for Mathematics	0.065	0.087	-0.094	-0.051	-0.007
Calculus & Analytical Geometry	0.042	0.064	-0.063	-0.038	-0.006
Advanced Calculus & Analytical Geometry	0.051	0.074	-0.076	-0.043	-0.006
Math for Math Majors/Educators	0.126	0.122	-0.166	-0.072	-0.009
Higher Level Mathematics (Discrete Analysis, Linear Algebra)	0.158	0.130	-0.199	-0.079	-0.010
Data Source: Authors' university To estimate the Math Course effect, Column 5 of Table 3 is used. All average differences are in relation to the University's Elementary and Intermediate Algebra courses.					

## CONCLUSIONS

Using a unique control for mathematics preparation prior to the college experience, this study examines whether math preparation and specific math skills

help students be successful in an economics course. The results of the analysis suggest: (1) *Ceteris paribus*, those individuals with the background that qualified them to take higher levels of mathematic courses were more likely to receive As and Bs in their first economics course, compared to those students who had relatively less math preparation from high school and subsequently placed no higher than in elementary or intermediate algebra. (2) The positive effect on grades grew as the placement level grew, and those whose highest placement was in the calculus course that included analytic geometry and trigonometry had the highest average probabilities of receiving an A or B grade in their first economics courses. (3) The effect of the ACT math subscores indicate that students who received higher scores in elementary algebra, college algebra, or trigonometry and geometry have a higher probability of receiving A and B grades in their economics courses. Again, the higher the level of ability in mathematics, e.g., trigonometry and geometry, the more likely the student will perform well in economics. (4) Taking college-level business calculus or higher level mathematics has an economically and statistically significant impact on performance in one's economics class.

The outcome of this analysis does not lead to an easy interpretation. Precisely how well one can actually do the mathematics does not appear to be so important, because marginal increases in the ACT subscores have little impact. Further, while it does appear that native ability (as measured by the overall ACT math score) matters, exposure to mathematical ideas appear to be more important in improving performance in economics. Despite the fact that higher level mathematical skills are not employed in the principles and survey courses, exposure to higher level mathematics is associated with higher grades in the first economics course, other factors held constant.

Thus, it appears that for the student, being exposed to more mathematics in high school is the important point. It does not appear that algebra skills matter, where one focuses on getting the answer. Calculus prepares the student, too, but now the student must see the function, how things are related, and the student will be exposed to marginal analysis (e.g., total and marginal revenue concepts). What seems to prepare the student most is the abstract reasoning associated with geometry or trigonometry.

These results suggest to us that mathematical maturity will help the typical student perform better in their first economics course. However, economics departments have little say in what math courses are taken at the high school level. But, we do have control on entrance requirements for courses. Thus, one possible policy implication might be to require students to take more mathematics before taking economics on the grounds that students gain some maturity that helps them

perform better in economics. In fact, this study suggests that the current required business calculus course aids the student in their understanding of economics and perhaps it should be a prerequisite for the principles levels classes.

Broadly speaking, our results suggest the importance of high school students selecting the proper mathematics courses for success later in college, both in mathematics and in other disciplines such as economics. Getting the word back to high schools is not easy, but is one possible way to proceed. For example, many states have graduation requirements that include a mathematics component. Working with agencies that set such standards would be one approach, although we can envision a number of political and bureaucratic problems with such an approach.

An additional problem is that students coming into our economics classes are often taking the class as part of a general education requirement or because an accrediting agency has recommended more economics, such as in education. What can be done for students in these areas where calculus may be not a reasonable requirement? It might make sense to offer some added help to these students to brush up on some mathematics and to add some simple calculus concepts through help sessions or computer learning packages.<sup>8</sup>

Finally, we also see an avenue for future research. It may be that universities would see that added quantitative strength would improve performance in other areas in addition to economics and may be well worth the cost of any program that enhances mathematics skills. It would be interesting to compare those institutions with programs that require a high level of math skill, such as engineering, to schools without such programs, to see how students in fair in a variety of programs. The larger pool of observations and the cross-comparison can tell us more about the effect of mathematical maturity on student performance in economics and other classes.

## ENDNOTES

<sup>1</sup> Thanks to Dr. David Meel of BGSU's Department of Mathematics and Statistics for providing the placement exams and for helping us understand the placement process at BGSU. Robert Zhang provided data in addition to the placement test data, a monumental job, for which we offer thanks. Julie Dibling provided some additional data as did Kelly Dove. We give our thanks for their help in our endeavor. The authors also thank session participants at the 2009 Midwest Economics Association meetings. No mistakes that may remain are due to these individuals. Please send all correspondence to Professor Hoag.

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- <sup>2</sup> Bowling Green State University Undergraduate Catalog, 2001-2003 provides the degree requirements information.
- <sup>3</sup> From time to time the university provides a report on the average grade by discipline in the lower division courses, as well as the upper division courses. One consistent outcome is that at both levels, the courses labeled ECON have among the lowest grade point averages in the university. This information is not circulated among the students. We suspect that many economics departments across the country face the same situation.
- <sup>4</sup> Of the 5429 observations, 759 had no ACT Math score, 516 were missing key university variables, including the dependent variable, 380 had no ACT math subscores, 664 had no math placement scores, 252 were double counts (in other words, they were in economics more than once in the sample). These deductions left a total of 2,858 observations.
- <sup>5</sup> We tested other controls for a student's major and did not find that these controls were statistically significant. Thus, we opted for the most parsimonious model and included only three controls for major that had a logical and statistically significant impact on the first ordered probit regression.
- <sup>6</sup> The department typically requires micro before macro, but exceptions do occur.
- <sup>7</sup> An OLS regression of the ACT math scores on the placement variables yields an adjusted  $R^2$  of 0.52 to 0.54 and the coefficients on all of the placement variables are statistically significant, indicating correlation. Results are available from the authors.
- <sup>8</sup> An alternative solution to this problem is to alter the direction of presentation for students in the principles level courses so that the material is accessible to students with weaker mathematics backgrounds. There are now textbooks on the market that eschew graphs and math, hoping to make economics comprehensible for the math-phobic individual. So, why not change the course and make the material more accessible? After all, almost no one would argue that knowledge of economics is irrelevant.
- While this is an attractive argument, our view is that there is something inherent in economics that calls for mathematical analysis. Further, disciplines that require economics for its analytical skill development would not find such a course useful. And, the bigger issue is that the tools of economics need mathematics. Somehow, the analysis of supply and demand is most deeply understood with a graphical analysis. The authors do not see a way to overcome this simple fact.

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# TEACHING SYNERGISTIC INTEGRATION OF ECONOMICS AND MATHEMATICS

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## ABSTRACT

*The purpose of this analysis is to present a Synergistic Integration Method (SIM) of enhancing higher level thinking and obtaining robust applications of numerous mathematical applications through problem design and presentation. This technique involves constructing problems that embed mathematical constants that are universally encountered across the arts and sciences. Although this method has been developed for use in economics, it can be applied in any mathematically-based discipline. Once the concepts are manifested throughout the problem specification and solution, the results are used to present applications from a variety of disciplines that extend well beyond economics. This methodology has a big payoff for instructors and for students by sharpening analytical skills, by increasing retention of material from broad curricula, and by enhancing creativity and awareness.*

## INTRODUCTION

A job worth doing is a job worth doing well. Most concepts in economics are primarily taught by presenting and solving a problem that is relevant to the issue of concern. When equations, numbers, and graphs are used as examples, they simply consist of arbitrary numbers and curves that are chosen with no plan or design other than to contain a solution that falls in some desired range. Once the example achieves the minimum objective, students move on to the next topic and the task is completed. The job is considered done, but it is not done nearly as well as it could be.

This paper presents a Synergistic Integration Method (SIM) that views every example not only as a utilitarian exercise, but also as a potential work of art. This method extends the teaching of any concept well beyond a given problem's initial seemingly narrow focus, and moves toward finding an additional inherent beauty

through an internally forged esoteric design that bursts forth a wealth of unexpected applications that cross over all disciplines. Students' learning truly becomes an adventure. The diversity of this method ensures that the instructor can draw from areas targeted such that each student finds the study more meaningful, relevant, and applicable to his or her own interests.

### **METHOD DESCRIPTION**

The SIM begins by embedding fundamental mathematical concepts within each example. This creates a layered esoteric, or hidden, design. It creates a story within a story. Only the students who recognize the mathematical constants will be able to understand both stories. Using this procedure, the problem may contain multiple layers whereby only the most knowledgeable students will fully perceive all that is hidden within the problem. As the problem is presented and solved, the instructor can share the dual ideas within the problem, and perhaps leave some of the other concepts as a puzzle or exercise for the student to discover. As will be shown below, students may have a partial perception of the underlying concepts without fully understanding why.

Finally, the instructor can present various applications of the mathematical concept in the non-economic areas where they used. Students learn not only economics but also a range of other interesting integrated topics as well. This binds the students' entire curricula together, and creates a synergy that arises due to the insights gained through the exploration of the common strands of various applications that share an underlying kernel. Without this nexus, these additional insights would otherwise be unobtainable.

The author has applied this method in a variety of economics and mathematics courses at the high school, undergraduate, master's, and doctoral level for over 20 years, and has found it adds greatly to the educational experience. It is based on an ancient technique of educating initiates that was used by the ancient Egyptians, Pythagoreans, and many others from unknown remote antiquity up through the present.

### **EXAMPLES AND ANALYSIS**

This section demonstrates the method through the use of four examples. For the first example, consider a microeconomic problem of determining the profit maximizing quantity of production for a monopolist.

Example 1: Consider a monopolistic producer that faces a cost function and an inverse demand function given respectively by  $C = 480,000 + 1947.1Q$  and  $P = 5159.7324 - .712463335Q$ . Find the profit-maximizing quantity, price, and profit.

Figure 1

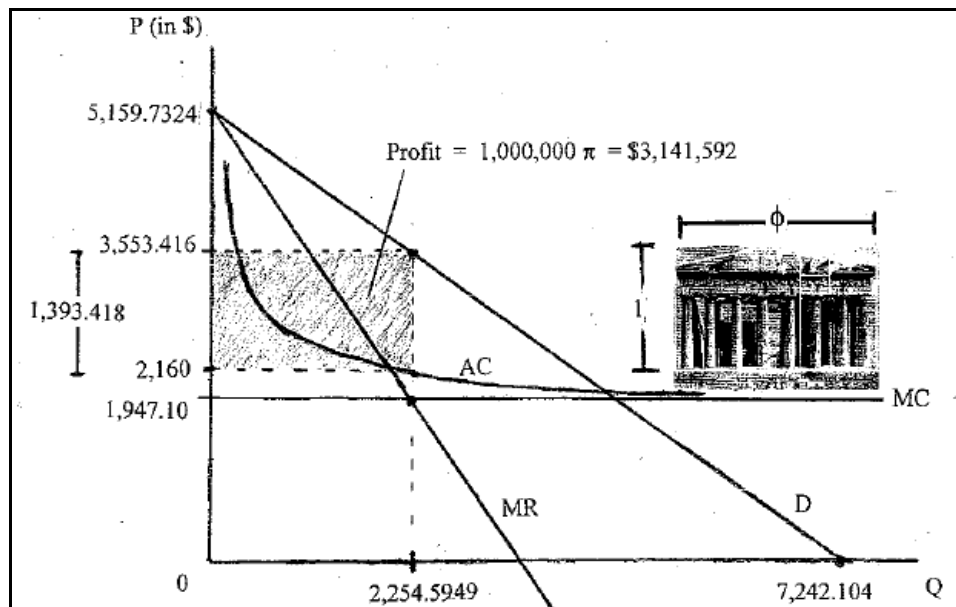


Figure 1 shows the (inverse) demand (D), marginal revenue (MR), marginal cost (MC), and average cost (AC) functions for this situation. The profit-maximizing quantity of production is 2,254.5959 units. Although firms generally must produce whole numbers of units, the numbers should be left as precise decimals or fractions in order to catch the full significance of the underlying values. The profit maximizing price is \$3,553.416. Although prices are usually stated to the nearest cent, it is often insightful to round the price to the third decimal place, as is routinely done with gasoline prices, in order to achieve more precision in the results.

At the profit-maximizing price and quantity, the average cost (AC) is \$2,160. The moon is exactly 2,160 miles in diameter! A figure of 2,160 years also commonly used as the ideal number of years for the earth to move through one astronomical age in the cycle of precession of the equinoxes. The average profit per unit sold is  $\$3,553.416 - \$2,160 = \$1,393.418$ , and the total profit to the nearest

dollar is given by  $(\$1,393.418)(2,254.5459) = \$3,141,592$ . This number is 1,000,000  $\pi$ ! This is the area of the shaded rectangle in figure 1.

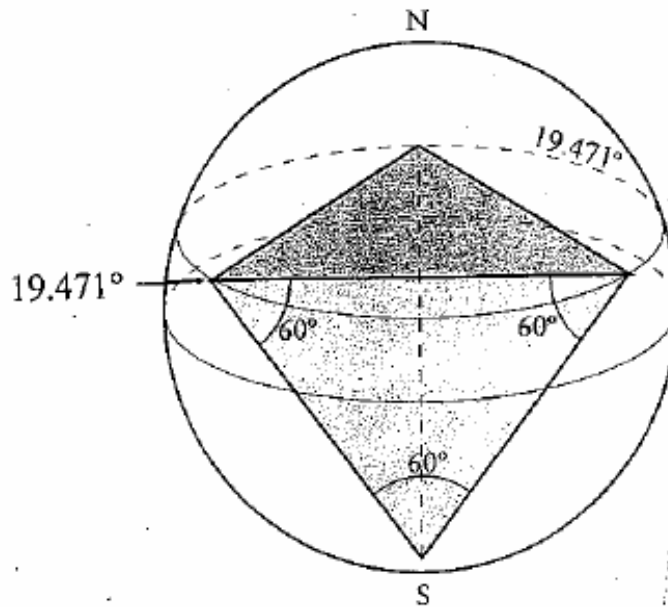
This example thus provides the decimal harmonics of two widely occurring mathematical constants, 216 and  $\pi$ . The frequency 216 Hertz is an octave below a tuning standard of  $A = 432$  Hertz, which is the tuning of the Stradivarius violin, and the tuning standards that many musicians advocate. The Bose Corporation sets the clock time to display 4:32 on the promotional materials for its wave radio, reflecting this tuning standard.

There are numerous other applications that could be pointed out. For example, students can be asked to find the circumference of the moon using the formula circumference equals  $\pi$  times diameter, so that  $C = (\pi)(2,160) = 6,786$  miles. This links the two constants together. Students thus get a lesson in economics, astronomy, music theory, and geometry. But that isn't all, because there are two other gems hidden in the problem.

Examine the shape of the rectangular profit region. The ratio of the base to the height of the rectangle is  $2,254.5949 / 1,393.418 = 1.61803$ . Voila—this is the golden number  $\phi$  to 5 decimals places! The number  $\phi$  is precisely equal to  $(1 + \sqrt{5})/2$ , and it is the limit of the ratio of the numbers in the Fibonacci sequence, where each successive adjacent numbers are added together to give 1, 1, 2, 3, 5, 8, 13, ... This also means that the profit region forms what is referred to as a golden rectangle. This is considered to be the most aesthetically pleasing rectangular shape for humans, and it has been designed into the great architectural structures of the ancient Egyptians, especially including the Great Pyramid at Giza, the Osirion at Abydos, and the temple at Luxor (Hudgins, 2003, Lawlor, 1998). It was commonly used by ancient Greeks, such as in the façade of the Parthenon, and has been employed by many countless others across the globe from ancient times throughout the present. Students get a lesson in art and architecture by examining this aspect of the problem. But that is not the end.

