Volume 7, Number 2 **ISSN 1533-3604**

JOURNAL OF ECONOMICS AND ECONOMIC EDUCATION RESEARCH

An official Journal of the
Academy of Economics and Economic Education
and the Allied Academies

Editor: Larry R. Dale
Arkansas State University

Academy Information
is published on the Allied Academies web page
www.alliedacademies.org

Whitney Press, Inc.

Printed by Whitney Press, Inc.
PO Box 1064, Cullowhee, NC 28723
www.whitneypress.com

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The *Journal of Economics and Economic Education Research* is published by the Allied Academies, Inc., PO Box 2689, 145 Travis Road, Cullowhee, NC 28723, USA, (828) 293-9151, FAX (828) 293-9407. Those interested in subscribing to the *Journal*, advertising in the *Journal*, or otherwise communicating with the *Journal*, should contact info@alliedacademies.org.

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LETTER FROM THE EDITOR

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

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

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

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ECONOMICS EDUCATION ARTICLES

ON-LINE MATHEMATICS REVIEWS AND PERFORMANCE IN INTRODUCTORY MICROECONOMICS

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Eric Kuennen, University of Wisconsin Oshkosh

ABSTRACT

We examine whether on-line remedial mathematics reviews can improve student performance in introductory microeconomics. In treatment sections, graded pre- and posttests were used to assess student understanding of graphing, systems of linear equations, area, slope, ratios and percentages. Students had on-line reviews and tutorials available between completing the tests. Pre- and posttest scores are positively and significantly related to course grade, more so than variables designating which mathematics courses have been taken by students. Ordered probit analysis suggests that each additional question answered correctly on the posttest over the initial pretest score is significantly related to final course grade, with students in the treatment sections earning on average 0.20 of a letter grade higher.

INTRODUCTION

Even at the introductory level, the abilities to think mathematically and reason abstractly have been shown to be important contributors to student success in economics, and many studies in economics education have attempted to control for students' mathematical backgrounds in their analysis. Durden and Ellis (1995) and Williams, Waldauer, and Duggal (1992) use Math SAT score as a measure of student mathematics ability and find that Math SAT score is positively and significantly correlated with student performance in economics courses. Anderson, Benjamin, and Fuss (1994), Brasfield, Harrison, and McCoy (1993), Brown and Leidholm (2002), Ely and Hittle (1990) and Lumsden and Scott (1987) include in their regressions of student performance the types of mathematics courses taken by students. These studies argue that the mathematics classes a student has taken are a reasonable proxy for student mathematics ability. Ballard and Johnson (2004) find

that the mastery of very basic mathematics concepts is one of the most significant contributors to student success in introductory microeconomics; they argue that studies that emphasize whether a student has taken calculus does not measure the influence of calculus *per se*, but rather measures the fact that students taking calculus are more likely to have mastered the basic mathematics concepts important for introductory economics.

The results of these studies suggest potential gains in student mastery of economics concepts if greater emphasis is placed on students' mathematics skills. In this study, we verify the link between basic mathematics skills and performance in introductory microeconomics and examine the use of on-line mathematics reviews as a method to improve student performance. As economics courses are increasingly being offered wholly or partly via internet, the effectiveness of this alternative format for student learning is important to assess. Brown and Leidholm (2002) and Katz and Becker (1999) examine whether internet courses can effectively substitute for classroom learning in economics. In this study, we examine whether an internet mathematics component to a standard lecture-based classroom course can improve student performance. We identify the advantages of conducting the mathematics reviews on-line as: (a) it does not require students to take additional mathematics classes or satisfy more prerequisites, (b) it can be done simultaneously with the economics course, and (c) it does not use valuable class time.

While introductory microeconomics is not, in general, a heavily mathematical course, the recognition of economics as a mathematics-based discipline at the introductory level is important. Instructors who de-emphasize the quantitative aspects of economics still must present concepts such as elasticity and consumer surplus, which can prove difficult if students cannot mathematically conceptualize the ideas. Additionally, students who enter intermediate-level economics classes with little idea that economics is a mathematics-based discipline are functionally unprepared to be economics majors.

We collected information on the background, motivation, and mathematics preparation of 445 students enrolled in nine sections of introductory microeconomics at a regional Midwestern university. To ascertain the degree to which mathematics skills are correlated with performance and whether mathematics reviews can improve student performance, six sections of introductory microeconomics were assigned or given the opportunity to complete on-line tutorials with quizzes on basic mathematics, and earn class points on graded mathematics pre-and posttests. The three remaining sections served as controls. Students' scores

on the mathematics pre- and posttests are significantly and positively correlated with final grades in the course, holding other factors constant. In addition, we find that students in the six treatment sections performed significantly better than their counterparts in the control sections, earning on average one-fifth of a letter grade higher in introductory economics. Further, each additional point earned on the mathematics posttest over the initial pretest score is positively and significantly related to course grade. The results suggest that one way to improve student performance in introductory microeconomics is to place more emphasis on improving students' basic mathematics skills.

DESCRIPTION OF THE DATA

Using a survey, data was gathered on students enrolled in nine sections of introductory microeconomics during the Fall 2002, Spring 2003, and Fall 2003 semesters at a regional-Midwestern university. The nine sections all had enrollments of roughly 50 students each. Professor 1 taught six sections (two sections each during the three semesters) and Professor 2 taught three sections (all during the Fall Semester 2002). Students were asked to provide background and demographic information including their gender, race, age, university class status, study habits, attendance patterns, mathematics background, grade point average (GPA), and ACT score. See Table 1 for a summary. While we rely primarily on student reported data, we find little evidence that our students overstated their GPA or ACT scores, comparing our means and standard deviations to those of the university as a whole.

Our sample consists of 445 students, a sub-sample of the 457 students that were enrolled. The students were primarily sophomores (64.8%) and juniors (18.0%) with a mean GPA of 2.90 and a mean ACT score of 22.6. The sections were 46.8% female, and 95.6% of students classified their race as "white." Nearly 88% of students were taking the class because it was required for their major.

To enroll in introductory microeconomics, students must score sufficiently well on a mathematics placement exam or have taken pre-calculus. However, this prerequisite is not enforced. Of the sample, at the time of taking introductory microeconomics, 7.7% of students had been required to take remedial mathematics; 72.8% had taken a pre-calculus course; 53.6% had taken calculus or business calculus; and 7.3% had taken a mathematics course more advanced than calculus. In addition, 83% of the students were currently taking a mathematics course or had taken one during the previous semester. Only 7.5% of students had not taken a

mathematics class in two or more years. Women were more likely to have been required to take remedial mathematics than men ($p < 0.05$), and were less likely to have taken calculus ($p < 0.001$).

On some survey questions, students occasionally chose an invalid option or left the question blank. For these students, we replace the missing values with sample mean values in an effort to preserve the sample size. In addition, some of the students were absent on the first day of class— the day the survey was given—and four students who completed the survey did not complete the course and do not have a final grade. In total, we are missing information on 2.6% of the students enrolled in the nine sections. There is the possibility of selectivity bias in our survey sample if the missing students are systematically different from the students in the sample (Chan, Shum, and Wright, 1997). While we lack information on the non-survey students, we do know that they performed relatively worse in the course than students who took the survey. If we compare the distribution of grades between the survey sample and the entire class sample, it is evident that grades are relatively consistent over the mid-range (from a 1.5 to a 3.5), but that there are statistically significant differences in the tails of the distribution. Students who completed the survey and were in the sample were more likely to earn a 4.0 in the course, and students who missed filling out the survey were more likely to have failed the class (both with $p < 0.01$).