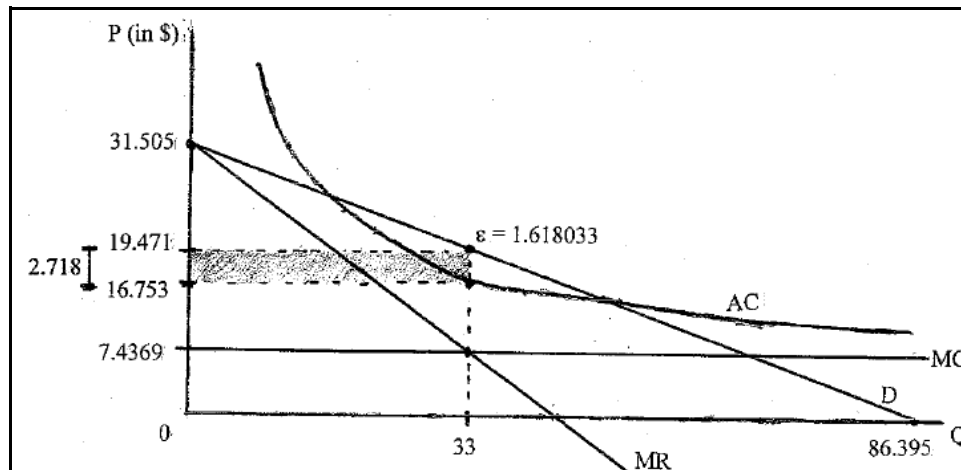
The marginal cost (MC) is \$1,947.10. Figure 2 shows a regular tetrahedron, which is the simplest of the five Platonic solids, inscribed within a sphere. When the apex of the tetrahedron is at the North Pole, the three base corners will be tangent to the sphere at 19.471 degrees south latitude. Similarly, if the apex is placed at the South Pole, then the three base corners will be tangent at 19.471 degrees north latitude. Thus, the marginal cost is equal to the decimal harmonic  $100t$ , where  $t$  is the circumscribed tetrahedral constant 19.471.

Figure 2



The largest volcanoes on earth occur in Hawaii, whose Big Island contains latitude 19.471. Olympus Mons, on the planet Mars, which is the largest volcano in the solar system, also resides at between 19 and 20 degrees, as does Jupiter's big red spot. Mexico City lies atop the old Aztec capital of Tenochtitlan at latitude 19.47 degrees. The state of Israel, which has a 2-dimensional version of this interlocking double tetrahedron on its flag, was enacted and placed in existence in 1947 and 1948. India's independence occurred in 1947, and the U.S. Air Force became an independent service in that year. Much of the post-war economic data begins in 1947. Thus, students can use these and other applications to learn lessons in geometry, geography, astronomy, and history.

Figure 3



Example 2: Consider a monopolistic producer that faces a cost function and an inverse demand function given respectively by  $C = 307.44 + 7.4369Q$  and  $P = 31.505 - .36464Q$ . Find the profit-maximizing quantity, price, and profit.

Figure 3 shows the graph for this situation. The profit-maximizing firm will produce a quantity of 33 units and sell them at a market price of \$19.471. Here is the circumscribed tetrahedral constant again, but now it is augmented with a new fact. The constant  $t$  actually derives geometrically from the fact that  $\sin^{-1}(1/3) = 19.471$  degrees. Since  $1/3 = .333\dots$ , the constants 33 and 19.471 are linked. There are many applications of this, but students get a bonus whenever the problem contains both figures.

In this problem, the students get other bonuses, too. The price elasticity of demand is  $\epsilon = (1/.36464)(19.471)/(33) = 1.618$ . Voila—there again is the golden section! And the students are sure to notice these numbers and their applications the second time around. Also, the average profit is equal to price ( $P$ ) minus average cost ( $AC$ ), so that  $\$19.471 - \$16.753 = \$2.718$ . This is the widely used exponential constant  $e = 2.718$ , given to 3 decimal places. This constant appears throughout every field of mathematical application, especially in problems of growth and decay.



Example 3: A family has spent \$19,471 to purchase a mutual fund to save for a daughter's college education. She plans to attend college in Hawaii. They expect the fund's annual rate of return to be steady at about 5.95%. If this holds true, how many years will it take for the value of this investment grow to \$60,000?

This example comes from statistics, algebra, and financial mathematics. The solution of this problem is 19.471 years, and it is found by solving the following equation for  $n$ :  $60,000 = 19,471 (1 + .0595)^n$ . The solution to this problem is the circumscribed tetrahedral constant  $t$ , and the principle of the investment in this example is  $1,000 t$ . The students can make the connections that Hawaii contains the latitude 19.471 degrees north. The Hawaiian Islands also contain latitude 21.6, which runs by Honolulu, the birth place of U.S. president Barack Obama. This number is  $216/10$ , where the number 216 and 2,160 were previously presented. The location of the college and monetary amounts can easily be altered, or used as they are in order to express other geographical and political lessons. For example, the president lives in Washington, D.C., which lies at a latitude that is exactly  $2t$ , or  $(2)(19.471)$ , which is between latitudes 38 and 39 degrees north.

The solution setup also contains the figure  $(1 + .0595) = 1.0595$ . This is the four decimal approximation of  $2^{(1/12)}$ , which is the incremental ratio between the frequencies of adjacent notes in an equal temperament tuning scale, which is used on most modern musical instruments. The instructor can explain equal temperament within the lecture, or outside of class to just those students who want to know more detail. This example thus allows for a lesson in geometry, geography, astronomy, history, politics, and music theory.

Example 4: A country produces cheese and wine, and it possesses 660.542 hours of labor where its Production Possibilities Frontier (PPF) is given by  $256 Q_C + 243 Q_W \leq L$ , where  $L$  represents labor measured in hours. Find the slope-intercept form where  $Q_W$  is the dependent variable, and state the opportunity cost of producing cheese.

This example appears in microeconomics and international trade. The slope-intercept form of the equation found by calculating the following:

$$Q_W \leq (660.542 / 243) - (256 / 243) Q_C,$$

which has the solution

$$Q_W \leq 2.71828 - 1.0535 Q_C.$$

The intercept of this equation is the exponential constant  $e = 2.71828$ , given to 5 decimal places. The slope of this equation is  $256 / 243 = 1.0535$ , which is also the opportunity cost of producing cheese. In order to produce one additional unit of cheese, the firm must give up producing 1.0535 gallons of wine. But this number is also the limma, or leimma, (also called a minor semitone) from the Pythagorean scale in music theory, which expresses the difference between the minor third and the tone. This number appears as a frequency in vibratory applications throughout physics (Hudgins, 2003).

## CONCLUSION

The Synergistic Integration Method (SIM) presented in this paper integrates different concepts within a carefully constructed framework that consists of a plethora of densely packed examples. Each of these examples tells a story within a story as the students peel back layer after layer of the innards. Students discover new paths for enhancing higher level thinking as they explore the robust range of applications of numerous applied mathematical constants. The subject becomes more of an art—more of a high-stakes game where the reward for spending time with a problem is the sweet fruit of understanding. Synergy results because the combined effect of the SIM exploration results in a journey that produces a much bigger experience and much deeper insight than that which could be obtained by trying to analyze each of the pieces alone in isolation.

The examples above are only a small set of the vast array of potential that this approach offers. Besides the numbers in the examples above, the author has commonly employed either the number or its decimal harmonic of the following: the comma of Pythagoras ( $CP = 3^{12}/2^{19} = 1.0136432$ ); the fine structure constant ( $\alpha = 1 / 137.036$ ); musical pi ( $MP = 360/84 = 4.2857$ ); the radian ( $180/\pi = 57.29578$ ); the square roots of 2, 3, and 5; the sizes, orbital periods, and distances of planets;

geographical coordinates of ancient monuments and modern cities; and many other interesting topics. For example, when working an example regarding current issue facing a country in the field of economic development, the country's geographic coordinates and its landmark dates can be embedded within the problem so that the class can get a fuller grasp on the country in its entirety.

But this approach does not end there. It strives for full integration. Thus, when setting the course schedule calendar for certain lecture topics or term paper due dates, the author has set them to be turned in online by mathematical constants in time. For example, some of these times included: 3:14 a.m. or p.m. ( $\pi$ ); 3:33 a.m. or p.m. ( $1/3$ ); 6:18 a.m. or p.m.; ( $10/\phi$ ); 4:18 p.m., which 16:18 hours military time ( $10\phi$ ); 7:47 p.m., which 19:47 hours military time ( $t$ ); and so on. These lecture dates or due date times can also be chosen on specific calendar dates, such as the equinoxes and solstices, or dates such as March 14 ( $3/14 = \pi$ ).

There also two further aspects that can be integrated: The labeling of the problems and the locations of the problems on the paper, including the margins and the size of the paper. For instance, example 1 above might be placed within a problem set where it is labeled as problem 16, since it contains the constant  $\phi = 1.618$  (and  $16 = 10\phi$ ). Example 2 might be numbered as problem 3 or 33, since it contains the number 33 and its inverse *sin* function. The Rhind mathematical papyrus from ancient Egypt places some problems on the page where the dimensions of the worked out problem follow the golden ratio  $\phi$ . For example, in that papyrus, problem 35 and its solution are divided horizontally so that ratio of the dimensions is 1 to  $\phi$  (Schwaller de Lubicz, 2001, pp. 152-3). Why has it been considered acceptable to work out problems and then present them in any manner as long a solution procedure is shown and the answer is correct? This lack of awareness removes the requirement of students to find beauty, art, and pride in all that they do. It loses a sense of purpose.

The economics problems can be typed and placed on the page in the dimensions of the constants that are embedded, such as having a base to height ratio of 1:  $\phi$  (1:1.618), for example. Even the borders on the word processed handout or problem set can be set so that the typing on the page takes up this golden section ratio. Just as with fine Japanese and other cultural food cuisines, the food presentation and atmosphere are considered to be just as important as the food when achieving a fully integrated dining experience.

The more effort that the instructor puts into creatively embedding all of the concepts that are relevant to the students' interests, needs, and learning objectives, the greater is the payoff. It is certain that every problem utilized in teaching cannot

be a multi-layered esoteric learning exercise, but the more that this method is utilized, the more aware the students will become as they gain a sense of synchronicity in their experiences. Architecture, art, astronomy, biology, economics, engineering, geography, history, mathematics, music, philosophy, political science, and more are all fused into one magnificent whole. Our objective as teachers is to continually raise our own existence to a higher plane, and to encourage our students to do the same. This is one technique toward following that path.

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# **ATTENDANCE, GRADES AND LEARNING IN THE MICROECONOMIC PRINCIPLES CLASS**

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## **ABSTRACT**

*This paper explores the relationship between attendance and learning in the microeconomic principles course. Using pre and post testing to measure learning, attendance, as well as several other factors are studied as possible explanatory variables as to how well students perform in microeconomics classes where attendance was voluntary. The outcome suggests that attendance did not significantly affect learning but was an important factor with respect to the grades students earned in the course. The strongest predictor of both student learning and student grades was prior academic success, as measured by the students' current GPA.*

## **INTRODUCTION**

How important is class attendance to student success in a college course? Many institutions, especially the smaller ones that emphasize personal attention, view it as valuable enough to maintain mandatory attendance policies. Prior research also indicates that attendance is positively associated with student success.

This paper addresses the relationship between student success and attendance in the principles of microeconomics offered at a relatively small liberal arts college with students of average ability.

## **SAMPLE OF PRIOR RESEARCH**

In a recent study Chen and Lin cite several researchers in the field of education and psychology that “have generally found that a student’s class attendance has a positive effect on exam performance.” [2008, p. 214] Similar results are also noted with respect to studies of economics principles courses that conclude “the more lectures a student attends, the better overall grade he or she

obtains.” [2008, p. 214] These conclusions reflect the consensus view from the broad array of literature on the subject.

While the literature clearly supports a significant link between attendance and performance in class, a plethora of caveats abound. Romer notes that “Absenteeism is rampant in undergraduate economics courses at major American universities.” [1993, p. 173] Attendance averaged only 67 percent in Romer’s data set. [Though this study is somewhat dated, current research does not indicate that attendance rates have improved.] This might be indicative of the perceived quality of instruction received in what are primarily research institutions. If students perceive that the return on attendance is higher, they may attend more classes. This may imply that smaller class sizes and institutions that emphasize teaching should experience higher rates of attendance.

Further, as noted by Stanca, attendance is not exogenous, especially when it is voluntary, but is a function of “unobservable characteristics, such as ability, effort, and motivation, that are also likely to determine performance.” [2006, p.252] Stanca also goes on to note that test scores may not be a good indication of learning. [2006, p. 263]

Durden and Ellis find that absenteeism does affect achievement in the principles of economics course, but that it is nonlinear and becomes important after a student misses four classes. [1995] The authors do not have an explanation for this “threshold effect,” but note that it might be due to the fact that better students make attending class a priority.

Marburger uses a controlled experiment and concludes that there is “an inverse relationship between absenteeism and student performance” and that it is significant but “does not appear to be substantial.” [2006, p. 154] This study used student performance on specific test questions where the material was covered in the class when the students were absent. In an earlier work Marburger had found that “the mean exam score was significantly affected by absenteeism.” [2001, p.107] He goes on to note that this impact is likely to be institution and instructor specific.

Finally, Armstrong points to conflicting studies to challenge the conventional wisdom that mandatory attendance is positively correlated with learning. [2004] He reasons that students who attend voluntarily should learn more than those required to attend. Those required to attend might assume they have met the class requirements and see no need to learn outside the classroom.

This brief sample of prior research represents what might be found in a more exhaustive review. It also summarizes some issues that will also be addressed in this paper. Previous efforts have focused on attendance in large lecture style class where

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adequate sample sizes are easily achieved. This paper will address the importance of attendance in smaller classes, numbering no more than 30 students.

### DEFINING LEARNING

Virtually all of the prior studies have used exam scores and course grades to define student success. Such an approach does not take into account the prior knowledge base that students bring to a class. To control for this, I use pre and post testing and define learning as the gains made by the students on the test. The specifics are described below. In economics we are fortunate to have a nationally normed test that can be used for this purpose.

### THE DATA

Over the past two academic years six sections of the principles of microeconomics classes were taught by the author at a small liberal arts college that places a strong emphasis on teaching excellence. In each class the *Test of Understanding in College Economics* (TUCE) [2007] was given on the first day (pretest) and used as part of the final examination (posttest). Any student that did not complete both tests was excluded from this study. This resulted in 131 students being included. Attendance using a seating chart was taken on a daily basis. The average number of absences was 3.50, in classes that met for lecture/discussion a total of 36 times. This implies an attendance rate of 90.3 percent that would be considerably higher than the rate used in the prior studies and probably reflects a structural difference between small classes and large lecture classes, or small colleges and large universities.

Additional background information was obtained on each student from the Registrar's Office for overall GPAs and SAT scores. The GPA variable is used as an indicator of prior academic success and the SAT variable is included as a measure of college level preparedness. Since the College uses a plus/minus grading system, final course grades were coded as A = 1, A- = 2, B+ = 3, etc.

### ANALYSIS AND RESULTS

To address the question of the importance of attendance to student learning several correlation coefficients were calculated. Defining learning as pretest to

posttest differences by individual students' TUCE scores and calculating a simple correlation results in the following:

$$\begin{aligned}\text{Pearson correlation of Difference and Absences} &= -0.209 \\ \text{P-Value} &= 0.017\end{aligned}$$

Defining the null hypothesis as there being no correlation between absences and learning, it appears we can reject this hypothesis at the 95 percent confidence level (based on the P-Value) and conclude there is a negative and significant relationship between absences and learning.

If we define the null hypothesis as there being no correlation between absences and course grades we get these results:

$$\begin{aligned}\text{Pearson correlation of Absences and Course Grade} &= 0.434 \\ \text{P-Value} &= 0.000\end{aligned}$$

We can reject the null hypothesis at the 99 percent confidence level and conclude there is a significant negative correlation between course absences and course grades (the positive sign is due to the assignment of low values to the higher grades, i. e. A = 1, and high values to the lower grades, i. e. F = 12). It is also notable that the value of the coefficient is more than twice the value of the one calculated for the correlation between absences and student learning.

Since the Durden and Ellis study found that nonlinearity existed, I used two sample t-tests to see if any such effects were present in these data. Dividing the class into two groups several times (those with fewer than 3 absences verses those with 3 or more absences, those with fewer than 4 absences verses those with 4 or more absences, etc.) the greatest disparity in the two groups occurred at a threshold of 4 absences. The results were:

Students who missed 4 or fewer classes average a post test gain of 8.11, while those with 5 or more absences averaged a gain of only 5.16. The T-Value and P-Value both indicate that the different means are significant.



Two-sample T for Difference				
ab lt 5	N	Mean	StDev	SE Mean
0	37	5.16	4.96	0.82
1	94	8.11	5.08	0.52
Difference = $\mu(0) - \mu(1)$ Estimate for difference: -2.944 95% CI for difference: (-4.878, -1.010) T-Test of difference = 0 (vs not =): T-Value = -3.04 P-Value = 0.003 DF = 67				

A threshold of 4 absences was also the most significant determinant for performance on the course grade. The results were

Two-sample T for Course Grade				
ab lt 5	N	Mean	StDev	SE Mean
0	37	7.54	3.24	0.53
1	94	4.79	2.69	0.28
Difference = $\mu(0) - \mu(1)$ Estimate for difference: 2.753 95% CI for difference: (1.551, 3.955) T-Test of difference = 0 (vs not =): T-Value = 4.59 P-Value = 0.000 DF = 56				

Both the T-Value and the P-Value indicate that the difference between the means is significant. Students with 4 or fewer absences received an average grade of 4.79 (B to B-) and students that missed 5 or more classes average a grade of 7.54 (C to C+). The results were not as significant when the threshold for absences was altered in either direction, leading to the conclusion that, in this instance, students missing 4 or fewer classes performed significantly better in terms of their overall course grade. This was the same threshold value found in the Durden and Ellis study.

To further examine relationships and feedback affects the following correlations were run:

	Difference Absences	SAT	GPA	Course G	Gender
Absences	-0.209	0.017			
SAT	0.365	-0.110			
	0.000	0.210			
GPA	0.470	-0.506	0.498		
	0.000	0.000	0.000		
Course G	- 0.597	0.434	-0.528	-0.749	
	0.000	0.000	0.000	0.000	
Gender	-0.177	0.069	-0.136	0.011	0.140
	0.044	0.433	0.121	0.901	0.111
Cell Contents: Pearson correlation P-Value					

The calculations indicated that such factors as the students' SAT scores and GPAs are strongly correlated with both their gains on the TUCE and their course grades. The students' gender did not show a strong significant relationship to any variable. The SAT score does not correlate significantly with student absenteeism, but there is a significant negative association with absenteeism and GPA.

Since simple correlation does not offer any insight for explanatory power, regression analysis was performed on the data. Including some of the above p potentially explanatory variables yields the following results:

Regression Analysis: Difference versus SAT, GPA, Absences				
The regression equation is				
Difference = - 7.41 + 0.00683 SAT + 0.0297 GPA + 0.011 Absences				
Predictor	Coef	SE Coef	t	P
Constant	-7.414	3.161	-2.35	0.021
SAT	0.006834	0.003582	1.91	0.059
GPA	0.029666	0.007996	3.71	0.000
Absences	0.0110	0.1474	0.07	0.941
S = 4.573    R-Sq = 24.4%    R-Sq(adj) = 22.6%				

With respect to gains from pretest to posttest score, absences and SAT score show no significant contribution. The dominate explanatory variable is GPA. Given the value of the adjusted R-Square there would appear to be other influences not being captured by this model.

The results are essentially the same in a step-wise regression analysis:

<b>Stepwise Regression: Difference versus Absences, SAT, GPA</b>		
Alpha-to-Enter: 0.15 Alpha-to-Remove: 0.15		
Response is Differen on 3 predictors, with N = 131		
Step	1	2
Constant	-2.407	-7.342
GPA	0.0360	0.0294
T-Value	6.05	4.33
P-Value	0.000	0.000
SAT		0.0069
T-Value		1.97
P-Value		0.052
S		4.61
R-Sq	22.13	24.41
R-Sq(adj)	21.52	23.23
C-p	3.8	2.0

The GPA variable remains strong with the SAT score offering some explanatory power. Note absences did not contribute at a significant enough level to be included in the equation.

For performance in the course (course grade), the results were:

<b>Regression Analysis: Course Grade versus SAT, GPA, Absences</b>				
The regression equation is Course Grade = 17.5 - 0.00539 SAT - 0.0263 GPA + 0.114 Absences				
Predictor	Coef	SE Coef	t	P
Constant	17.489	1.367	12.79	0.000
SAT	-0.005390	0.001549	-3.48	0.001
GPA	-0.026251	0.003458	-7.59	0.000
Absences	0.11371	0.06376	1.78	0.077
S = 1.978    R-Sq = 60.3%    R-Sq(adj) = 59.3%				

As with pretest and posttest difference, there is no indication that absences have a significant effect on course grade, and GPA dominates the equation. An interesting difference is that the SAT offers some explanatory power with respect to course grade (that it did not with the learning proxy). The adjusted R-Square indicates that the equation is offering a fuller explanation of what determines a student's grade in the course.

The stepwise results were:

<b>Stepwise Regression: Course Grade versus Absences, SAT, GPA</b>			
Alpha-to-Enter: 0.15    Alpha-to-Remove: 0.15 Response is Course G on 3 predictors, with N = 131			
Step	1	2	3
Constant	14.76	18.24	17.49
GPA	-0.0342	-0.0295	-0.0263
t-Value	-12.83	-9.93	-7.59
P-Value	0.000	0.000	0.000
SAT		-0.0049	-0.0054
t-Value		-3.17	-3.48
P-Value		0.002	0.001

<b>Stepwise Regression: Course Grade versus Absences, SAT, GPA</b>			
Alpha-to-Enter: 0.15 Alpha-to-Remove: 0.15 Response is Course G on 3 predictors, with N = 131			
Step	1	2	3
Absences			0.114
t-Value			1.78
P-Value			0.077
S	2.06	1.99	1.98
R-Sq	56.06	59.27	60.26
R-Sq(adj)	55.72	58.63	59.32
C-p	13.4	5.2	4.0

In this instance, the GPA and SAT variable remain significant, as was the case in the prior model, and absences do contribute enough to warrant inclusion, unlike the step-wise regression with difference as the dependence variable.

To examine whether absenteeism is related to GPA and SAT the following regression was run:

<b>Regression Analysis: Absences versus SAT, GPA</b>				
The regression equation is Absences = 6.64 + 0.00462 SAT - 0.0284 GPA				
Predictor	Coef	SE Coef	t	P
Constant	6.637	1.802	3.68	0.000
SAT	0.004620	0.002108	2.19	0.030
GPA	-0.028417	0.004083	-6.96	0.000
S = 2.742    R-Sq = 28.3%    R-Sq(adj) = 27.2%				

It is clear, as was suggested by the correlation coefficients, that absenteeism has a strong negative association with GPA (the higher the GPA, the fewer the absences). However, it is interesting to see that SAT has a positive and somewhat significant association, perhaps indicating that students with higher SAT scores see less of a reason to come to class.

### SUMMARY AND INTERPRETATION OF RESULTS

This paper has addressed an array of results that are derived from a data set developed from my Principles of Microeconomics classes over the last two years. Some observations:

- 1) While the literature suggests that absenteeism is rampant in economics classes at American universities, this is not the case for principles of microeconomics classes at my College. Future collaborative projects with colleagues at other small liberal arts colleges will determine whether this fact might be generalized to show a deeper contrast with the larger universities.
- 2) Absenteeism has a significant correlation with learning. That is, higher rates of absences correlate with lower levels of performance from pre to post test results (the learning proxy).
- 3) Absenteeism is even more highly correlated with the grades students receive in the course.
- 4) This paper further confirms the threshold effect identified by Durden and Ellis that suggests that students missing more than 4 classes as a group do significantly less well than those students that miss 4 or fewer classes. This implies the existence of nonlinearity between absenteeism and course grades. This paper found this to be true both for course grades and the learning proxy.
- 5) Student GPA and SAT scores were significantly correlated with both learning and course grade. SAT scores did not correlate significantly with absenteeism, but GPA was strongly associated with absenteeism, with students earning higher GPAs also being more likely to attend class.
- 6) The regressions that used the learning proxy (difference) as the dependent variable did not reveal any explanatory power with respect to absenteeism, and only some significance to SAT scores. GPA was a strong explanatory independent variable, though the value of the adjusted R-Square indicated that it was not a strongly predictive model.

- 7) When the course grade was the dependent variable, both GPA and SAT scores carried significant explanatory power. Absenteeism did have a stronger relationship to course grade (compared to learning), but it was the weakest of the three independent variables used in the model.
- 8) When SAT and GPA were regressed on absences there was a strong negative relationship with GPA, indicating that students that make good grades generally come to class. The positive and significant relationship of SAT to absences indicates that students that might have been (predicatively) better prepared academically to enter college are less likely to attend class.

While this paper cannot conclude that attendance is not important to classroom learning, it does weaken the case made in prior studies. Since course grades reflect more on overall class performance, it is reasonable to expect attendance matters, and this study supports this supposition. For future studies, including a measure of learning that involves pre and post testing might yield different results than those that only used course grades as indicators of success in the classroom.

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# ECONOMICS ARTICLES



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# MARKET ADJUSTMENT AND IMPERFECT COMPETITION: ENTREPRENEURIAL RESPONSES TO EQUILIBRIUM AND DISEQUILIBRIUM IN MARKETS FOR HETEROGENEOUS GOODS

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## ABSTRACT

*The present paper applies a market-clearing analysis to the neoclassical model of imperfect competition in which firms may produce differentiated products, and for which long run equilibrium is described as  $ATC = P > MC$ . Most textbooks describe the disequilibrating impact of product differentiation, and the eventual return to long run market equilibrium, in terms of comparative statics, with little or no discussion of the adjustment process and the role of entrepreneurship in that process. This paper models the process of market adjustment in imperfectly competitive markets by incorporating a product-differentiating or Schumpeterian view of entrepreneurs who create changes to which price-adjusting entrepreneurs may respond. This paper describes the **process** by which entrepreneurs move imperfectly competitive markets from equilibrium to disequilibrium, and eventually to a new long run equilibrium. To that end it employs the graphic tools of neoclassical economics.*

## INTRODUCTION

Undergraduate courses in economics rarely provide more than superficial mention of entrepreneurial responses in explaining the market-clearing process.

Brief references to entrepreneurs making price changes are sometimes incorporated in textbook chapters presenting the supply and demand model, and virtually no references are to be found in discussions of imperfect competition to the role of entrepreneurs in coordinating market activity.

Research previously published in this journal (Foshee, Heath, and Balic, 2003) has provided a useful methodology for explaining the important role entrepreneurs play in the market-clearing process under purely competitive conditions where firms produce a homogeneous product, market entry is free, and long run equilibrium is described as  $P = MC = ATC$ . That analysis is limited to the case of **price-adjusting** entrepreneurs who are alert to the opportunity to make gains by changing their prices in the face of a market surplus or shortage. Entrepreneurial gains come in the form of producer surplus obtained by selling (or, on the consumer side of the market, buying) at a price which differs from the price of other producers of the same product. The credibility and usefulness of the pure competition model (and the supply and demand analysis which issues from it) are significantly enhanced by this analysis. The present paper applies a similar market-clearing analysis to the neoclassical model of imperfect competition in which firms may produce differentiated products, and for which long run equilibrium is described as  $ATC = P > MC$ .

### **ENTREPRENEURIAL ACTION IN THE MODEL OF IMPERFECT COMPETITION**

Entrepreneurs in imperfectly competitive markets can exercise a greater range of responses to disequilibrium conditions than in the model of pure competition. These responses include product differentiation through innovation, a form of competition disallowed (by assumption) in the model of pure competition. Most textbooks describe the disequilibrating impact of product differentiation, and the eventual return to long run market equilibrium, in terms of comparative statics, with little or no discussion of the adjustment process and the role of entrepreneurship in that process. This paper models the process of market adjustment in imperfectly competitive markets by incorporating a product-differentiating or Schumpeterian view of entrepreneurs who create changes to which price-adjusting entrepreneurs may respond.

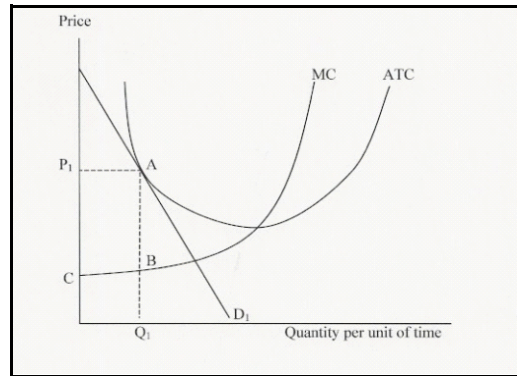
We consider two types of entrepreneurial action: price adjusting and product differentiation. Firms producing a differentiated product can also employ a price-adjustment response to competition, just as firms producing a homogeneous good do in the familiar neoclassical model of “*cartel cheating*.” In the cartel model, each

cartel member perceives two demand curves: a less elastic demand curve jointly faced by cartel members when they maintain their collusive behavior, and a more elastic demand curve perceived by an individual entrepreneur who is alert to new opportunities for making gains by acting alone. The entrepreneurial cartel member weighs the possibilities of making gains by “secretly” cutting price while the rest of the cartel maintains the accepted cartel price.

In a similar fashion, the entrepreneurial imperfect competitor weighs the possibilities of making gains by *product differentiation*, as well as the possibility of “secretly” cutting price, while other less entrepreneurial competitors maintain their current product characteristics and/or prices. In both cases less-than-perfect market coordination is the underlying condition for the entrepreneurial activity. In the cartel case, the entrepreneur is the “cheater” who breaks ranks with cartel pricing. In the case of imperfect competition, market coordination is temporarily disrupted by the competitive behavior of a (Schumpeterian) product differentiating entrepreneur who introduces new or additional product differentiation in hopes of earning greater rewards by better satisfying consumer tastes. The rewards come about in two ways: initially, through greater consumer demand, as buyers are attracted to the differentiated product; and subsequently, through entrepreneurial price changes which are potentially profitable as other producers emulate the successful product differentiation. Price “cheating” follows product differentiation.