We argue the inclusion of the missing students in the study would actually strengthen our results. Consider an equation determining attendance:

$$Attendance_i = a + Sum_j (b_j x_{ij} + u_i)$$

where, for every individual i, a is a constant, b_j is a vector of coefficients on the exogenous variables x_i, and u_i is the error term. We argue that the error, u, in this equation is positively correlated with the error in an equation determining student final grade:

$$Grade_i = d + Sum_j (g_j x_{ij} + e_i)$$

In the grade equation, d represents the constant, and g_j represents the vector of j coefficients on the same explanatory variables, x_i, where e_i is the error term. Such a relationship would indicate that the students who are more likely to attend class (and thus were more likely to complete the survey) are also more likely to get higher grades and have better mathematics skills. The negative correlation between

mathematics skills and the error term, *e*, would cause the coefficient on the "treatment section" dummy variable to be underestimated. In other words, the error from the attendance equation effectively operates as an omitted explanatory variable in the grade equation, causing downward bias in the estimated coefficient for the treatment-section dummy variable. Therefore, although the sample of students who took the survey was not drawn randomly from the class as a whole, we argue that this does not significantly affect our conclusions.

We have two additional concerns regarding the data. First, some students in the sample do not have an ACT score. For students who took the SAT instead, the university's admissions scale was used to convert the SAT scores to ACT scores. However, there also were a number of transfer students and special scholarship students enrolled in the sections who were never required to take the ACT exam before being admitted to the university. Since we do not want to drop these students from the analysis, we replace their missing ACT scores with predicted ACT scores. The predicted values were found by a simple regression of ACT on explanatory variables, including student academic performance, student individual characteristics, and family background.

A second concern is that the division of students between the control and treatment sections was not random; students selectively enrolled in sections of microeconomics and students with fewer credits had fewer choices of sections, though students did not know of the experiment in advance of the first day of class. In an effort to control for this non-random assignment, we collected information as to whether the student was enrolled in his or her first-choice section and the student's preferred sleeping habits. Overall, 87.1% of students enrolled in their preferred section, and fewer than 7.4% of the students were enrolled in sections they considered "too early." However, both variables have insignificant coefficients and *t*-statistics in the performance regressions and are thus not included in the final reported results.

Table 1: Summary of the Data

Variable	Percent	Mean	Standard Deviation
Female	46.77		
Male	53.23		
Age		20.47	3.43
Freshmen	10.24		

Table 1: Summary of the Data			
Variable	Percent	Mean	Standard Deviation
Sophomores	64.81		
Juniors	18.01		
Seniors	4.9		
Other	2.04		
White	95.55		
Non-white	4.45		
Hours Work per Week		12.57	11.69
Hours in Extra-curricular Activities		4.9	5.41
Weekly Hours Study all Classes		11.1	6.37
Course is Required for Major	87.63		
Not Required for Major	12.37		
Took Economics in High School	46.55		
Did Not Take in High School	53.45		
Took Econ at Another College	9.58		
Did Not Take at Another College	90.42		
Never Skip Class	58.13		
Hardly Ever Skip Class	38.08		
Don't Usually Class	3.57		
Often Skip Class	0.22		
Almost Always Skip Class	0		
GPA		2.9	0.53

Table 1: Summary of the Data			
Variable	Percent	Mean	Standard Deviation
ACT Score		22.64	3.08
First Choice of Sections	87.08		
Not First Choice of Sections	12.92		
Naturally Awake Before 8am	14.92		
Awake between 8 and 9am	53.67		
Awake between 10 and 11am	24.05		
Awake in the Afternoon	7.35		
Required to take Remedial Math	7.73		
Not Required to take Remedial	92.27		
Have Taken Pre-calculus	72.83		
Have Not Taken Pre-calculus	27.17		
Have Taken Calculus	53.63		
Have Not Taken Calculus	46.37		
Have Taken Advanced Math	7.26		
Have Not Taken Advanced Math	92.74		
Currently Taking a Math Class	40.05		
Took Math Last Semester	42.39		
Took Math Last Year	10.07		
Took Math 2 Years Ago	3.04		

Table 1: Summary of the Data			
Variable	Percent	Mean	Standard Deviation
Took Math More than 2 Yrs. Ago	4.45		
Took the On-Line Math Pretest	60.33	26.71	4.5
Did not Take the Math Pretest	39.67		
Took the On-line Math Posttest	41.67	27.73	5.8
Did not Take the Math Posttest	58.33		

PRETESTS, POSTTESTS, AND TUTORIALS

To test the effectiveness of the mathematics reviews in improving student performance, three of the nine sections of introductory microeconomics were assigned to be controls, and did not have access to the mathematics review materials. The remaining six sections were either required to, or could voluntarily, use the review materials. We began by assessing student mathematics skills in the six treatment sections with a mathematics pretest. Students could supplement the basic review of the pretest with tutorials and homework assignments during the first three weeks of the semester. Professor 1 assigned the mathematics pre- and post-tests as homework, allowing students to keep the highest number of points earned on the tests in her four treatment sections. Professor 2 gave students the option of completing the pre- and post-test, keeping the greatest number of points earned as extra credit in his two treatment sections.

All review materials were made available to students on-line, through the economics course management and content web company, Aplia™ (see www.aplia.com). None of the review material was discussed in class, other than providing general instruction for logging-on, etc. Each pre- and posttest contained 35 questions divided among five key topics: (1) reading graphs, (2) solving systems of linear equations, (3) manipulating ratios and fractions, (4) calculating areas, and (5) finding slopes. (Note: this differs from Ballard and Johnson (2004) who used a pretest of only 10 questions covering topics 2 through 5, above.) The tests

contained some standard multiple-choice questions and some questions that relied on interactive graphing technology. For example, students were asked to place a point at a particular *x*-*y* coordinate pair, to plot a line, or to change the slope of a line to a particular value.

Students were given one week to complete the pretest. Students who chose to review the mathematics concepts in more detail could complete up to five tutorials, covering the five major basic mathematics concepts. Each tutorial contained a 10 to 15 minute explanation of the mathematics concepts, with sample problems. Students also had the option of doing practice homework problems relating to each of the five concepts, and students could review their answers to the pretest, comparing them against the correct answers and detailed explanations. Students were given two weeks to work with this review material. Following that two-week period, the students had the option of completing a posttest on the same mathematics concepts. Students were awarded the highest number of points earned on either the pre- or the posttest.

Professor 1 had 162 students who took the pretest out of an eligible 200 students (81%); of those, 142 students opted to take the posttest. Professor 2 had 49 of an eligible 103 students (47.6%) take the pretest, and 33 of these students opted to take the posttest. Additionally, 30 of Professor 1's students and 8 of Professor 2'sstudents opted to only take the posttest. The average score on the pretest was 26.7 out of 35 and the average score on posttest was 27.7 out of 35; the difference is statistically significant ($p < 0.001$). There was no statistically significant difference in test scores across professors on either the pre-test or the post-test. Of those students who took the pre- and posttests, 22.6% of students did worse on the posttest than the pretest (the average being 5.43 fewer questions answered correctly). This may be attributed to a handful of students who began the posttest, completed a few questions, and then quit, perhaps deciding that the opportunity cost of finishing the entire posttest was too high.