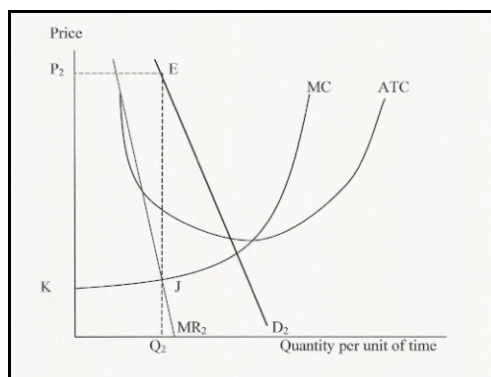
### ENTREPRENEURIAL PRODUCT DIFFERENTIATION

As noted earlier, our purpose is to analyze the *process* by which entrepreneurs move imperfectly competitive markets from equilibrium to disequilibrium, and eventually to a new long run equilibrium. To that end we employ the graphic tools of neoclassical economics. **Figure 1** depicts a representative firm in an imperfectly competitive market which is in long-run equilibrium where  $MR = MC$  and  $P = ATC$ . Economic profit is zero and producer surplus is equal to the area defined by points  $P_1ABC$ . At this equilibrium, there are no price changes for a price-adjusting entrepreneur to make, because both demanders and suppliers are able to execute their plans successfully at the price  $P_1$ . Of course there remains the possibility of creating opportunities for gains through product differentiation, a type of Schumpeterian entrepreneurship.

**Figure 1.**

$D_1$ —Initial Equilibrium and Long-Run Equilibrium:  
 Producer surplus =  $P_1ABC$

Suppose an entrepreneur is able to capture a larger share of the market through product differentiation. Graphically, this development is shown in **Figure 2**. Note that the entrepreneurial firm's new demand curve,  $D_2$ , lies to the right of  $D_1$  and is steeper as well—reflecting an additional influence on elasticity, namely that the products of other firms are now *less substitutable* in the minds of buyers. (Mathematically, a parallel shift of the demand curve would reduce the price elasticity coefficient. Increasing slope depicts a further reduction in elasticity.) Price is at  $P_2$ , and the intersection for the demand curve and the  $P_2$  price line is point E. We do not distinguish here between more elastic and less elastic demand curves for the innovating firm at  $P_2$ , because the distinction between the individual firm's demand and the collective demand is not yet relevant. In other words,  $D_2$  is not a collective demand curve, as the other firms have not yet responded. The innovating firm is capturing greater producer surplus (defined by  $P_2EJK$ ) and above-normal profits and, by the same token, other firms are experiencing smaller producer surplus and below-normal profits (suffering economic losses). As they lose sales to the successful innovating entrepreneur, their revenues fall short of covering average total costs of production.

**Figure 2.**

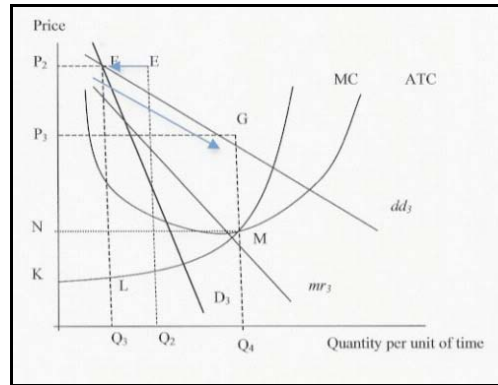
$D_2$ —E ( $P_1$ ,  $Q_1$ ): Disequilibrium resulting from Schumpeterian entrepreneurial response (product differentiation), other entrepreneurs have not yet imitated (heterogeneous products).

Producer surplus =  $P_2EJK$  ( $>P_1ABC$ )

In the model of pure competition, barriers to entry are assumed to be nonexistent, making entry essentially “free.” When profit opportunities arise, competition from entrepreneurs who are already operating within the market will cause some erosion of profits. Subsequently, new firms enter the market and remaining profit is rather swiftly competed away. For a number of reasons, not the least being legal barriers in the form of patent laws and copyright protection, entry is hardly “free” for imperfectly competitive firms. Nevertheless, eventually entry does occur – in this case, entry into the market for the differentiated product as firms earning economic losses begin to respond competitively to the innovating firm. The losers are *compelled* to act, and the perception among them will have been “shown the way” to compete, by embodying imitative characteristics in their own products.

As these followers come forth with products that are “substitutable” in the minds of consumers, the original innovator finds its position in the market beginning to weaken. Graphically, the firm is taken to a point off its demand curve, to point F (for example) in **Figure 3**.

Figure 3.



Point E→F: other entrepreneurs now imitating product differentiation.  
 (F→G),  $P_3$  Entrepreneurial price cutting  
 Producer surplus =  $P_3GMN$  ( $>P_2FLK$ )

Not only has demand weakened for the product of the original innovator, it has also become more elastic. There are essentially three reasons for this. The first is mathematical (see Note #3). The second reason is that the availability of substitutes is now greater. The third reason for greater elasticity at point F relates to the analysis of cartels (Baird, 1982). As with a cartel, we expect that when the number of firms in the market is small, they are likely to change price together because there is too much to lose by not responding to events such as a change in market demand and the subsequent change in the market share. However, with a larger number of rivals, the impact on other firms is *very small* when one firm changes its price. The firm is therefore more likely to change price alone – “to cheat” – in the large numbers case. Thus the number of competing firms (which now has increased) determines both the position of the individual firm’s demand curve and its price elasticity. The third of these three reasons gives relevance to an individual firm’s demand curve, as distinguished from the collective demand curve.

The original innovating firm finds itself in a sort of “good news / bad news” situation at point F. The bad news is the loss of product uniqueness, and consequently the loss of market share, profit and producer surplus, which is now defined by  $P_2FLK$ . The good news is—perhaps paradoxically—that another

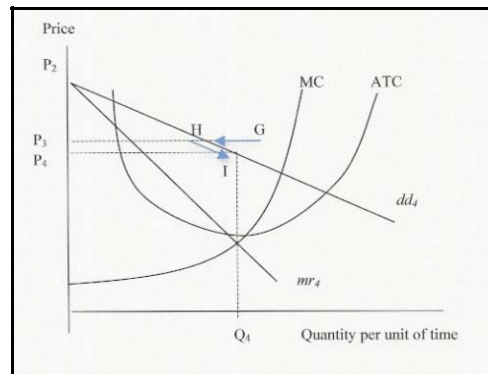


entrepreneurial opportunity has been created with a larger number of firms in the market. Specifically, a price reduction by the firm *acting alone* will result in significantly increased sales and greater producer surplus—temporarily, at least.

### ENTREPRENEURIAL PRICE ADJUSTING

Returning to **Figure 3**, we may now explicitly describe the *single* firm's demand as  $dd_3$ , a "*ceteris paribus*" curve in that it depicts the demand faced by a single firm when all rivals leave their prices unchanged. The collective demand is  $D_3$ . The new surplus-maximizing price is  $P_3$  and the point of intersection for curve  $dd_3$  and the  $P_3$  price line is point G. The firm's producer surplus, defined by  $P_3GMN$ , is larger than at price  $P_2$  (E), and the increase has come at the expense of others in the market who failed to recognize the new opportunity to make gains by being the first to lower price.

The gains to the firm at point G are, as suggested earlier, only temporary. When other firms finally recognize the first entrepreneur's competitive price cuts, they follow with price cutting of their own. Consequently the first entrepreneur is bumped off  $dd_3$ , the "*ceteris paribus*" demand curve, and is moved from point G to some point to the left of G, as shown by point H in **Figure 4**. Assume now that all of the firms are charging the same price,  $P_3$ . From there, one or more firms will perceive the opportunity for gain through further price cutting ("cheating"), along the new  $dd_4$  to Point I, taking the price to  $P_4$ . This process continues in this manner as long as entrepreneurs see gains to reducing price. The competitive price cutting (which was initiated in the wake of the original product differentiation) would eventually come to an end. At some point, price will no longer exceed the ATC of these firms and further price cutting will then cease. The entrepreneurial process in imperfectly competitive markets moves the market towards the familiar long run equilibrium where  $P = ATC$ .



G→H: other entrepreneurs matching price cuts,  
(H → I), P<sub>4</sub> Entrepreneurial price cutting

## SUMMARY AND CONCLUSION

This paper has sought to show that the familiar graphical tools of neoclassical theory can be used to describe the processes by which Schumpeterian and price-adjusting entrepreneurs drive imperfectly competitive markets from equilibrium to disequilibrium and eventually to a new equilibrium. The pursuit of producer surplus is fundamental; it provides a useful way to conceptualize entrepreneurial behavior within the familiar framework of neoclassical price theory. It is an important matter, for without a theory of entrepreneurship, theory of the firm reduces to comparative statics, which is something less than a theory of economic behavior.

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## THE MAKING OF THE PACIFIC TIGER: LESSONS FROM THE CELTIC TIGER

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### ABSTRACT

*This paper describes how Ireland drastically improved its economic position through its adoption of what came to be referred to as the Celtic Tiger strategy. Because of the surprisingly striking similarities between Ireland and Guam and the finding that the Celtic Tiger strategy represents nothing but “sensible policies” for enhancing economic growth, we believe that Guam can employ those elements of the Celtic Tiger strategy that worked, and modify those elements that did not. By doing so, Guam can transform itself into the Pacific Tiger.*

### INTRODUCTION

Guam is at the crossroads of major economic changes that are expected to result from the impending military build-up on the island. These changes offer both challenges and opportunities to our island and our people. They also call upon us to respond so that these changes lead to long-lasting improvements in the lives of our people. One such opportunity presented by the military build-up is that for reviving the island economy and positioning it for higher economic growth that can be sustained well after the five year time frame associated with the military build-up (2010-2014).

Guam has had a stagnant economy since 1996, owing partly to the reduction of military presence on the island (aka Base Realignment and Closure (BRAC)) in the early 1990s. Then in 1997, the Asian Crisis negatively impacted the island’s main economic sector, tourism. The island also experienced a series of natural disasters. Since then, economic developments mimicked the fate of the tourism sector, which recovered somewhat owing to the U.S. and global economic recovery in 2002. Increased foreign investment flows, mostly toward real estate, around 2003 also contributed to the island’s economic activity. There was some optimism in late 2005 in anticipation of the \$13 billion and 30-40% population increase associated

with the military build-up. Although construction projects will commence in 2010, there were anticipatory construction booms as early as 2006.

For years, Guam has investigated strategies to develop its economy, but has yet to define one. Instead, what appears to be the 'default' strategy has been a heavy reliance on the tourism sector, which has not returned to its peak in 1996. Especially with the current global economic challenges, where incomes in major tourist markets have stagnated or declined and tourist arrivals have dropped significantly (down by 30% in May 2009 on a year-on-year comparison), this default strategy needs to be supplemented by other sources of growth by diversifying the economy, which would likely be a cleverly designed and hopefully effective industrial policy. Such policy will form a crucial part of what could be Guam's clearly defined economic development strategy.

This is an opportune time to seriously evaluate what economic development strategies might work well for Guam, keeping in mind the challenges of the current global economy on the island's economy and the opportunity presented by the impending military build-up. What economic development strategy can Guam adopt in order to sustain the growth of the island economy and improvements in its residents' standard of living beyond the construction boom and activities related to the military build-up? In this regard, we ask the questions: What is the way forward for Guam? What examples should Guam follow?

The paper is organized as follows. The next section will look closely at the characteristics of Guam's economy as a starting point in identifying which tiger economy has characteristics similar to Guam's. Having identified Ireland as this tiger economy, the paper goes on to study Ireland's Celtic Tiger strategy, starting with the question of whether the Celtic Tiger strategy continues to be valid in light of Ireland's current economic crisis, followed by a closer look at select elements that comprise the Celtic Tiger strategy. This is then followed by an evaluation of how well Guam fares and what would be required to meet each element and some concluding comments.

### **IN SEARCH OF THE 'IDEAL' ECONOMIC DEVELOPMENT STRATEGY FOR GUAM**

An economy that undergoes rapid economic growth over a relatively short period of time has been referred to as a 'tiger'. Could Guam be the first to earn the title 'Pacific Tiger'? Which of the other tiger models would provide Guam with an economic development strategy that would work best for Guam, given specific characteristics of its economy?

The most well-known and the first-to-be-called tigers are the ‘Asian Tigers’, comprised of Hong Kong, Singapore, South Korea and Taiwan. Since then, several economies have earned the nickname ‘tigers’, including Ireland as the Celtic Tiger, referring to its impressive growth since 1987 until its current economic challenges started in 2007. The city of Dubai has been referred to as the Arab Gulf Tiger; Estonia, Latvia and Lithuania have been called the Baltic Tigers in the 2000s; and Bulgaria and Serbia as the Balkan Tigers. Brazil, Russia, India and China (aka BRICs), along with Vietnam, have also been called ‘tigers’.

Among these tigers, which one shares the greatest similarity with Guam’s economy? To aid this comparison, the following characteristics of the Guam’s economy have been highlighted:

- ◆ *Small domestic market, with an estimated population of 171,000 people and a limited amount of productive resources; a nominal Gross Island Product in 2007 estimated at \$6 billion (U.S. Census Bureau, 2007)*
- ◆ *An island located in the Western Pacific ocean; the largest island in the Micronesian region*
- ◆ *Open, with significant trade, mostly imports, given its limited resources and productive sectors*
- ◆ *Non-diversified economy, relying heavily on tourism, and to a lesser extent, on the military presence on the island.*
- ◆ *A U.S. territory and part of the larger U.S. market, implying an English speaking population, the presence of U.S. legal infrastructure, no autonomous central bank and inability to use interest or exchange rate policy, fiscal policy that is heavily resource-constrained and hence highly influenced by U.S. fiscal policy and availability of Federal funds (including the economic stimulus plans, not recognized as a separate entity by international organizations, hence not eligible for international development assistance (must rely on U.S. Federal funds)*
- ◆ *As a separate economy, Guam would be classified as a ‘high income economy’ by the World Bank, International Monetary Fund and many international organizations (World Bank, April 2009), with this classification, high wages (with minimum wages mimicking U.S. Federal levels), a challenge given the proximity of much lower wage economies in the Asia-Pacific region*
- ◆ *Economically free. Using the Heritage Foundation’s methodology for calculating the Index for Economic Freedom, authors calculated Guam’s scores in the ten areas and found it similar those for the U.S., except in*

*fiscal freedom. The U.S.'s overall score is 80.7 out of 100 in 2009, with a ranking of #6 (Heritage Foundation, 2009).*

- ◆ *Democratic, following from it being a U.S. territory. Although Freedom House Foundation does not estimate Guam's political rights and civil liberties, a review of the foundation's methodology would lead to scores of '1' and '1' for Guam's political rights and civil liberties, respectively, thus classifying it as a "politically free" economy. (As expected, the U.S. gets scores of '1' and '1'. However, many political analysts will agree that Guam is the most politically free island in the Pacific, even more than its neighboring island, Federated States of Micronesia, for which Freedom House Foundation estimated scores of '1' and '1' for political rights and civil liberties.*
- ◆ *Multicultural society, with 37% Chamorro (Guam's native culture), 27% Filipino, 7% other Pacific Islander, 6% non-Filipino Asians, 7% Caucasian, 2.2% all others. In addition, 14% of the population classify themselves as being of mixed culture (U.S. Census Bureau, 2000; Guam Bureau of Statistics and Plans, 2005)*
- ◆ *Large growing presence of U.S. military; strategic in the defense and stability of the Asia-Pacific region*

### **WHY IRELAND AND ITS CELTIC TIGER STRATEGY**

Undoubtedly, there are other smaller economies whose tiger-like experiences might serve as a model for Guam. It is always tempting to look for a model economy within the same region (i.e., Asia-Pacific), in which case we would consider the economic experiences of Hong Kong, Singapore, Taiwan, or South Korea. However, the term "Guam is U.S.A. in Asia-Pacific" summarizes our challenge at hand: Guam is located in Asia-Pacific and has cultures and sub-cultures that share many in common with countries in the region. At the same time, its business, legal and political environments are very much influenced by the U.S. system, thus giving it characteristics of "the West". It is this challenge that leads us to a seemingly odd finding that, upon closer scrutiny, Guam's economy in fact shares many similar features with Ireland's economy, more than it does with other Asian economies. This finding thus provides us with a justification for considering the adoption of the Celtic Tiger strategy to guide Guam's future economic development.

Presented in the same way as Guam's economy was presented in the previous section, the characteristics of Ireland's economy are highlighted below:

- ◆ *Small domestic market, especially in comparison to neighboring economies of the United Kingdom, France and Germany, with an estimated population of around 4 million people.*
- ◆ *An island located in the North Atlantic Ocean, with the Irish Sea to its east*
- ◆ *one of the most open economies, with exports and imports in 2005 at 83% and 68% of GDP, respectively*
- ◆ *a non-diversified economy during the pre-Celtic Tiger years, with strong focus on agriculture and a large rural population*
- ◆ *a member of a large market, the Euro bloc, and an even larger market, European Union (E.U.), the only English-speaking member of the Euro bloc; Being part of the Euro bloc, its monetary policy is determined by the supranational European Central Bank while its former domestic currency is now fixed against the Euro and hence its exchange rate policy depends on how the Euro changes vs. other major currencies; as a requirement for being in the Euro bloc according to the Maastricht treaty, its fiscal policy is autonomous to some extent but must be coordinated with other Euro bloc countries. Pre-Celtic Tiger years, was not eligible for international development assistance. However, since admission to the E.U. in 1973, was a recipient of Structural Funds.*
- ◆ *classified as a 'high income economy' by the World Bank, International Monetary Fund and many international organizations (World Bank, April 2009) and, with this classification, high wages (largely due to minimum wage laws), a challenge given the proximity of much lower wage economies in Eastern Europe, many of which are now members of the expanded E.U.*
- ◆ *Economically free, with an Index of Economic Freedom score of 82.2 out of 100 in 2009 and ranked #4 (Heritage Foundation, 2009)*
- ◆ *Democratic, classified by the Freedom House Foundation as being "politically free", with scores '1' and '1' for political rights and civil liberties*
- ◆ *Since the 1980s, Ireland has become less of a homogeneous society and more of a multicultural society through in-migration of people from other cultures. In addition, Ireland's economy has become diverse as returning emigrants who bring back to Ireland their knowledge, skills and experience having lived elsewhere.*
- ◆ *In terms of national security and military, Ireland is also strategic, or at least, challenged, with the island divided into two entities: Ireland and in its north, Northern Ireland, which is part of the U.K. Such arrangement occasionally leads to security concerns and instability.*

The similarities between Guam and Ireland are summarized in Table 1.

### **IS THE CELTIC TIGER DEAD AND THE STRATEGY INVALIDATED?**

We have shown that there are many similarities between Guam and Ireland and that Guam's adoption of the Celtic Tiger strategy is not unfounded. On the contrary, it is hoped that the similarities between Guam and Ireland will enhance the success of Guam's adoption of the Celtic Tiger strategy. Of course, the above statements presume that the Celtic Tiger strategy continues to be valid, if not desirable, in light of the severe economic difficulty that Ireland is currently experiencing. Do Ireland's current economic challenges debunk the validity of the Celtic Tiger strategy in its entirety?

With the global economic slowdown taking place in 2007, which continues to negatively impact domestic conditions in a globally integrated economy like Ireland, many writers began to declare the Celtic Tiger dead (Economist, 2008; Hennigan, 2008; Irish Examiner, 2008; McDonald, 2008; Meo, 2008).

As we look at Ireland's economic experience, it bears reminding ourselves of the difference between the short run and the long run time period, as we learned from our introductory macroeconomic course. We also learned that most people are myopic, that is, short-sighted, which explains the temptation of focusing in the short run while others subscribe to Keynes' famous statement, that "in the long run, we are all dead".

The current economic troubles in Ireland are occurring in the short run and that they do not predict the economy's future performance in the long run. For example, Hirsch (2008) notes that "Ireland's economic fall from grace will be temporary... investments it has made in education, attracting investment, and fostering a creative economy will once again prove to be wise" (page 2). As Ruane (2008) so exactly says it, "Economic Cycles Happen... (they) are a fact of life – they happen again and again and we must continuously plan with this in mind. Our experience ... of long periods of sustained growth in our major markets ... should not cause us to forget this" (page 22).



Table 1: Similarities Between Guam and Ireland

BASIS FOR COMPARISON	GUAM	IRELAND
Small economy	An estimated population of 171,000 people and a limited amount of productive resources; Nominal Gross Island Product in 2007 \$6 billion (estimate)	In comparison to neighboring economies of the United Kingdom, France and Germany. Estimated population of around 4 million people
Island	Located in the Western Pacific Ocean; the largest island in the Micronesian region	Located in the North Atlantic Ocean, with the Irish Sea to its east
Open	With significant trade, mostly imports, given its limited resources and productive sectors	One of the most open economies, with exports and imports in 2005 at 83% and 68% of GDP, respectively
Non-diversified	Heavy reliance on tourism, and to a lesser extent, on the military presence on the island	In pre-Celtic Tiger period, a strong focus on agriculture and a large rural population
Part of a larger market	A U.S. territory and part of the larger U.S. market, implying an English speaking population, the presence of U.S. legal infrastructure, no autonomous central bank and inability to use interest or exchange rate policy, fiscal policy that is heavily resource-constrained and hence highly influenced by U.S. fiscal policy and availability of Federal funds (including the economic stimulus plans), not recognized as a separate entity by international organizations and hence not eligible for international development assistance (must rely on U.S. Federal funds)	Member of the Euro bloc and the European Union (E.U.), the only English-speaking member of the Euro bloc; Being part of the Euro bloc, its monetary policy is determined by the supranational European Central Bank while its former domestic currency is now fixed against the Euro and hence its exchange rate policy depends on how the Euro changes vs. other major currencies; as a requirement for being in the Euro bloc according to the Maastricht treaty, its fiscal policy is autonomous to some extent but must be coordinated with other Euro bloc countries. In pre-Celtic Tiger period, Ireland was not eligible for international development assistance. However, since admission to the E.U. in 1973, was a recipient of Structural Funds
High income economy	High wages (minimum wage laws mimicking U.S. Federal levels), a challenge given the proximity of much lower wage economies in the Asia-Pacific region	High wages, partly due to minimum wage laws, a challenge given the proximity of much lower wage economies in Eastern Europe, from which many countries have gained membership to the E.U.
Economic Freedom	Economically free. Using the Heritage Foundation's methodology for calculating the Index for Economic Freedom, authors calculated Guam's scores in the ten areas and found it similar those for the U.S., except in fiscal freedom. The U.S.'s overall score is 80.7 out of 100 in 2009, with a ranking of #6	Economically free, with an Index of Economic Freedom score of 82.2 out of 100 in 2009 and ranked #4
Democracy/Political Freedom	Democratic, following from it being a US territory. Although Freedom House Foundation does not estimate Guam's political rights and civil liberties, a review of the foundation's methodology would lead to scores of '1' and '1' for Guam's political rights and civil liberties, respectively, thus classifying it as a "politically free" economy, especially since the U.S. of which Guam is a part and neighboring islands, Federated States of Micronesia, are both classified by Freedom House Foundation as politically free	Democratic; classified by the Freedom House Foundation as "politically free", with scores '1' and '1' for political rights and civil liberties
Culture and Diversity	Multicultural society, with 37% Chamorro (Guam's native culture), 27% Filipino, 7% other Pacific Islander, 6% non-Filipino Asians, 7% Caucasian, 2.2% all others. In addition, 14% of the population classify themselves as being of mixed culture	Since the 1980s, Ireland has become less of a homogeneous society and more of a multicultural society through in-migration of people from other cultures. In addition, Ireland's economy has become diverse as returning emigrants who bring back to Ireland their knowledge, skills and experience having lived elsewhere.
Geo-political Considerations	Large growing presence of U.S. military; strategic in the defense and stability of the Asia-Pacific region	In terms of national security and military, Ireland is also strategic, or at least, challenged, with the island divided into two entities: Ireland and in its north, Northern Ireland, which is part of the UK. Such arrangement occasionally leads to security concerns and instability

Those who declare the death of the Celtic Tiger, which presumes the end of Ireland's growth success, fail to distinguish between the short run business cycles and the long run growth as focus is given to the current, short term negative situation in Ireland while ignoring or heavily discounting the many years of impressive growth. As in any proposed change, in this case, the adoption of the Celtic Tiger strategy by Guam, the benefits and costs must be evaluated and compared. Such analysis should be used to decide whether to proceed with the proposed change.

Similarly, looking beyond the recent years and taking a longer term perspective on the impact of the Celtic Tiger strategy on Ireland will show that the strategy produced more benefits than harm. Hence, it would be foolish to dismiss the Celtic Tiger strategy without a closer analysis of which elements of it worked and which did not, as well as which elements will continue to contribute positively to the economy and which ones should be modified or eliminated. Indeed, this is the beauty of studying another economy's long run development and deriving lessons from it that Guam could learn and use to guide its road to a better future. Figuratively speaking, Guam could have its cake and eat it, too, as it could enjoy the positive outcomes of the Celtic Tiger strategy (rapid economic growth, job creation, increasing standard of living) while introducing corrective measures along the way in order to avoid, minimize or simply delay the negative temporary outcome that Ireland is currently experiencing. In doing so, Guam would have created its own economic development strategy and become its own tiger, the Pacific Tiger.

### **ELEMENTS OF THE CELTIC TIGER STRATEGY**

The Celtic Tiger strategy was Ireland's response to the economic and fiscal challenges of the 1980s, which restored economic growth to Ireland for many years, until the recent recession which began in 2008. The turnaround occurred in 1987, which was marked by the adoption of the National Economic Plan (Fitz Gerald, 2008). This plan "detailed market-oriented reforms designed to shrink the size of the government budget deficit, stimulate investment, increase employment, and reduce inflation" (Hennessey, 2008, page 1). The growth period that followed was impressive that it earned Ireland the title "Celtic Tiger". Standard of living in Ireland, which in the mid-1980s was comparable to those of Greece, Portugal and Spain and substantially below that of the U.K.'s, increased appreciably and caught up with the U.K. level in 1996 and with the EU-15 average soon thereafter. By 2003-04, Ireland's standard of living was 40% above the EU-15 average. Compared

to U.S. standard of living, Ireland narrowed the gap from it being 60% below the U.S. standard of living in 1960 to 10% in 2005 (Borooah, n.d., page 4).

Many (Dorgan, 2006; Hirsch, 2008; Fitz Gerald, various years; Borooah, n.d; Ruane, 2008; Jamieson, 2008; Florida et al., 2008) attribute Ireland's Celtic Tiger performance to several elements of its economic development strategy, most notably the following:

- ◆ Openness of its economy to global markets for goods and foreign investments since 1980s
- ◆ Investment in human capital since 1960s
- ◆ Public sector reforms and fiscal discipline
- ◆ Availability of young, productive and creative labor force
- ◆ Effective policymaking and social partnership
- ◆ Hard work and sacrifice

These six elements will be discussed briefly below with the intent of deriving lessons for how to design Guam's economic development strategy.

## **Openness**

This is one element of the Celtic Tiger strategy that has been highlighted by many analysts and scholars. More recently in the midst of daily news about how poorly Ireland's economy is currently doing, Fitz Gerald (2008) continues to hail economic openness, noting the "globalization is good for you!" (page 30) Ireland has not always been an open economy. It had an isolationist orientation from its independence from the U.K. in 1922 until the early 1970s. It was only until it became a member of the E.U. that it became open, in this case, regionally. It was not globally open until the 1980s, which was most obvious in its pursuit of foreign direct investments (FDI). It was at this time that Ireland, through the IDA Ireland went on full speed to promote Ireland as an FDI site by highlighting its initially low labor costs relative to more advanced EU member countries, not to mention its English-speaking labor force, and low corporate tax rates (Fitz Gerald, various years; Dorgan, 2006; Borooah, n.d; Hirsch, 2008; Ruane, 2008). Also part of Ireland's FDI encouragement were policies that target winning or ascendant sectors (Hirsch, 2008; Fitz Gerald 2009), including high-value manufacturing and technology-intensive sectors (Florida et al., 2001; Fitz Gerald, 2008), or as Ruane (2008) identified as Ireland's engine of growth: "high-tech internationally-traded manufacturing and services" (page 20).

Of course, globalization is a double-edged sword because it offers economies greater opportunities and higher risks, both of which increase in magnitude with the extent to which the domestic economy and its markets are tied with other economies and markets. “This means that we get greater upswings from international growth but we also get correspondingly greater downswings.” (Ruane, 2008, page 19) What is impressive about Ireland’s experience is its ability to reinvent or restructure its economy, which is not an easy task, but which is necessary in order to reap the benefits of globalization. As Hirsch (2008) puts it, “Ireland didn’t grow into the Celtic Tiger by growing bigger potatoes, or by implementing a better agricultural policy to keep more people at home on the farms. It went a totally different direction, getting into the globalization game and proving it could win” (page 1). Similarly, Ruane (2008) says that “openness means a continual restructuring of our economy into higher value-added products and services and constant pressures for innovation” (page 4).

From hindsight, we see areas where Ireland could have been more cautious in its drive to attract FDIs. As several analysts noted, perhaps Ireland became heavily dependent on FDIs as a source of domestic income and employment growth as well as for its exports in that not enough attention was given to ensuring that indigenous businesses benefited from the presence of FDIs. There are some questions to what extent indigenous businesses might have been crowded out by the more technologically advanced FDIs that have greater access to capital (Fitz Gerald, 2000).

Another issue to consider is that this period of increasing globalization, development of the financial sector represents a significant gamble in that it can be potentially destabilizing because it can generate years of rapid growth that often lead to financial and property bubbles, followed by major crisis in the financial sector which spills over to the real sector (in the U.S. context, “from Wall Street to Main Street”). Part of the story is the fact that the financial sector is notoriously prone to asymmetric information problems, especially moral hazard, while at the same time, difficult to supervise and regulate. The current troubles in Ireland can also be attributed to “unsustainable rise in property prices; banks’ exposure to property lending soared while their reliance on (global) wholesale funding intensified” (IMF, 2009; page 1).

### **Investment in human capital**

Since the 1960s, Ireland saw education of its population as an integral part of its economic development strategy. As Fitz Gerald (2000) noted, “once policy

was changed to a more developmental role, the new policies were pursued with consistency by all subsequent governments, providing considerable continuity in policy formation” (page 12). An educated labor force was one of the key contributors to Ireland’s high productivity during its growth years. It also made Ireland internationally competitive, which allowed it to reap the benefits of globalization. Many blame the combination of increasing wages and decreasing productivity in Ireland in recent years for its loss of international competitiveness and, in turn, its current economic troubles. Without its own currency which it could devalue, the remedy would either be to increase productivity (through R&D) or to allow wages to drop, or both (Fitz Gerald; 2008).

In addition, it was found that among those who migrated out of Ireland, the likelihood of returning to Ireland increases with the emigrant’s education level. These returning emigrants brought back to Ireland their education, knowledge, skills, talents and global experience, which enhanced Ireland’s economic success in a globalized arena (Fitz Gerald, 2000, Fitz Gerald, 2005; Florida, et al., 2001). According to Fitz Gerald (2005), these returning emigrants increased their productivity and earnings by 10% from having worked abroad. They also “kidnapped” foreign spouses or partners, adding to Ireland’s human capital (page 5). One negative impact of the current economic woes is that it has had the effect of reversing this trend, as some of Ireland’s population began emigrating elsewhere for better economic opportunities, which would be a loss of human capital, at least temporarily.