In addition, 9.5% of students did exactly the same on the pre- and posttests, and 67.9% of students did better. The average improvement across all students who took both the posttest and the pretest was 1.9 more questions answered correctly. We attempt to calibrate the pre- and post-tests by switching the order in which they were given during the Fall 2003 semester. That semester, the post-test was given as the pre-test and the pre-test served as the post-test, and there was no noticeable differences in means.

An examination of simple correlation coefficients indicates that students who performed better on the pre- and posttests also received higher grades in the

class. See Table 2. Further, while students with higher GPAs did better on the pre- and posttests overall, students with lower ACT scores saw more improvement between the pre- and the posttest. In addition, the correlation coefficient between GPA and the posttest is smaller than the correlation coefficient between GPA and the pretest. The same relationship is observed for correlation coefficients between ACT score and the pre- and posttests. This may indicate that students who are less prepared than their counterparts are not necessarily permanently disadvantaged; they can gain the skills they lack through review work.

To test the reliability of student performance on the pre- and posttests we use Cronbach's alpha with test items of GPA, ACT score, grade in the course, pretest and posttest scores. We find the item-test correlations are roughly the same for all items, the lowest belonging to ACT score and the highest belonging to GPA. An alpha of 0.6680 is calculated for the pretest; the posttest alpha is 0.6860. This suggests that student performance on the mathematics tests is reasonably well-correlated with their general academic performance.

Table 2: Correlation Coefficients

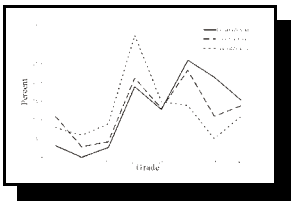
Variable	Grade	GPA	ACT	Pretest Score	Posttest Score	Improvement
Grade	1.0000					
GPA	0.5827	1.0000				
ACT	0.4095	0.4634	1.0000			
Pretest Score	0.3570	0.2727	0.2905	1.0000		
Posttest Score	0.4128	0.2490	0.2058	0.2859	1.0000	
Improvement	0.0895	0.0095	-0.0429	-0.5232	0.6670	1.0000

ANALYSIS OF THE DATA

The students in the experimental and control sections for each professor in the study had the same lectures, homework, and exams. Students were not allowed to keep their exams, so as not to influence student performance across sections or semesters. In Figure 1, the grade distributions for all nine sections are examined. Students are grouped into three categories: those who were in the control sections and did not have an option to do the mathematics reviews and tutorials (Control Series), those who were in Professor 2's treatment sections with the option to do the

mathematics reviews and tutorials (Optional Series), and those in Professor 1's sections for whom the mathematics reviews were required (Required Series). It is apparent that the students in the required treatment sections were more likely to earn a B or better in the class. Students in the control sections earned consistently lower grades than those in the required treatment sections; this result is particularly evident at the tails of the grading distribution. For the optional sections, the results are less clear. Overall, *t*-tests of means suggest that students in the treatment sections earned on average 0.45 of a letter grade higher than students in the control sections ($p < 0.01$), not controlling for other factors.

Figure 1: Distribution of Grades



While completing the mathematics tests and reviews is correlated with higher grades in introductory microeconomics, we are concerned about whether we are measuring student motivation or the actual effects of the review. We run a series of regressions to determine if the treatment sections actually perform better than the control sections, taking into account exogenous influences. The dependent variable in this study is "grade," which indicates the grade a student received overall in the course, on a 4.0 scale.

The model we use is the education production function, as developed by Allison (1979) and Hanushek (1979). This model suggests knowledge is produced out of a variety of student motivational and background variables as well as university and professor specific variables. A calculation of the variance inflation factors suggests we do not have a multicollinearity problem with our explanatory variables. Our dependent variable, "grade", is an ordered categorical variable, and therefore we primarily use ordered-probit estimation techniques. We suggest the grade for each student, *i*, depends on a student's background (gender, race, age), the effort put into the class, innate intelligence, and mathematics ability.

$$Grade_i = f\,(background_i,\ effort_i,\ intelligence_i,\ math\ ability_i)$$

We proxy student effort with variables including how often they report skipping class, hours spent studying per week, and hours spent working for pay per week. Intelligence is proxied with student GPA and ACT score. We also include a vector of control variables for the semester and the professor. Student mathematics ability is measured variously by the mathematics courses a student has taken as well as their performance on the mathematics pre- and posttests. Although we have a wide variety of data on students, such as previous economics experiences, whether economics is required for their major, etc., we found that those variables are not significantly related to student grades, and they did not pass an *F*-test of inclusion in the regressions. Additional results and tests are available upon request.

Initially, we seek to verify a relationship between basic mathematics skills and performance in introductory microeconomics. In Table 3, the results from two initial ordered probit regressions of course grade on the explanatory variables and student scores on the pre- and posttests are reported. The most important determinants of student grade are college GPA and ACT score. We find no significant differences between the grades of men and women, nor do we find significant differences by university class-levels. These results are consistent across a variety of regression specifications. Variables controlling for student motivation, such as self-reported skipping and hours spent working per week are also not statistically significant. We do find significant differences in grading across professors: Professor 2 gave lower grades on average than Professor 1 ($p < 0.001$). However, there is no significant difference in grades given by the same professor across semesters ($p = 0.56$).

Both a student's pretest score and posttest score are positively and significantly related to course grade. All else equal, for every additional question a student answered correctly on the pretest, students increased the probability of earning a higher letter grade. For example, a student scoring a 30 on the pretest is predicted to earn 0.6 of a letter grade higher than a student who scored a 20 on the pretest. These results are consistent with Ballard and Johnson (2004), who also find basic mathematics skills to be significantly related to performance in introductory microeconomics. Unlike previous studies, we find that neither having taken calculus nor having taken remedial mathematics are as significantly related to course grade as the pre- and posttest scores. This suggests that there may be a specific group of mathematics skills which are particularly important for microeconomics students, rather than general mathematics knowledge.

Table 3: Raw Math Pre- and Posttest Scores and Grades in Microeconomics		
Variable	Regression 1—Pretest and Grade	Regression 2—Posttest and Grade
Female	0.147 (-0.88)	0.104 (-0.57)
Minority	-0.558 (-1.63)*	-0.608 (-1.55)
Freshmen	-0.046 (-0.19)	0.148 (0.55)
Junior	0.373 (1.77)*	0364 (1.57)
Senior	-0.762 (-1.82)*	-0.777 (-1.54)
Other	0.476 (0.53)	0.360 (0.39)
Skip Class	-0.988 (-0.60)	-0.396 (-1.90)*
Hours Study Per Week	-0.001 (-0.07)	-0.003 (-0.21)
Hours Work Per Week	0.004 (0.56)	0.009 (1.18)
GPA	1.283 (6.63)***	1.224 (5.85)***
ACT Score	0.083 (2.73)***	0.057 (1.64)*
Took Remedial Math	-0.411 (-1.42)	-0.329 (-0.95)
Took Calculus	0.282 (1.70)	0.305 (1.63)*
Spring 2003	0.054 (0.25)	0.035 (0.13)
Fall 2003	-0.384 (-1.43)	-0.103 (-0.41)
Professor 2	-0.915 (-3.93)***	-0.953 (-3.41)***
Pretest Score	0.067 (3.52)***	--
Posttest Score	--	0.057 (3.59)***
Number of Observations	209	174
R-squared	0.2036	0.2006
Dependent Variable is Course Grade. Significance is indicated as * = 10%, ** = 5%, and *** = 1%. The comparison category for "University Class" is sophomores and the comparison category for "Semester" is Fall 2002.		