### **Public Sector Reforms and Fiscal Discipline**

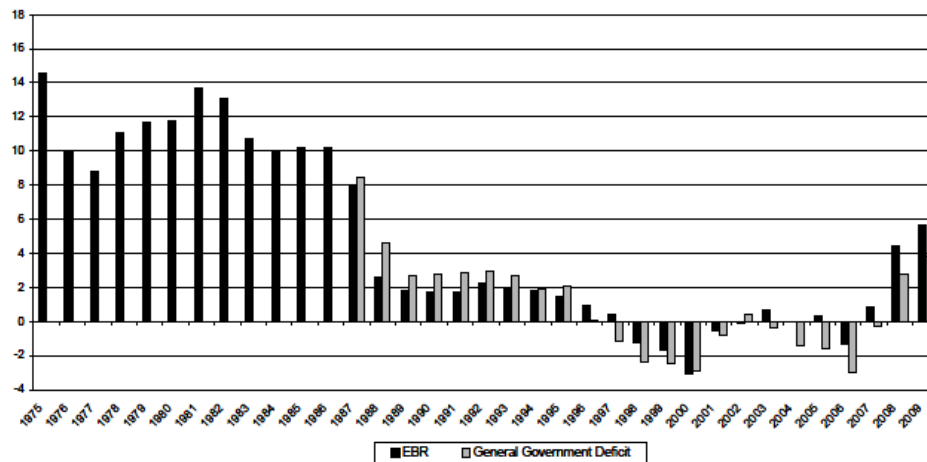
One of the key factors believed to have caused the turnaround in Ireland’s economy beginning in 1987 and leading to its Celtic Tiger period, was the adoption of the National Economic Plan, which realigned the economy along market principles and reduced government intervention, thereby requiring a reform of its public sector and discipline in its fiscal affairs. “Without the fiscal correction that took place over the course of the 1980s, the convergence in living standards would not have been possible” (Fitz Gerald, 2000; page 20).

Figure 1, taken from Ruane (2008), shows significantly higher government budget deficits in the mid-1970s until 1987, ranging from 8% to 14% of GDP (see graph bars in lighter shade). The period between 1988 until 2007 displayed Ireland’s success in public sector reforms and restoring fiscal discipline, as the government deficit decreased substantially during the late 1980s to mid-1990s,

turned into surplus in 1997 until 2007. More importantly, this period highlighted the Irish leaders' strong political will toward reforming the public sector.

Of course, timing also affected Ireland's fiscal success since it is easier for any government to get its fiscal affairs in order when the economy is growing as opposed to when it is declining. For this reason, a virtuous cycle exists in that a strong economy brings in more revenues and presents a better time to reduce public sector spending, thus improving the fiscal situation which, in turn, supports further economic growth. It is also interesting to what extent Ireland's membership to the Euro bloc imposed additional restraint on the government to satisfy the fiscal requirements by the Maastricht Treaty (government deficit and debt not to exceed 3% and 60% of GDP, respectively), as well as the need to coordinate fiscal efforts among Euro countries.

**Figure 1: Ireland's Government Deficit as % of GDP**



Source: Ruane (2008), Figure 6, page 12.

Note: EBR=Exchequer Borrowing Requirement.

As Figure 1 shows, Ireland exceeded the fiscal deficit target for 2009 but not the debt target (although its debt-GDP ratio had increased since 2007, it currently is around 45%, which is still below target). This worse fiscal picture in recent years, owing to the current economic woes, is predictable for a country that lost autonomous control over its monetary affairs when it joined the Euro bloc, which took away alternative policies instruments (in this case, monetary-interest rate policy

as well as exchange rate policy) with which to assist the economy out of its current recession.

It is important to note that fiscal discipline does not necessary imply running a balanced budget every year. On the contrary, it must allow for Keynesian countercyclical policy to smooth economy cycles. As Ruane (2008) says, the “government needs to ... be ready for a downturn – it should not be taken by surprise when the inevitable happens” (page 22). This readiness means that the government should run budget surpluses during years of strong economy. As the IMF (2009) pointed out, Ireland’s use of procyclical fiscal policy during its growth years, including reduction of its income taxes, left little room with which to maneuver when the need for the classic Keynesian policy of higher spending and/or lower taxes are needed, such as in the current situation. As Hirsch (2008) noted, “if a government is busy cutting taxes during the good economic times, there won’t be room to cut taxes during the bad economic times” (page 2). Fitz Gerald (2008) stated that Ireland should have run surpluses during the growth years. In place of income taxes, Ireland has relied increasing on capital gains which, when the financial and real estate sector turned sour in 2007, brought asset values down and reduced or eliminated capital gains. With significantly lower tax revenues and increased spending to boost the economy, as well as to bail-out troubled financial institutions, it is easy to understand why Ireland’s budget surplus in 2007 quickly turned into deficits in 2008 and 2009.

### **Availability of Young, Productive and Creative Labor Force**

Another factor credited for Ireland’s Celtic Tiger performance is its demographic structure, its availability of young, productive and creative labor force, in particular (Dorgan, 2006; Jamieson, 2008; Fitz Gerald (2000), who considered this factor an “enabling” factor). While many advanced economies such as the rest of Euro bloc, EU-15 members, as well the U.S. and Japan that all expect a large share of their population to retire within 10-20 years, Ireland’s has less retiring population to worry about because many in this age group migrated out of Ireland before 1970s. At the same time, those who remain in Ireland can be comfortably supported by a large share of the young population, owing to the baby boom that continued through the 1980s in Ireland, twenty years later than in other advanced economies. This young population is expected to work for many years, thus keeping the dependency ratio in Ireland much lower than it is in many other economies with aging population. This also helps the government’s budget situation as there are

fewer retirees to support and more working individuals that are expected to contribute to the retirement fund.

This young workforce also includes two other groups of people. The first group represents returning emigrants or “homing pigeons” (Fitz Gerald, 2005, page 5) who tend to have relatively higher education level and who bring back with them knowledge, skills, experience and a global orientation. The second group comprise of new immigrants from different countries who bring diversity to Ireland’s workforce and society. (Florida, et al. 2001) called this “tolerance”, which is one of “three Ts” that they claim make up the Celtic Tiger strategy, with the other Ts being “technology” and “talent”.

Fitz Gerald (2005) also noted the contribution of increased female labor participation in Ireland during the Celtic Tiger years (post-1987), which “added at least 1% a year to the growth rate in the boom years” (page 4).

### **Effective Policymaking and Social Partnership**

The easy part of the Celtic Tiger strategy, or any economic development strategy for that matter, is to identify the types of policies that will result in economic success. In Ireland’s experience, these were already discussed above. The difficult and hence more impressive part of Ireland’s Celtic Tiger success is that the fact that these policies were actually and effectively implemented. Indeed, this is the part that will be most difficult for other economies that try to replicate the Celtic Tiger strategy. As Dorgan (2006) noted, policy implementation requires pragmatism (see page 1, which attributes Ireland’s success to “a combination of sensible policies and pragmatism”). Hirsch (2008) cited the importance of “a lot of political will” (page 1: “With a few key policy initiatives and a lot of political will, (Ireland) was able to mount a stunning comeback” in the late 1980s. “By the early 2000s, it was an economic powerhouse.”). Fitz Gerald (2000, page 39) highlighted the importance of “following a consistent strategy over a long period of time”, meaning investment for 30-40 years, in that it creates continuity. Commenting on the policy approach to Ireland’s current economic troubles, Ruane (2008, page 25) said that “central to good and sustained leadership is realism – a time to face up to issues squarely, in contrast to recent years when the benefits of exceptionally high growth rates allowed us to take easier routes” (page 25).

We believe that Ireland’s social partnership approach (aka the Tallaght Strategy (Hennessey, 2008)) played an important role in how successfully policymakers were able to implement the correct policies, which required sacrifice and cooperation of the government, business leaders and organized labor. Fitz



Gerald (2000) noted that this approach was borrowed from Netherlands and Germany and applied to policy formation in Ireland in the late 1980s. It was also used in wage negotiations, saying that “while it is difficult to quantify the benefits of a substantial reduction in industrial disputes, this (approach) has played a significant role in enhancing the performance of the economy. The partnership approach has also contributed to a more coherent approach to economic policy making” (page 22). Similarly, journalists Hastings and Sheehan wrote that “(s)ocial partnership helped to trigger a momentum that turned Ireland from an economic basket case into one of Europe's most successful economies” (in Hennessey, 2008, page 1).

However, the social partnership approach requires a balancing act. For one, wage increases must be justified by productivity increases, otherwise, competitiveness is lost. As characteristics of many growing economies, wages in Ireland increased substantially during its growth years. So did minimum wages, which currently stands at 13 Euros per hour. At the same time, productivity has not kept pace with wage increases, thus contributing to Ireland's loss of competitiveness in the global market. One consequence of Ireland's rising wages is the movement of FDI's from Ireland to other lower-wage economies in the expanded E.U., especially Poland. An example is the movement of Dell's facility from Limerick, Ireland to Lodz, Poland, resulting in a layoff of 1,900 Irish workers (Szustek, 2009). The same approach might have led to an overly generous welfare system and pay scale for public sector employees, which reduced fiscal surpluses in the 1990s.

### **Hard Work and Sacrifice**

The last element of the Celtic Tiger strategy that will be highlighted in this paper is the hard work and sacrifice by all parties involved in order to achieve economic growth. In many consumptive societies, saving is indeed a sacrifice and not an easy thing to do. However, investing in the future requires saving current resources, which in turn means sacrificing or restraining current consumption in order to set aside resources that will expand an economy's future productive capacity. For Ireland, this hard work and sacrifice paid handsomely, as Dorgan (2006) puts it, “Ireland's experience shows that hard work and good policy can bring rewards” (page 13). Echoing this point is Fitz Gerald (2000) who notes of the pain of a major restructuring of the economy in the 1980s, the price to pay to grow the economy. He says, “there is no quick fix for problems of underdevelopment” (page 39). Additionally, looking at Ireland's current situation, it is apparent that even a tiger economy has to face economic challenges, where policymakers and

citizens are once again called upon to hard work and sacrifice in terms of making the “the tough decisions necessary to deal with our current difficulties” in order to restore long-term growth (Ruane, 2008, page 21).

### **THE PACIFIC TIGER: A VISION FOR GUAM**

Having looked at the elements of the Celtic Tiger strategy in the previous section, we now ask the question: what’s in the name “Celtic Tiger”? Upon closer scrutiny, this seemingly intriguing, mysterious, loaded, even “sexy” phrase represents nothing but a strategy for making an economy grow based on what Dorgan (2006) referred to as “sensible policies”. As such, the crucial elements of the Celtic Tiger strategy, which were discussed in the previous section, can be replicated with some modification, in many economies similar to Ireland’s, including Guam’s economy, but this would require strong leadership and political will, supported by participation of the island community. Guam’s economic stagnation need not continue, but deliberate policymaking and planning will be required. The impending military build-up that is predicted to grow Guam’s economy and expand its local revenue base should not lend the island toward a passive enjoyment of what is being called unprecedented growth. Instead, the island’s policymakers and leaders must proactively seize the opportunity to position its local fiscal policies and economic strategies in such a way that effectively manages the resulting surpluses that can balance the anticipated cyclical nature of economies after a buildup occurs. The proceeding examines the six elements of the Celtic Tiger strategy for where Guam fares and what would be required to meet each.

#### **Openness**

As noted earlier, Guam is a relatively open economy, both in terms of trade of goods as well as FDIs but Guam should focus more on increasing its exports. In Ireland, exports growth coincided with FDIs, which exported proportionately more than domestic businesses (90% vs. 30%, Fitz Gerald, 2000, page 15). For Guam, this would mean creation of a manufacturing sector of the high-value type, along with services. Already available as an incentive to boost the manufacturing industry is the General Headnote 3(a) program of the Tariff Schedules of the U.S. which allows duty-free entry into the United States on most exports for those items manufactured and assembled in Guam. Certain requirements enable Guam materials or component parts, to which at least 50% of the value of the finished product must

be added on Guam. These items must undergo a “substantial transformation” in order to benefit from the duty-free provision of this program.

As a trade incentive, the local economic development agency offers the Generalized System of Preferences, a program that allows a product manufactured on Guam to be imported by participating nations, including Japan, Australia and the E.U. nations, at a reduced tariff rate. As a means to diversify its economic base, Guam’s local government offers through its local economic development agency a variety of tax incentives (known as ‘Qualifying Certificates’ or QCs) to attract prospective businesses to Guam and to help create new employment and expand the economy. Incentives are intended primarily for manufacturers, insurance underwriters, commercial fishing operations, corporate headquarters, agricultural operations and the tourism industry (Guam Economic Development Authority, n.d.).

Further review of the preceding programs and a renewed holistic economic development strategy lend promise toward diversifying Guam’s primary tax base from the tourism industry, which has served as the basis for the status quo of either stagnant or persistently deficient revenues.

Guam could even extend the Celtic Tigers lesson analogously to domestic but extra-territorial investment. Delaware has long held the title for most attractive forum of incorporation. Its state corporate law fostered this development by removing transactional impediments, relaxing its corporate governance requirements, and allowing for anti-takeover provisions. As a consequence, “[t]he incorporation industry in Delaware employs about 1,000 people and yields more than \$400 million in taxes and fees, which represent about one quarter of the state's budget” (Jarblum & Bollinger, 1999).

### **Investment in Human Capital**

Guam has post-secondary education institutions from which residents avail, including a specialized trades academy that provides national certification and licensing opportunities for those pursuing the construction and automotive trade professions. A four-year and graduate degree granting land-grant public university provides an array of professional and academic degrees, including continuing and professional education for all disciplines. Further, a community college affords citizens with professional certification pathways and associate degrees. Professional organizations across major disciplines (Accounting, Human Resources Management, Nursing, Realtors) make allowances for providing continuing certification requirements, while industry-specific organizations such as contractors and the tourism and hospitality sector provide education committees that highlight training

and scholarship opportunities. For degree programs not offered in the local university, for example, medicine, law and engineering, most recent high school graduates go to the continental U.S. Like Ireland that benefits from its returning emigrants, Guam benefits from the one third of those students who graduate from the continental U.S. and return to make up the diversified pool of college degree holders entering the workforce.

The lag in human capital investment on Guam is more apparent in the K-12 grade levels. Current infrastructure solutions have been implemented with the anticipated population boom related to the impending military buildup. However, increased physical infrastructure should not be done in isolation. Increased and improved focus toward addressing the improvement of developmental skills in the primary and secondary school levels are critical to sustain the economy long beyond the buildup.

### **Availability of Young, Creative, Productive Labor Force**

Guam has a young population but the focus must be in increasing the marketability of this population through education and training. Varied levels of educated and trained workforce exist on Guam. Local government jobs as well as those in Guam's primary industry, tourism, were once provided attractive jobs with traditionally lower pay scales. The anticipated build-up of U.S. military base activities have created new job opportunities for the tertiary military industry, with offers of higher wages. Meeting the labor needs for the impending U.S. military build-up on Guam has shifted the priority of various employment sectors toward hiring for construction-related, engineering, and contracting positions. This has created the recent phenomenon of a sparked interest of the current local higher educated labor pool toward federal U.S. jobs for higher wage opportunities. The construction trades and local community college training programs have expanded as a result of the demand for construction trades employees at all levels, with available scholarship funding toward this purpose.