We find that students who were required to take remedial mathematics had slightly lower grades in introductory microeconomics. This is consistent with the findings of Ballard and Johnson (2004), though the remedial mathematics dummy variable is not significant in our regressions. Also as expected, we find that taking

calculus is positively related to performance in introductory microeconomics. This result is consistent with previous studies (e.g., Brown and Leidholm, 2002).

In the next series of regressions, we examine whether students can improve their performance in economics by improving their mathematics skills through on-line reviews. The results are reported in Table 4. As before, grade earned in microeconomics is our dependent variable. In columns 1 and 2, we simply include a binary dummy variable indicating whether a student was assigned to a mathematics treatment or control section. In columns 3 and 4, we look more closely at student performance on the mathematics pre- and posttests and their performance in introductory microeconomics. We include a student's pretest score as a control for initial mathematics ability and examine whether an improvement on the posttest score, compared to the pretest, is associated with a higher grade in introductory microeconomics.

Table 4: Regression Results

Variable	Regression 1	Regression 2	Regression 3	Regression 4
Female	0.109 (1.25)	0.121 (1.10)	-0.322 (-1.50)	-0.431 (-1.78)*
Minority	-0.203 (-1.03)	-0.293 (-1.19)	-0.824 (-2.04)**	-0.722 (-1.60)*
Freshmen	0.034 (0.23)	0.129 (0.68)	0.122 (0.41)	0.053 (0.16)
Junior	0.115 (1.03)	0.182 (1.29)	0.465 (1.73)*	0.430 (1.43)
Senior	-0.003 (-0.01)	-0.015 (-0.06)	-0.836 (-1.60)*	-0.971 (-1.72)
Other	0.398 (1.20)	0.576 (1.31)	0.137 (0.15)	0.524 (0.55)
Skip Class	-0.193 (-2.39)**	-0.231 (-2.28)**	-0.210 (-1.00)	-0.250 (-1.08)*
Study	0.003 (0.54)	0.006 (0.69)	-0.015 (-1.06)	0.003 (0.06)
Work	0.000 (0.02)	0.001 (0.20)	0.011 (1.23)	0.006 (0.67)
GPA	0.857 (9.18)***	1.239 (9.89)***	1.323 (5.56)***	1.425 (5.15)***
ACT Score	0.030 (2.04)**	0.054 (2.87)***	0.071 (1.85)*	0.003 (0.06)
Took Remedial Math	-0.088 (-0.59)	-0.122 (-0.65)	-0.823 (-1.96)**	-0.769 (-1.80)*
Took Calculus	0.210 (2.43)**	0.290 (2.66)***	0.411 (1.88)*	0.453 (1.79)*
Spring 2003	-0.061 (-0.44)	-0.064 (-0.37)	0.059 (0.21)	0.121 (0.42)
Fall 2003	-0.107 (-0.88)	-0.222 (-1.46)	-0.355 (-1.14)	-0.195 (-0.61)
Professor 2	-0.621(-5.59)***	-0.881(-6.15)***	-0.982(-3.14)***	--

Table 4: Regression Results

Variable	Regression 1	Regression 2	Regression 3	Regression 4
Treatment Group	0.206 (2.24)**	0.161 (1.39)	--	--
Pretest Score	--	--	0.119 (4.21)***	0.144 (4.14)***
Improvement	--	--	0.062 (3.08)***	0.092 (3.29)***
Constant	0.367(0.67)	--	--	--
Observations	445	445	136	111
R-squared	0.3829	0.1473	0.2439	0.2519

Dependent Variable is Course Grade. Significance is indicated as * = 10%, ** = 5%, and *** = 1%. The comparison category for "University Class" is sophomores and the comparison category for "Semester" is Fall 2002.

We consider two regression specifications, both with "grade" as the dependent variable. In regressions 1 and 2, reported in Table 4, we include a binary dummy variable to indicate whether a student was enrolled in a treatment or control section, and find that Ordinary Least Squares (OLS) and Ordered Probit techniques produce similar results. In all cases, we check a variety of interaction terms and nonlinearity specifications, but find that these have no significant impact on our regression. In addition, we also enter dummy variables for each individual treatment section, but find that these are also not statistically significant. GPA, ACT score, and Professor 2 remain the most significant explanatory variables, as we saw in Table 3. In the OLS analysis we find that on average, students in the treatment sections earned 0.20 of a grade point higher than students in the control sections (whereas the ordered probit approach finds them to have a higher probability of earning a better grade in the course). This result was significant in the OLS estimation, but not in the ordered probit regression, due to the higher specification requirements for probit estimation.

Perhaps more informative are the regressions that control for initial mathematics ability with the pretest score. The regression reported in Regression 3 of Table 4 examines whether student improvement from the mathematics pretest to the posttest is associated with better performance in introductory microeconomics, including the full sample of treatment sections. In the regression reported in the last column of Table 4, we examine the same question, but only looking at Professor 1's students, for whom the pre- and posttests were required. We define "difference" as the posttest score minus the pretest score. As in previous studies, GPA and ACT

score remain highly significant indicators of student performance in introductory economics. Students who had taken calculus did significantly better in economics and students who were required to take remedial mathematics did significantly worse, indicating again the importance of mathematics skills to introductory economics students.

Despite including the two variables for mathematics course background, we find both the pretest score and the difference in test scores are positively and highly significantly related to student performance in the class for the entire sample and the Professor 1 sub-sample. Controlling for initial mathematics skills, students of all levels find that improved mathematics skills are associated with the probability of earning higher grades. An examination of the tails of the distribution—those with poor and those with excellent initial mathematics skills—indicates that the benefits of the mathematics review accrue relatively evenly across all students.

In the economics education literature, there is some concern that women generally do worse in economics than men. It has been suggested that this is due in part to course content and grading policies and also because of the lack of female role models (Dynan and Rouse, 1997). Other studies identify that women have or perceive themselves to have weaker mathematics skills then men, and this negatively influences their course grade (Ballard and Johnson, 2005). We find women scored an average of 1.85 questions fewer correct on the mathematics pretest than men ($p < 0.001$), but that there was no statistically significant difference between the performance of men and women on the posttest. Women and men were equally likely to complete the pre- and posttests. Pair-wise comparisons indicate that women and men benefit equally from the mathematics reviews. Ultimately, we find little evidence that women performed worse in economics than men (see Regressions 1-3 in Table 4).

Thus, in general, we find that a student's gender is not statistically significantly related to course grade. However, if we include a measure of basic mathematics skills as a control by looking only at the improvement between pretest and posttest scores, women are predicted to earn higher grades. This is consistent with our earlier finding that women score more poorly than men on the pretest, but as well as men on the posttest. Thus, while the benefits to on-line remedial work seem to accrue generally to all students, there is perhaps some small additional benefit to women.

We also compare minority and non-minority students, but find that our sample of minority students is too small to draw any valid conclusions.

CONCLUSIONS AND RECOMMENDATIONS

In this paper, we document the connection between basic mathematics skills and performance in introductory microeconomics and examine whether on-line mathematics reviews can be used to improve student performance in the course. The mathematics reviews encompassed pre- and posttests, designed to measure student knowledge of five basic mathematical concepts frequently used in introductory microeconomics: solving linear equations, reading and understanding graphs, manipulating fractions and ratios, calculating area, and finding the slopes of lines. In addition, students had the option of completing tutorials and homework on each topic between the pre- and posttest. All review material was available on-line, though Aplia™

We find that basic mathematics skills, as identified by our mathematics pre- and posttests, are positively and significantly related to higher course grades. A more careful examination of these skills shows that review of basic mathematics concepts can improve student grades. Students enrolled in the treatment sections with access to the on-line review material earned statistically significantly higher grades in the course than students enrolled in the control sections. Further, we find that for each additional question answered correctly on the mathematics posttest, compared to the pretest, students have a higher probability of earning a better grade in the course, regardless of the initial pretest score. These results suggest that one way to improve student mastery of introductory economics concepts is to address their basic mathematics deficiencies.

Basic mathematics skills can make a difference. Our analysis suggests that quantitative skills are important even at the introductory level in economics, and that remedial mathematics work, done concurrently with taking the economics, can improve student mastery of basic economics concepts. The results also suggest that there are alternative ways to make effective use of informational technology, including out-of-class assignments and reviews. With the use of on-line reviews, the burden of completing remedial mathematics work can be placed on the students, instead of using valuable class time.

We thank Charles Ballard, Fred Blank, Scott Adams, Kevin McGee and Jim Grunloh for helpful comments, and thank our research assistant Lucas Jackson for his help. We would especially like to thank Paul Romer and the staff of Aplia™ for assistance with the experiment. Research was supported by a University of Wisconsin System Undergraduate Teaching and Learning Grant (UTLG), 2002-2003.

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MOTIVATING THE RELUCTANT, NOVICE LEARNER: PRINCIPLES OF MACROECONOMICS

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ABSTRACT

Most instructors recognize the correlation between student motivation and academic learning and achievement. This is supported by literature not only establishing the link, but also work that includes myriad strategies for affecting multiple aspects of motivation. As a result, instructors who may desire to improve student motivation in their courses, but are unclear about how to address this vague, but important concept can seek out indications of how they can begin. A specific model (ARCS) was developed by John Keller (1983) to help instructors operationalize the important elements of motivation so that they could improve the impact of their instruction. The ARCS model—by examining the motivational constructs of attention, relevance, confidence and satisfaction—provides a practical framework for faculty to design instruction that increases student motivational perceptions. This paper describes how the ARCS model can be used to design and improve instruction in the economics classroom. Strategies are presented for increasing student perceptions in four motivational constructs. Specific economics examples and instructional ideas are offered to give practical applications of the model. Finally, a Principles of Macroeconomics course redesign is described and evaluated in terms of increasing elements of interest consistent with motivational constructs.

INTRODUCTION

Every time college instructors walk into a required introductory level class, they face the unique challenge of motivating reluctant, novice learners. Meeting this challenge is important because most college instructors recognize there is a direct

correlation between motivation and academic learning and achievement. Certainly, the instructor has the goal of meeting learning objectives set, and if instructor enthusiasm for his/her chosen field were sufficient to motivate students, there would be no challenge. But motivating students requires more than an instructor's passion for the subject taught. So the authors have been faced with a series of questions: how does an instructor proceed in seeking to increase student motivation overall, how does this apply to introductory required courses generally, and how does this apply to introductory economics courses specifically? The authors suspected that a key factor in motivation was in demonstrating to the student why particular course content was important in that student's learning and life. They also believed that it was paramount that students believe they were capable of using/applying the material beyond the classroom setting for it to be meaningful. This led to further questions. Beyond intuition and dedication, is there a more systematic way of addressing student motivation in the authors' courses in particular and courses in general? Is there a practical way to address student motivation in designing and delivering instruction?

Fortunately, extensive work has been done in motivation of learning research. Exploration of the literature reveals a wide variety of factors to be considered by the instructor seeking to improve the motivation to learn, including those of particular concern to the authors: making material relevant to students, and helping students master application of the material. Based on the foundation of learning motivation literature, John Keller created a model for systematic inquiry into motivating students with particular attention to the authors' desired areas of inquiry. Keller (1983) developed the ARCS model to help instructors operationalize the important elements of motivation so that they could improve the motivational impact of their instruction. The ARCS model provides a practical framework for faculty to devise motivationally designed strategies to increase student effort toward instructional goals. This paper: 1) explores the literature regarding motivation and learning, 2) explores the potential use of the ARCS model to design and improve instruction in economics courses in general, and 3) applies the ARCS model to a Principles of Macroeconomics course redesign, targeting the relevance and confidence subscales.

MOTIVATION AND LEARNING

The link between motivation and learning has been studied extensively by psychologists. Kohn (1993) concluded that the research was quite clear that typical

extrinsic motivators such as rewards, praise, and grades were not effective in enhancing student learning. For example, one group of researchers in studying what factors helped third and fourth graders remember what they had been reading, "found that how interested the students were in the passage was *thirty times* more important than how 'readable' the passage was" (Kohn, emphasis his, 145). Others who have directed their study to learning and motivation emphasize the intrinsic factors of purpose, interest, relevance, and satisfaction in motivating the student to engage in learning opportunities and instructional programs (Wlodowski, 1986; Keller, 1983).

The importance of intrinsic motivation has been found in work settings, as well (e.g., Kohn, 1993). Herzberg's (1968) classic on motivating employees developed the idea of motivators and hygiene factors. Hygiene factors, according to Herzberg (1968) were things that often caused dissatisfaction but rarely were motivating in doing the work. These hygiene factors included things like relationships with supervisor, company policies, personal life, and salary, while motivators were more intrinsic, such as taking on responsibility, being in a position that allowed growth, being part of a winning team, and interest in the work itself.

At the college level, studies confirm the impact of intrinsic motivators on learning. Feldman's (1989) extensive study of the factors impacting both student perceptions of instruction and student learning found that in addition to course organization and presentational clarity, the most important factors for learning were relevance of subject, stimulation of interest, and encouragement of discussion with peers. In applying these findings, Harvey Brightman (2005) uses the hygiene metaphor to compare factors often associated with instruction and course development. That is, factors such as textbook selection, quality of exams, knowledge of subject, and grades have much less impact on student learning than the high impact factors, which include the three factors that relate closely to motivation (i.e., relevance, peer support, and stimulation). The point is not that these hygiene factors are unimportant, but that they are not motivators towards student learning. Interestingly, grades act much like salary does in the workplace in that both can cause negative attitudes—and must be attended to carefully—but have much less impact on creating motivation to do the work.

Although there is some sentiment reported about teachers believing it is not their job to motivate students (e.g., Gorham and Millette, 1997), many scholars support the notion that student motivation can be influenced by teachers (Wlodkowski, 1986; Brophy 1987; Porter and Brophy, 1988; Sherman et al., 1987; Gorham and Christophel, 1992; Keller (1987a and 1987b); and Small and Gluck,

1994). Wlodkowski (1986) claims that although teachers cannot directly motivate students because each is responsible for his or her own motivation, "we can make things attractive and stimulating. We can provide opportunities and incentives. We can allow for the development of competence and match student interest with learning activities" (Wlodkowski, 1986, 14). Wlodkowski (1986) specifies motivation to "describe those processes that can (a) arouse and instigate behavior; (b) give direction and purpose to behavior; (c) continue to allow behavior to persist; and (d) lead to choosing or preferring a particular behavior" (Wlodkowski, 12). Specifically with respect to learning Wlodkowski (1986) identifies "a sequential pattern of motivation" as

"Energy→Volition→Direction→Involvement→Completion." (Wlodkowski, 12)

The pattern focuses attention on the learner's interest and interaction with the subject and activity.