Additionally, the need to hire a significant number of new employees to assist with the \$1 billion worth of contracts on the military base on Guam for fiscal year 2010 and beyond has prompted an unprecedented shift of college degree hires from various sectors of Guam's workforce to federal jobs. Of specific interest are holders of business or engineering degrees from on-island as well as off-island who have a long-term interest in working and living on Guam. This is a natural inducement of returning emigrants who left Guam during the economic downturn in the 1990's and particularly during the downsizing of military bases on Guam in

the early 1990s. Job opportunities include environmental professionals, IT professionals, transportation specialists and utilities professionals, along with architects, engineers, and planners needed for the U.S. military build-upage. Internship programs are also part of the shift to federal job opportunities, as the U.S. Navy has significantly expanded its internship program intended for “recent college graduates or applicants who are looking for a career change.” The local university’s business school has been credited as a great feeder into the internship program (Santiago, 2009).

Improved wage adjustments have positive implications for a growing middle class to expand the tax revenue base for Guam. Further, the recent spike in unemployment in the U.S. and the impending boom on Guam has prompted an increase in returning emigrants who are former college educated Guam residents looking for better employment opportunities. This unanticipated in-migration for Guam-bound jobs creates a pool of diversified education, knowledge, skills, talents and global experience from which Guam’s improved economic policy can draw from.

With opportunities on Guam come threats to the local community from opportunistic behavior by outsiders whose primary interest is to serve themselves and the interest groups they support. Among these outsiders is Hawaii’s Representative Abercrombie whose proposal in the 2010 National Defense Authorization Act, made on June 2009, included the provision that “the minimum wage standard for all construction workers on Guam will be at the prevailing wage level for similar construction projects in Hawaii”, which would be approximately twice the existing wage levels on Guam (U.S. House of Representatives Press Release, June 17, 2009). As many on Guam already noted (for example, Robertson, July 17, 2009), Abercrombie’s proposal is self-serving because, if it becomes law, it would provide workers in Hawaii, some who are currently or recently unemployed, with the opportunity to work on Guam, at least until Hawaii’s economy recovers from the current recession. As Robertson (July 17, 2009) put it, “the construction industry in Hawaii is now in a slump and he wants to provide a place for Hawaiian tradesmen to be employed on Guam at inflated wage rates until their economy rebounds.” By doing so, he would be endearing himself to voters and labor unions in Hawaii. Flores (2009) said it best: “Abercrombie is running for governor, and if he can boost his state’s struggling economy by giving (*Hawaiian*) construction workers jobs on Guam that pay just as much as if they were working in Hawaii, it would be a large feather in his political cap.” Examples like this remind us of the complex realities we face as a community, the enviable economic opportunity that is ahead of us, and the need for us to work together to ensure that,

on our way to economic development, we make choices that will benefit our community on Guam.

### **Public Sector Reforms and Fiscal Discipline**

As in many other economies, public sector reforms and fiscal discipline might be economically desirable but they are always politically difficult to achieve. Policymakers as well as the community must be convinced that getting the island's fiscal affairs in order is good in the long run as it will grow Guam's economy by making it more attractive for foreign and domestic businesses to invest in and for the local labor force to stay and work in. The absence of a long-term fiscal policy with broader positive implications, such as that adopted by Ireland in the 1980's, explains the ongoing short-term need-based budget planning process across all local government agencies that persists on Guam. The shortfall in local tax revenues to support key government services has resulted each year in competition across all local government sectors, with disproportionate allocations to support key government services to the public at-large, including health care, education, public safety, utilities, and others. The short-term annual-based planning without real reform has created budget shortfalls and left key government services undermanned. That lawmakers have mandated public school education as the priority funding recipient of dwindling local tax revenues is consistent with the need to invest in human capital, it however leaves all other government entities seriously underfunded, which compromises the quality of the service they provide to the public.

Persistent local government revenue shortfalls have prompted policymakers to pass legislation to create the Office of Finance and Budget (OFB) as a means to "renew fiscal discipline through the practice of open government, cooperation between the legislative and executive branches, and the assignment of fiscal responsibility to appropriate government entities and officials, all to promote public confidence and government efficiency." This reform calls for future fiscal policy to be consistent with government reorganization, performance-based budgeting, measurable program goals and transparency. Restrictions for future fiscal policy however need to be examined, considering the following duties: (a) develop and adopt a model for Guam's existing and projected economy that simulates the effect of revenue raising, the effect of any proposed benefits to said economy, optional revenue generation and the utility thereof; (b) compile and provide to I Liheslaturan Guåhan (the Guam legislature), I Maga'lahi (the governor) and the public forecasts of revenue that do not consider new or increased taxes, fees or other revenue

enhancements authorized by an Annual or Supplemental Operating Budget Bill, but that do consider current and prior year expenditures, surpluses and deficits; (Supreme Court of Guam, Compilers of Law Office, date). The emphasis appears to focus on tracking revenues for planning purposes, as opposed to deliberate economic development planning for increased and expanded income base beyond the status quo. What is also required is a plan for retaining the expanded educated workforce by availing of new development opportunities for job sustainability or new job creation through diversified industries.

### **Effective Policymaking and Social Partnership**

Guam historically lacked a collaborative effort across members of its broader civic society to guide the development of an economic development strategy. At best, these efforts drew from selected minority representations across the local government sectors and some representation from business industries. Advocates for economic progress through sound fiscal policy and effective economic development have primarily been in the private sector, with Guam's local chamber of commerce and other private sector based industry-specific associations at the forefront toward countering or endorsing laws that benefit the business community. However, policymaking has often been based on special interests and not broad based toward long-term economic development. The recent assessments of the potential impacts of the military build-up will require engagement of stakeholders across all sectors to address the potential for a more sustainable growth through sound fiscal policies and an economic development plan that makes long-term sense for Guam, in light of growing uncertainty of what economic growth the military build-up purports to bring.

### **Hard Work and Sacrifice**

Like effective policymaking, the need for hard work and sacrifice will require a united effort and a joint vision from all sectors across the Guam community and a clear understanding of the reward for making the sacrifice at present. No one can argue a public's receptiveness toward improving one's quality of life through an improved standard of living that is derived from a stronger economy. However, that receptiveness can only be garnered through the engagement of all stakeholder representation toward planning. The political will by the executive and legislative branches of government toward adopting the pragmatic policies to guide long-term economic development is an essential ingredient.

Although there are no guarantees for what the future will bring through these changes, they are worth the try. A promise of a better future, even if just a promise, is better than the stagnant economy at present.

### **CONCLUSION**

The knowledge that Ireland was able to adopt an economic development strategy and succeed gives hope for a brighter future for Guam. Indeed, Guam can be the Pacific Tiger, and there is no better time to act toward this goal than the present.

Recent sharp declines in revenue from Guam's primary industry have forced local government and business leaders to reassess the island's preparation toward taking advantage of the anticipated growth from the impending military expansion. The reverse in emigration of the educated workforce, along with education reform at the K-12 levels, lends promise toward building the knowledge-intensive workers Guam needs to support the development of a diversified economy. Although economic growth for Guam is anticipated to rise perhaps at double digit in the next five years, sustained long-term economic development cannot be guaranteed without a proactive economic strategy and repositioned fiscal policy.

One thing is certain. A passive approach toward global changes will ultimately hurt one's economy if necessary slight adjustments in policy and strategy are not made to best position a country to benefit from the change. Renewed efforts are inevitable toward this end. The timing is opportune, given growing concern from various sectors of Guam's civic society about cultural, social, and fiscal implications of this unprecedented growth on the island. Through civic engagement, there is hope toward advancing efforts with policymakers to accomplish what the government cannot or will not do.

With that said, Guam can be the Pacific Tiger but we must come together, play our part and make it happen. Hence, we say, "People of Guam, unite!"

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## **MORE ECONOMICS IN THE MOVIES: DISCOVERING THE MODERN THEORY OF BUREAUCRACY IN SCENES FROM *CONSPIRACY* AND *VALKYRIE***

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### **ABSTRACT**

*This essay describes how the elements in the modern theory of bureaucracy (Breton and Wintrobe, 1982), and in its application to the Nazi Holocaust (Breton and Wintrobe, 1986) and the 20 July 1944 plot to kill Adolf Hitler, can be integrated into the “Bureaucracy” portion of an undergraduate course in public choice economics using scenes from the movies *Conspiracy* (HBO Films, 2001) and *Valkyrie* (United Artists, 2008). In doing so, it builds upon the “economics in the movies” approach to pedagogy developed by Mateer (2004 and 2009), Dixit (2006), Sexton (2006) and Mateer and Li (2008).*

### **INTRODUCTION**

This essay describes how the elements of the modern theory of bureaucracy (Breton and Wintrobe, 1982), and its application to (1) the Nazi Holocaust (Breton and Wintrobe, 1986; Mixon, Sawyer and Trevino, 2004a and 2004b; Mixon and King, 2009; Mixon and Trevino, 2009) and (2) the 20 July 1944 plot to kill Adolf Hitler (Mixon, Sawyer and Trevino, 2004b), can be integrated, and in an innovative way, into the “Bureaucracy Theory” portion of an undergraduate course in public choice economics. Specifically, this article shows how the theory and its applications above are reconstructed in the movies *Conspiracy* (HBO Films, 2001) and *Valkyrie* (United Artists, 2008), respectively, and it suggests scenes from each movie that can be incorporated into classroom discussion of the modern theory of bureaucracy.

Given the paucity of specialized undergraduate textbooks in this genre of economics, an “economics in the movies” approach to pedagogy like that described in Mateer (2004 and 2009), Dixit (2006), Sexton (2006) and Mateer and Li (2008) could be quite beneficial. As Mateer and Li (2008: 303) point out, among the

pedagogical advantages to using short film scenes to introduce economic concepts are (1) increased student engagement, (2) an enhanced ability to critically analyze core content, and (3) the availability of an alternative to the lecture-discussion format. They also add that this new approach can, unlike some other pedagogical techniques, complement the traditional development of economic theory without sacrificing a significant amount of class time (Mateer and Li, 2008: 303).

This essay begins with a brief review of the relevant literature, including a summary of the modern theory of bureaucracy. This summary is followed by a description of how the theory has been applied to the Nazi Holocaust and other elements of the history of Nazi Germany. From there, some scenes from the movies *Conspiracy* and *Valkyrie* are presented as useful tools for teaching undergraduate economics students about the modern theory of bureaucracy.

### **A BRIEF REVIEW OF THE RELEVANT LITERATURE**

It is not often that a new way of approaching a subject is accompanied by an example as compelling as that Breton and Wintrobe (1986) used to illustrate the applicability of their modern theory of bureaucracy (Breton and Wintrobe, 1982). The traditional theory of bureaucracy in Niskanen (1971) argues that government bureaucrats seek to increase their power, influence, and other job-related perquisites by engaging in the process of budget-maximization (Shughart, 2008; Olson, 2008).<sup>1</sup> In this formal model, bureaucrats are able to capitalize on the lack of technical know-how exhibited by those in the legislature who provide resources for the bureaucracy, and on what Downs (1957) characterized as the “rational ignorance” of voters (the electorate), who represent the other principals (along with legislatures) who might constrain the activities of bureaucrats and bureaus (Shughart, 2008; Olson, 2008). At the same time bureaucracies seek growth, there is a general consensus that they are inefficient and inflexible, a conclusion that stems partly from a lack of information they confront as a result of their output being indivisible and unmarketable (Olson, 2008).

Breton and Wintrobe’s (1982) modern theory of bureaucracy is based in large part on the ideas of “vertical trust networks” and “informal payments.” According to the model, subordinates within a bureaucracy provide top-level bureaucrats with “informal services” that are the result of their own enterprise and initiative, and that advance the aims of the bureaucracy’s leadership. The bureau’s subordinates also trust that the bureaucrats will later reward them informally by providing opportunities for more rapid advancement (promotion), better offices, travel, etc. These perquisites are all *quid pro quos* that are not part of formal

contracts between bureaucrats and a bureau's subordinates, and often result from trades that are described above as inter-temporal in nature (Breton and Wintrobe, 1982 and 1986; Mixon, Sawyer and Trevino, 2004a and 2004b). Use of such an informal payments mechanism allows bureaucrats to establish a competitive process in the promotion of the bureau's goal(s), and one which provides greater efficiency and flexibility.

Breton and Wintrobe's (1986) application arrived through their article in the *Journal of Political Economy* titled "The bureaucracy of murder revisited," wherein they point out that the traditional theory of bureaucracy fails to explain how the Nazi bureaucracy formed as a conglomeration of competing agencies that (for a time) carried out the large-scale "Final Solution" to the "Jewish question" (Mixon, et al. 2004b). As Mixon et al. (2004b: 372) explain, the Breton and Wintrobe (1986) model is not only well-suited to explain how a quasi-government bureaucracy carried out the systematic murder of six million people in a relative short period of time, it is also adept at establishing the guilt of the bureau's subordinates who claimed (in judicial proceedings and interviews) to simply have been carrying out orders from superiors in the bureaucracy.<sup>2</sup> The Breton and Wintrobe (1986) story of the Nazi Holocaust is built mainly around that of Adolf Eichmann, the *SS-Obersturmbannführer* in Subsection IV-B-4 (Jewish affairs) of the Reich Central Security Office, who (for a time) showed significant enterprise and initiative in the promotion of the systematic murder of Europe's Jews throughout the early 1940s. As a result, Eichmann advanced from the 45<sup>th</sup> percentile of the Nazi Holocaust bureaucracy to the 65<sup>th</sup> percentile, all from 1938-1941 (Mixon, et al. 2004a: 863).

The following section describes how the elements in the modern theory of bureaucracy (Breton and Wintrobe, 1982), and in its application to the Nazi Holocaust (Breton and Wintrobe, 1986; Mixon et al. 2004a and 2004b) and the 20 July 1944 plot to kill Adolf Hitler (Mixon et al. 2004b), can be integrated, and in an innovative way, into the "Bureaucracy" portion of an undergraduate course in public choice economics. Specifically, section 2 below shows how the modern theory of bureaucracy and its application are reconstructed in the movies *Conspiracy* (HBO Films, 2001) and *Valkyrie* (United Artists, 2008), respectively. In doing so, this article highlights scenes from each movie that can be incorporated into classroom discussion of the theory and its application to the Nazi bureaucracy of the 1940s.

### THE MODERN THEORY OF BUREAUCRACY: A LOOK AT THE MOVIES

As stated earlier, there are few instances where an application of a model or theory is more compelling than that represented by the Breton and Wintrobe (1986) application of their own modern theory of bureaucracy (Breton and Wintrobe, 1982) to events constituting the Nazi Holocaust. The kinds of bureaucratic entrepreneurship that give rise to informal services and payments that are part of vertical trust networks described by Breton and Wintrobe (1982) fit well into the “Bureaucracy” portion of an undergraduate course in public choice economics, and they are relatively easy to impart to students without the requirement that students acquire Breton and Wintrobe’s 1982 book.<sup>3</sup> After such an exposition, Breton and Wintrobe’s compelling 1986 article on bureaucratic entrepreneurship in the Third Reich is accessible to, and appreciated by, students.<sup>4</sup>

Another option for integrating the Breton and Wintrobe (1982) modern model of bureaucracy in a public choice economics course is to employ a Hollywood adaptation of one of the more important aspects of the Nazi Holocaust -- the Wannsee Conference of 1942. That adaptation comes via HBO Films’ 2001 movie *Conspiracy*, and pedagogical use of a television movie adaptation of the 1942 Wannsee Conference follows the recent wave of using movies and television to teach undergraduate economics that is emphasized in Mateer (2004 and 2009), Dixit (2006), Sexton (2006) and Mateer and Li (2008).