In fact, other scholars claim that it is not enough to simply teach students, "but also [attract] their attention and interest and stimulate them to activate information-processing strategies, sense-making strategies, and other cognitive and metacognitive components of learning for meaningful understanding" (Porter and Brophy, 1988, 75). Sherman et al. (1987) note that among the five primary characteristics common for excellent college instructors is that they are stimulating. Thus, there is strong evidence that instructors have some ability to influence student motivation towards learning.

So how does one motivate student learning? Studies as those cited above are not necessarily helpful for instructors to operationalize and apply. Wlodkowski (1986) provides one helpful framework for implementing motivational instruction. Specifically, he breaks down instruction into three periods (beginning, during, and ending), and identifying "two general motivational factors that serve as categories for strategies that can be applied with maximum impact during those periods or time. They are:

Beginning:	1.	*Attitude*—the student's attitude toward the general learning environment, teacher, subject matter, and self.
	2.	*Needs*—the basic needs within the student at the time of learning.
During:	1.	*Stimulation*—the stimulation process affecting the student via the learning experience.

2. *Affect*—the affective or emotional experience of the student while learning.

Ending:

1. *Competence*—the competence value for the student that is a result of the learning behavior.
2. *Reinforcement*—the reinforcement value attached to the learning experience for the student." *(Wlodkowski, 1986, 19)*

Combining this model with the identified critical factors cited by Feldman and other researchers, begins to show specific instruction can attend to the motivational needs of learners.

Brophy (1987) provides a five category framework, which includes over 30 strategies relevant to student motivation. One of the categories, "Stimulating student motivation to learn," speaks directly to creating interest by students; among the strategies for the category are:

- "Model interest in learning and motivation to learn"
- "Project enthusiasm"
- "Induce task interest of appreciation"
- "Induce curiosity of suspense"
- "Induce dissonance or cognitive conflict"
- "Make abstract content more personal, concrete, or familiar"
- "Induce students to generate their own motivation to learn"
- "State learning objectives and provide advance organizers"
- "Model task-related thinking and problem solving" (Brophy, 45)

Consistent with the instructional motivation literature is Keller's ARCS model (1983), which identifies four categories or constructs of motivating instruction. In explaining his model, Keller (1987a, 1) states, "The challenge of how to stimulate students' motivation to learn can be made more predictable and manageable by considering four basic human characteristics and the motivational dynamics associated with them". According to the ARCS Model, four general requirements need to "be met in order for people to be motivated to learn, and there are practical strategies to use in achieving each of the four requirements" (Keller 1987a, 1). These requirements—gaining attention, establishing relevance, building confidence, and achieving satisfaction—focus on intrinsic motivation goals. It is this model that is applied here, first to show economic examples for increasing student perceptions on four motivational constructs, and second to give specific

instructional ideas to show a practical application of the ARCS model in a Principles of Macroeconomics course.

THE ARCS MODEL

Keller (1983) developed the ARCS model as both a tool to design motivating instruction and as a framework from which motivational perceptions of students could be assessed. ARCS is an acronym identifying the four constructs to achieving motivation: attention, relevance, confidence, and satisfaction. Keller identifies specific motivational objectives related to these constructs that can be met in any instructional sequence (see Table 1). Thus, the ARCS model serves as a tool for instructors to make specific instructional interventions in terms of increasing student interest and motivation in the courses they teach. Specifically, this section of the paper will describe how college teachers in Economics can use the ARCS model to help them design—either at the first stages of a new course or as an intervention to an existing course—motivating and appealing instruction for their students.

Table 1 - Motivational Components and the Objectives Sought by Instruction*

ARCS Component	Instructional Objectives
Attention	Capture learner interest Stimulate curiosity Maintain learner attention
Relevance	Address learner needs Provide appropriate choices and responsibilities for learners Tie instruction to learner's experiences
Confidence	Build positive expectation for success Support students' beliefs in their competence Communicate that success is based on effort and ability
Satisfaction	Provide meaningful opportunities for learners to use their newly acquired skills. Reinforce learner successes Leave students with positive feeling for their success

* From Keller, 1987b

USING THE ARCS MODEL FOR COURSE DESIGN IN ECONOMICS

Motivation research suggests that an essential component of motivation is based on expectancy-value theory. "The expectancy x value theory of motivation implies that, in order to motivate their students to learn, teachers must both help them to appreciate the value of academic activities and make sure they can achieve success on these activities if they apply reasonable effort (Brophy, 1987, 41)." Based on this theory the ARCS model asserts that careful instructional design can influence and improve student perceptions of value and expectancy for success. Understanding each subscale and how it relates to student motivation is essential before designing instructional interventions to increase motivation.

This section of the paper 1) describes each subscale as it relates to the college classroom, 2) identifies primary instructional design or improvement questions to address when evaluating courses, 3) provides supporting strategies to address the design questions, and 4) provides a specific application example within an introductory economics course context.

Attention

The first ARCS subscale refers to capturing and sustaining student attention. Keller states, "In the learning process, a student's attention has to be directed to the appropriate cues, but before it can be directed, it has to be acquired. The motivational concern is for getting and sustaining attention. It is not usually too difficult to get attention, but sustaining it is often a challenge (Keller 1987a, 1)." In addition, the instruction should help stimulate an attitude of inquiry and generate interest in the particular topic and the subject in general.

Strategies

At the college level, students are responsible for engaging in the learning environment and remaining attentive. However, the instruction can enhance students' ability and willingness to focus attention on the learning outcomes. That is, the instructor can design and deliver instruction that captures and maintains student attention. Attention strategies include using incongruity and conflict in presenting issues, using engaging instructional materials in text or video format, incorporating problem solving activities, and providing students the opportunity to

select projects or topics that reflect their interests. The following table provides classroom design questions an instructor might consider when addressing the attention subscale and suggests possible supporting strategies related to the economics classroom.

Table 2 - Attention Subscale Design Questions and Supporting Strategies

Design Questions	Examples of Supporting Strategies
How can I stimulate an attitude of inquiry?	Use exercises, activities or questioning techniques that generate unanswered questions or increase curiosity about a topic.
What can I do to capture student attention for this topic or content area?	Create student curiosity by referencing current issues or events to introduce a topic.
Once I capture their attention, how can I maintain their interest?	Create connections by solving or helping students solve the unanswered questions generated about a topic. Vary styles and instructional methods. Allow student choice in selecting topics that interest them.

Economics Application Example

A structured student debate uses both current issues and varied instructional methods to address student attention in a course. Free trade can be a contentious issue in the classroom as students disagree about the whether short-run micro-economic costs outweigh long-run efficiency benefits. Adding to the disagreement are environmental, political, and human rights positions. Assigning student groups different stakeholder roles to represent and defend in class can provide a rich opportunity for students to evaluate many perspectives of a contentious issue. The key, of course, is that the group is tasked to represent a particular stake regardless of their own feelings or position on the issue.

Relevance

The relevance subscale refers to how important students view the subject matter being learned. In terms of expectancy theory, if students perceive the

material or exercises as relevant to their personal or educational needs, the level of effort expended will increase. Relevance answers the question, "Why or how is this material important to me?"

Strategies

Relevance can be present or future oriented. In an instructional setting, present-oriented relevance can be achieved by linking course content or concepts to the students' existing frame of reference. Relevance is achieved by a student understanding how the content or concept relates to his or her prior experiences or knowledge base. Future-oriented relevance is achieved by linking course content or concepts to the students' future goals. Using job-related examples in the classroom or posing situations likely to be faced in the future are methods to increase future-oriented relevance. Table 3 provides design questions and supporting strategies related to the relevance subscale.

Economics Application Example

Establishing relevance in required introductory economics courses is a challenge. Many, if not most students are planning to major in a discipline outside economics. At the sophomore level, prior education and job experiences are limited, and career goals may not yet be defined. Nevertheless, connections with the outside world to economic material can be made.

For example, an assignment for students may be to find a newspaper article relating to the concepts currently being discussed in class. The student may then be required to write a short essay on the economic concepts relied upon in the news article. This can be couched as "show me how this represents what we have covered in class" or "show me the relationship of this to what we have done in class." An article detailing how American businesses are increasing their exports of computer software implicitly draws upon the concepts of comparative advantage, specialization, exchange rates, and determinants of demand. By delineating these concepts, the student creates a connection between the classroom and other aspects of a student's life.

Table 3 - Relevance Subscale Design Questions and Supporting Strategies	
Design Questions	**Examples of Supporting Strategies**
What existing knowledge or experiences do students have related to the topic?	Survey students on the first day of class as to their prior courses, familiarity with economic concepts from media, job experiences and career goals.
How can I relate the topic to students' present knowledge or experiences?	Create intentional connections between experiences of *this* student group to the topic. The closer the connections, the greater the perceived relevance.
How can I relate the topic to students' future experiences or goals?	During class discussions or exercises, create situations in which students are responding as a consumer, an employee in their chosen field, or an employer.

Confidence

The confidence subscale measures the students' perception of their ability to successfully learn or perform the required concept or task. Experiences that are challenging enough to require thought and effort to succeed facilitate learning. Experiences that are *unnecessarily* vague or unstructured, or that are challenging to the degree of serious anxiety do not facilitate learning and are not motivating to students. High confidence leads to students maintaining effort associated with performing a task. Low confidence leads to blocks that prevent students from beginning or engaging in learning activities (Smith and Ragan, 1993).

Strategies

Designing classroom experiences that increase student confidence depends on the student level and course objectives. Logically, a sophomore introductory course with relatively unfamiliar material would lend itself to moderately challenging exercises that are clear and structured with early and frequent feedback. Advanced courses within the economics major would lend themselves to a higher level of uncertainty in the exercises or experiences, as well as a higher level of challenge. A successful instructor will read the classroom environment and make the adjustments necessary to challenge students to meet and exceed objectives, and

he or she will also recognize indicators of unnecessary anxiety that can lead to lower confidence and student efforts. Table 4 provides design questions and supporting strategies related to the confidence subscale.

Economics Application Example

Macroeconomic statistics such as inflation can seem confusing to the introductory economics student. Guiding the student through a process to calculate inflation which mirrors the government's can give students confidence not only in understanding this measurement but, also, in interpreting inflation data. Student groups may be required to establish a "market basket" of goods for the typical college student and then track the prices of these items for ten weeks. At the same time, students would gather national and regional data from news sources pertaining to inflation. After calculating the inflation rates for their market basket, students compare this to national and regional data. They then may account for the differences in the inflation rates in terms of the biases introduced into their and the government's measurement processes. Student confidence and expectations for success would be enhanced by clear instructions in terms of market basket formation, data collection, data manipulation, and data interpretation. This may include guidance from the instructor in terms of weighing the impact of promotions for products in the student's market basket as well as of the particular product mix and geographical limitations. This instructional intervention is more fully described and evaluated later in this paper.

Satisfaction

Satisfaction is achieved when students connect the achievement of learning goals with their individual effort. The connections can be made as the course progresses as well as when the course is completed. Satisfaction is also achieved when students are stimulated to maintain or increase efforts because of feelings of challenge or accomplishment.

Strategies

To connect learning goals with effort as the course progresses, students should be able to compare their performance with stated expectations and see how their efforts have led to achievement of course goals. Implicit in this subscale is an

element of equity. Students need to perceive that their efforts are being evaluated equitably as compared to the efforts of other students. At the end of the course, satisfaction can be enhanced when students see how they are now able to perform significant or comprehensive activities that they did not have the skills for at the beginning of the course. This summative confidence helps students feel a continued motivation to learn. If they are close to graduation, it can also help promote their transfer of new skills to their first professional work environment. To increase feelings of positive challenge or accomplishment, instructors can focus on personal attention, consistent feedback and the avoidance of negative comparisons. Table 5 provides design questions and supporting strategies related to the satisfaction subscale.

Table 4 - Confidence Subscale Design Questions and Supporting Strategies

Design Questions	Examples of Supporting Strategies
Do students fully understand my expectations and course requirements?	When assigning student projects or activities, give explicit guidance on the expected outcomes as well as how the activity will be evaluated. Let students know the likelihood of success given varying amounts of effort.
Did I consider student composition and course level when designing the classroom activities?	Evaluate classroom assignments in introductory versus advanced courses. Assess the level of instructor support required at each level. Evaluate whether your assignments are not challenging enough or too challenging for the course level.
Do I appropriately support students in unstructured activities so that they are challenged to achieve the objective, but are not overwhelmed by the activity?	If asking students to perform a novel or unfamiliar task or activity, model the expectations. Give enough guidance to remove unnecessary anxiety, but yet achieve challenging learning objectives.

Economics Application Example

In economics, it is difficult to consider giving up an hour of course content for summative exercises or reflection. However, part of the faculty role is to help students understand how the learning in a specific economics course relates to their overall understanding of the wider world. If classroom time simply cannot be sacrificed, consider assigning a short reflection paper in which students discuss what they learned in the class and how it relates to other choices they make, strategies businesses pursue, and policies the government implements.

Table 5 - Satisfaction Subscale Design Questions and Supporting Strategies

Design Questions	Examples of Supporting Strategies
Have I provided sufficient and appropriate opportunities for students to demonstrate their achievement of course objectives?	Review your course evaluation structure. Reflect on the quantity of exams, exercises and projects. Discuss course evaluation strategies with colleagues in your area.
Have I recognized student achievement in ways other than course grades?	Use verbal praise when appropriate. Recognize student achievement in front of others. Showcase quality student work in your classroom and office.
Have I considered a culminating exercise to help students understand how their course experience relates to other courses or their work environment?	Reserve all or part of the final class session for reflection and application exercises.
Are course requirements and policies applied consistently throughout the semester? Are exceptions rare and justified?	Review the syllabus to ensure that course policies are included and are presented clearly. Compare your course syllabus with those of other colleagues you respect to assure you have considered other class policies.

Instruction designed according to motivational factors can enhance learning outcomes. As students increase their expended amount and level of effort,

classroom objectives can be more easily met. Instructors interested in intentional improvement of their courses can design interventions to increase one or more of the motivational constructs in the ARCS model. When thoughtfully implemented, instructional activities often affect several motivational subscales. For example, a late-semester presentation could increase student perceptions of relevance, confidence and satisfaction. An analysis of current policy proposals could improve student attention, relevance and confidence. A thorough understanding of the subscales and strategies allows an instructor to design interventions that can potentially increase motivation in several areas. It is this possibility that led the authors to redesign and restructure a Principles of Macroeconomics course using the ARCS model.