*Conspiracy* was written by Loring Mandel, who won an Emmy Award for Best Writing, and it received 10 total Emmy nominations.<sup>5</sup> Another of the 10 nominations turned into a victory for Kenneth Branagh, who received a Lead Actor Emmy for his portrayal of Reinhard Heydrich, Chief of the Reich Central Security Office (RSHA) who “chaired” the 1942 Wannsee Conference. The role of Adolf Eichmann, the leading figure in Breton and Wintrobe (1986), is played by Stanley Tucci, an Emmy and Golden Globe Award winner for his work in the movie *Winchell*. Most of the Conference participants, and their *Conspiracy* counterparts, are listed in Table 1.



**Table 1: Wannsee Conference Participants as Portrayed in *Conspiracy***

Conference Participant	Bureau	Portrayed in <i>Conspiracy</i> by
Reinhard Heydrich	Chairman, Reich Central Security Office (RHSA)	Kenneth Branagh
Dr. Alfred Meyer	Reich Ministry for Occupied Eastern Territories	Brian Pettifer
Dr. Georg Liebbrandt	Reich Ministry for Occupied Eastern Territories	Ewan Stewart
Erich Neumann	Secretary of State, Reich Ministry for the Interior	Jonathan Coy
Dr. Roland Freisler	Secretary of State, Reich Ministry of Justice	Owen Teale
Dr. Josef Bühler	Secretary of State, Office of the Government General of Poland	Ben Daniels
Dr. Martin Luther	Under-Secretary of State, Foreign Office	Kevin McNally
Gerhard Klopfer	Party Chancellery	Ian McNeice
Friedrich Kritzinger	Reich Chancellery	David Threlfall
Otto Hofmann	Race and Settlement Main Office (RuSHA)	Nicholas Woodeson
Heinrich Müller	Reich Main Security, Gestapo Chief	Brenden Coyle
Adolf Eichmann	Reich Central Security Office (RHSA, Subs. IV-B-4)	Stanley Tucci
Dr. Karl Schöngarth	SD Chief of the General Government of Poland	Peter Sullivan
Dr. Rudolf Lange	SD Chief of Latvia	Barnabay Kay
Sources: Mixon, Sawyer and Trevino (2004a) and HBO Films (2001).		

*Conspiracy* is rich in instances wherein aspects of Breton and Wintrobe's (1982 and 1986) competitive model of bureaucracy – one which provides greater efficiency and flexibility than that depicted in earlier models of bureaucracy – are superbly reconstructed in the story of the Nazi bureaucracy's goal of genocide. Several instances have significant pedagogical value, such as the scene in the movie

wherein Heydrich reads aloud a memo which is believed to have been penned by *himself*, but was actually *signed* and *sent* to Heydrich by German *Reich Marshall* Hermann Göring, authorizing a “solution” to “the Jewish question.” The memo authorizes a solution involving “emigration or evacuation in the most favorable way possible” of the Jews living in the German sphere of influence within Europe.

As Breton and Wintrobe (1986) state, one indicator of competition among bureaus (bureaucrats) or within bureaus concerns the imprecision of orders from higher echelons within the bureau or bureaus (Mixon et al. 2004a: 858). In *Conspiracy*, Heydrich and the other Wannsee Conference participants wrangle with the lack of precision in the term “evacuation,” which Heydrich takes to mean the “cleansing” of Europe’s Jews, itself an imprecise term. As Mixon et al. (2004a: 866) point out, the fact that Heydrich had to interpret (for others) a memo that he penned himself is itself interesting; that Heydrich’s interpretation was also *imprecise* remarkably supports the Breton-Wintrobe thesis that *vague* and *imprecise* directives motivate would-be bureaucratic entrepreneurs into devising innovative and enterprising initiatives that assist the bureau in achieving a goal.<sup>6</sup> These ideas are reinforced through some of the pre-Conference conversations portrayed in *Conspiracy*. It is in one of these that Josef Bühler, the Secretary of State in the Office of the Government General of Poland, who is portrayed in *Conspiracy* by British actor Ben Daniels, offers dialogue that supports the discussion above concerning Heydrich’s memo. In a pre-Conference conversation scene Bühler says “. . . we will soon discover what new concepts our SS friends have in mind [for addressing ‘the Jewish question’] . . .” It is through statements like this one that enterprise and initiative in putting forward “solutions” to “the Jewish question” included new and innovative ideas, concepts, initiatives, and policies (Mixon et al. 2004a: 866).<sup>7</sup>

Once the framework for bureaucratic competition and entrepreneurship is established, as it was with the Nazi’s Wannsee Conference of 1942, the role of vertical trust networks, with the attendant informal payments and informal services that are discussed above, take over the process of achieving the Nazi Holocaust bureaucracy’s goal of genocide. The benefits of these relationships to the Nazi bureaucracy’s superiors, and their attendant trades, are not seen in *Conspiracy*. However, pre-Conference vertical trust networks, along with some of the *concepts* used in the genocide of Lithuania’s Jews (during the fall of 1941), are described by Mixon et al. (2004b: 374-376) in a way (i.e., non-technical, brief) that allows public choice economics instructors to supplement scenes from *Conspiracy* with passages and tables from some of the historical episodes.<sup>8</sup>

The antithesis of vertical trust networks in the Breton and Wintrobe (1982) model are “horizontal trust networks.” These are networks that exist between

officials who operate at roughly the same level of a bureaucracy's management structure. They are seen as being inefficient, in a large numbers setting such as in the Nazi Holocaust bureaucracy, from the leadership's perspective because cooperation among similarly-situated subordinates often works to thwart the goals of the bureau's leadership (Breton and Wintrobe, 1982 and 1986; Mixon et al. 2004b). According to Mixon et al. (2004b: 376), "[t]he history of the Nazi regime provides an insightful example of an extreme form of horizontal network inefficiency: the 20 July 1944 plot to kill Adolf Hitler." In just a few pages, Mixon et al. (2004b: 376-378) provide details of the plot as an example of horizontal trust networks in a way that both generalizes and supplements Breton and Wintrobe's essay on the Nazi Holocaust bureaucracy and Adolf Eichmann's role in advancing it. In that way, Mixon et al. (2004b) can be integrated into the bureaucracy discussion of a public choice economics class relatively easily.

As in the case of vertical trust networks described above, the academic literature on horizontal trust networks in the Nazi Holocaust bureaucracy (i.e., Mixon et al. 2004b) can also be supplemented with scenes from a movie. In this case that is the motion picture *Valkyrie*, released by United Artists in 2008, and starring Tom Cruise as German Reserve Army Colonel Claus Schenk Graff von Stauffenberg, the central figure in the 20 July 1944 plot to kill Hitler.

**Table 2: Conspirators in July 1944 Plot to Kill Hitler as Portrayed in *Valkyrie***

Conspirator	Position in Nazi Hierarchy	Portrayed in <i>Valkyrie</i> by
Claus Schenk Graff von Stauffenberg	Colonel, Reserve Army	Tom Cruise
<i>Military/Intelligence Conspirators</i>		
Ludwig Beck	Colonel General, Chief of General Staff (retired, 1939)	Terence Stamp
Wilhelm Canaris	Admiral, Head of Counterintelligence	
Friedrich Fromm	General, Commander of Reserve Army	Tom Wilkinson
Adolf Heusinger	Colonel General, Operations Chief of the Army High Command	Matthew Burton
Erich Höpner	Colonel General (dismissed, 1941)	
Günther Hans von Kluge	Field Marshall	

**Table 2: Conspirators in July 1944 Plot to Kill Hitler as Portrayed in *Valkyrie***

Conspirator	Position in Nazi Hierarchy	Portrayed in <i>Valkyrie</i> by
Friedrich Olbricht	Colonel General, Reserve Army	Bill Nighy
Hans Oster	Major General, Counterintelligence	
Erwin Rommel	Field Marshall	
Karl Heinrich von Stülpnagel	Colonel General, Military Government of France	
Henning von Tresckow Major General	Kenneth Branagh	
Erwin von Witzleben	Field Marshall (retired, 1942)	David Schofield
<i>Diplomatic Corps Conspirators</i>		
Hans Bernd Gisevius	Diplomatic Office, Switzerland	
Christian von Hassell	German Ambassador to Italy (retired)	
Adam von Trott zu Solz	German Foreign Ministry	
<i>Political/Civil Conspirators</i>		
Carl Goerdeler	Lord Mayor of Leipzig (former)	Kevin McNally
Wolf Heinrich von Helldorf	Chief of Berlin Police	Waldemar Kobus
Julius Leber	Member of Reichstag (former)	
Johannes Popitz	Prussian Finance Minister	
Sources: Mixon, Sawyer and Trevino (2004b) and United Artists (2008).		

As Table 2 points out, Cruise is joined in *Valkyrie* by Kenneth Branagh who portrays Henning von Tresckow, and by Tom Wilkinson, Bill Nighy, and Terence Stamp, who play German Reserve Army Commander Freidrich Fromm, German Reserve Army Colonel General Freidrich Olbricht and retired Chief of General Staff Ludwig Beck, respectively. Directed by the critically acclaimed Bryan Singer, each of these actors performs solidly in their respective roles.

The scenes and dialogue also provide a portrayal of the concept of horizontal trust networks found in Breton and Wintrobe (1982 and 1986). Though *Valkyrie* is more of an action movie than *Conspiracy*, one critical scene in *Valkyrie* depicts Stauffenberg meeting, for the first time, the plot's original conspirators. To set the scene, Stauffenberg has only recently recovered from wounds suffered during the German retreat in North Africa, and he is, at the time of the meeting scene described earlier, an officer in the German Reserve Army. Stauffenberg (Cruise) is urged to meet the original conspirators by Olbricht, and after being received at the meeting by von Tresckow, and he is impressed by what he learns about the lofty positions the conspirators hold (or once held) in various branches of the larger Nazi (German) bureaucracy. The positions fall under the military/intelligence, diplomatic, political and civil corps of the Nazi (German) bureaucracy, as pointed in Mixon et al. (2004b) and in Table 2.<sup>8</sup> After hearing how the original conspirators appear to have all of the bases covered for building a new, post-Hitler Germany, Stauffenberg questions his presence in the room to von Tresckow and the others, and attempts to exit. Though sympathetic to the cause, by military rank Stauffenberg does not necessarily fit into the horizontal trust network that he is being introduced to in this scene. However, he is convinced that the act of tyrannicide has to be carried out, and that, given his inclinations and position in the Reserve Army, he might have the means and opportunity to assist.

In giving his assistance to the plot, Mixon et al. (2004b: 377) explain that Stauffenberg, and others at his level, or a lower level in the larger Nazi bureaucracy, contributed "vertical loyalty" (i.e., they formed a vertical trust network) to assist those in the horizontal trust network presented in Table 2. Though not as rich in the quantity of scenes and dialogue with pedagogical value as *Conspiracy*, the particular scenes from *Valkyrie* described above really hit a mark with regard to capturing part of the Breton and Wintrobe (1982 and 1986) concept of horizontal trust networks in bureaucracy.

### CONCLUDING COMMENTS

The recent wave of using movies and television to teach undergraduate economics, emphasized in Mateer (2004 and 2009), Dixit (2006), Sexton (2006) and Mateer and Li (2008), is potentially most beneficial in those economics courses for which the publishing industry has yet to produce a specialized textbook. That is the case with an undergraduate course in public choice economics. Here, some instructors adopt books of readings, supplemented by a reading list containing published journal articles, while other instructors simply opt for the latter.

This article provides some guidelines for integrating “economics in the movies” into a part of a public choice economics course. Various scenes from the HBO Films (2001) production of *Conspiracy*, and at least one key scene from the United Artists (2008) production of *Valkyrie*, offer avenues for using movie scenes to explain critical aspects of the modern theory of bureaucracy (Breton and Wintrobe, 1982). Given the benefits of an “economics in the movies” approach like those described in this essay, its use to cover some of the bureaucracy theory portions of an undergraduate course in public choice economics might make for a successful pedagogical enterprise.

### **AUTHOR’S NOTE**

The author thanks two anonymous referees of this journal for helpful comments on an earlier version of this article. The usual caveat applies.

### **ENDNOTES**

- 1 In Niskanen’s (1971) formal model, the bureaucrat’s power, influence, job-related perquisites are an increasing function of the bureaucracy’s size or budget (Olson, 2008).
- 2 As Breton and Wintrobe (1986) indicate, it is more difficult to establish the guilt of subordinates using earlier theories of bureaucracy.
- 3 As many public choice scholars are aware, there is no specialized textbook for undergraduate courses in public choice economics. As a result, instructors often choose to assign (require) books of readings that generally contain published journal articles. Given the limited use of original source materials (e.g., Niskanen, 1971; Breton and Wintrobe, 1982) in any one portion of a semester-long public choice economics course, particularly those in book form, instructors may find it difficult to justify having students purchase those materials.
- 4 Given the lack of public choice economics textbook options noted earlier, instructors often use reading lists containing various journal article publications from the genre. Though which articles to require (or recommend), if any, in each portion of the course is often a matter of personal preference, I have found that students show interest in the Breton and Wintrobe (1986) application of the modern theory of bureaucracy.

- 5     *Conspiracy* consists almost entirely of the dialogue from the Conference, which is generally recognized as the origin of earlier-used terms such as “Final Solution” and “Jewish Question.”
  
- 6     *Conspiracy* contains other examples of imprecise language regarding the “Final Solution” that are not included in *Mixon et al. (2004a)*. At the beginning of the Conference, Heydrich is shown stating that “We have a *storage problem* in Germany with these Jews,” and that “I have been asked to direct the *release* of Germany and all of Europe from the Jewish stranglehold, and I believe that together we will.” Emphasis has been added to the quotes above to highlight the other uses by Heydrich of *imprecise terms* that are hoped by him to motivate competitive behavior on the part of the Conference attendees and the branches or divisions of Nazi Germany that they represent. Heydrich’s last line above, that he believes the group can *together* accomplish *something* with regard to the *evacuation* of the European Jews supports the Breton and Wintrobe (1982 and 1986) notion that a new or modern kind of bureaucracy was motivated to action in this case. Finally, it is interesting that in the movie Heydrich is pressed by the Conference attendees to judge some of their interpretations of “evacuation” and the other imprecise terms. At one point the movie portrayal of events even has Heydrich specifying his own preference for interpreting the term(s).
  
- 7     At points in the movie Eichmann relays to attendees the preliminary results of various applications of “concepts” and “initiatives,” such as mobile gassing vehicles and the infamous furnace systems that would ultimately used in the death camps. It is also worth noting here that *Conspiracy* portrays some of the perquisites that Nazi Holocaust participants might expect as a result of their successful “concepts” and “initiatives.” Heydrich is shown stating to some Conference attendees how he is fond of the Wannsee mansion where the Conference was held, and that he expects it to become his post-war home.
  
- 8     One lesson from *Mixon et al. (2004a and 2004b)* is that the “solutions” implemented by *Einsatzkommando 3* in Lithuania in 1941 were inadequate for achieving the Nazi bureaucracy’s ultimate goal of the “cleansing” of Europe’s Jews (*Mixon et al. 2004b: 375*). For that the Nazi bureaucracy turned to another *initiative* developed in 1941, the construction of death camps like those at Belzec, Sobibor, and Treblinka (*Mixon et al. 2004a: 861*).

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