REDESIGNING AND RESTRUCTURING PRINCIPLES OF MACROECONOMICS FOR INCREASED MOTIVATION

Procedure

Principles of Macroeconomics is an introductory, freshman/sophomore level course that serves three curricular purposes. First, it is a required, lower-division prerequisite course for students pursuing degrees in business. Also, it is a required course for students majoring in economics or economics/finance. Finally, it fulfills a core requirement of the university in the scientific-relational mode of inquiry. By far the largest numbers of students are in the course requisite to their business degrees, followed by those fulfilling course requirements, and finally by those pursuing majors in economics. Thus, the students are young, and are enrolled in the course not because of their interest in the subject matter, but because it is something they simply must take. In addition, most students have not had previous economics courses. The challenge to the instructor within such a context is to motivate students to learn the subject matter, see the relevance of the course material, and gain confidence in interpreting and applying the material outside the classroom.

The Course

The challenge presented by Principles of Macroeconomics lies not only in its being an introductory and required course, but also in the perceived difficulty of the subject matter. Although students are likely to have been exposed to some of the

relevant terminology through newspapers and news broadcasts, few have a good (if even accurate) understanding of this terminology, and even fewer have been exposed at a deeper level. The course involves a great deal of abstract conceptualization in building, applying, and interpreting economic models. Furthermore, making the connection to the real world can be challenging for some.

Initially, this course was delivered in a lecture/discussion format with the prime disseminator of information being the instructor. Although students were asked to make connections between course material during the lectures and discussions, and they completed simple application assignments dealing with real world events and developments, the content material flowed from the instructor to the student in a traditional manner.

Instructional Interventions

The introductory macroeconomics course was restructured to enhance the relevance and confidence elements in the ARCS model. This restructuring included a regrouping of the course material into four sections more recognizable to students with little or no exposure to economics. These were: *Our economy*, *Modeling the Macroeconomy*, *Problems in our Macroeconomy*, and *Policies to Change the Macroeconomy*. This increased the number of exams from three to four.

Further, three news assignments specifically geared to the first, second, and fourth sections of the course were assigned. These topics not only tied into the particular section of the course but also helped the students make connections between the classroom and the wider world by examining current and relevant topics. These topics were general information on the current economy, international trade issues, and current policy proposals. Students were required to trace the connections to class material in written form to turn into the instructor, as well as orally present their work to the class. The written work was graded, but the oral presentation provided for immediate feedback on the topic and its relationship to the class, how the student performed, allowed for ungraded practice of oral presentation skills, and broadly exposed the entire class to real world connections.

Two additional projects—one on inflation and one on unemployment—were designed to relate to the third section of the course. Economics relies heavily on the gathering of data and its analysis to reinforce or repudiate proposed models and policies for the economy. What the students learn from class is based on this scientific approach. To help the students understand not only the process through which the material they study came to be, but also the processes of data gathering

and analysis, student groups were required to gather and track relevant data on prices and unemployment. Students worked with this data on two levels. First, students established their own "market basket" of goods for the typical college student and then followed the prices of these items for eight to ten weeks for the inflation project. For the unemployment project, students surveyed their class to gather relevant employment data. At this point all economists are crying "bias" in the processes of and pools for data collection, but these inherent biases were intentionally built into the project. Part of the assignment, to be elaborated upon below, requires the students to critically assess biases in their projects.

In the second phase of these projects, students gathered national and regional data from news sources pertaining to inflation and unemployment. Using the data gathered, students then analyzed the data to determine the inflation rate for their group and the unemployment and underemployment rates for the class. They then compared these to to national and regional data and in paper form evaluated the strengths and weaknesses of the process for the evaluation of these economic problems, accounted for the differences in their statistic and those gathered for the macroeconomy, and critically evaluated the biases which result from such calculations whether their own or those for official rates.

The last phase of the projects involved a restructuring of the final exam. Previously, the final exam had taken the form of an oral presentation. Student groups were assigned a chapter covered during the course of the semester and were required to prepare a presentation for the final that did not summarize or teach the information, but rather drew further connections between the class material and the current economic situation. To re-focus this assignment and make it even more relevant and clearly structured, the subject matter was changed. Each group selected current policies being proposed or implemented on the national level with respect to either inflation or unemployment. The group was then responsible for researching the policies, evaluating the policies using their research and models developed in class, and interpreting the possible outcomes of the policies in terms of what they were intended to accomplish and what they might actually accomplish. This format was selected over a traditional final exam because it would give students the opportunity to more firmly establish in their minds the relevance of the material studied as well as give them confidence in applying the material even after finishing the course.

Evaluation of Course Modifications

The primary interest in this course revision was student motivation, especially, in terms of student perceptions of course relevancy and their own confidence to successfully complete assignments. Two evaluation measures were used to this end, the IDEA student survey, and student ratings of the effectiveness of two new classroom assignments. The purpose of this course modification was not to attempt an empirical study of increased motivation. Class sizes at the authors' university makes empirical educational studies difficult. The authors do attempt, however, to show how faculty members can use existing course survey instruments and simple targeted questions to gauge the effectiveness of course modifications and assignments.

The IDEA student survey, developed by Hoyt and Cashin (1977), is a goal-based survey form where students rate the relative effectiveness of twenty teaching and learning elements. Among these elements are several items that help reveal student perceptions of motivation. Relevant IDEA items include:

- Promoted Teacher Student Discussion
- Helped Students Answer own Questions
- Encouraged Students to Express Themselves
- Demonstrated the Significance of the Subject
- Related Material to Real Life Situations
- Stimulated Students to High Intellectual Effort
- Introduced Stimulating Ideas About the Subject

Student ratings generally reflect teacher characteristics such as organization, approach, and personality. However, the IDEA norms each of the items against similar courses. Because similar courses are based on the factors of class size and student motivation, the IDEA provides some comparative data with other courses sharing the class size and student motivation challenges of introductory macroeconomics.

Results

Design changes to the Principles of Macroeconomics course were aimed at improving students' perceptions of course relevancy and their own confidence in completing difficult content material. The results from the IDEA student survey,

administered the first semester of restructuring, support the notion that the Principles of Macroeconomics course tended to make the content relevant and maintain student confidence. All the items are normed against the large IDEA data base of similar courses. On all items cited in Table 6, both sections of the course were rated above the mean for similar courses and in all but two cases were given a 'high' relative frequency. These results might be tied to the teacher characteristics rather than the course design, nevertheless, the results do show students feeling more confident and seeing more relevance than in similar type courses.

Table 6 – Means of Student Responses to Selected Items on the IDEA Student Survey

	1st Implementation of Course Redesign					
	Section 1: N=32			Section 2: N=28		
IDEA Item	**Mean**	**Diff. Similar courses**	**Relative Frequency**	**Mean**	**Diff. Similar courses**	**Relative Frequency**
Promoted Teacher Student Discussion	4.0	+0.5	High	4.1	+0.7	High
Helped Students Answer Own Questions	3.3	+0.1	Medium	3.7	+0.4	High
Encouraged Students to Express Themselves	4.1	+0.5	High	4.0	+0.3	High
Demonstrated the Significance of the Subject	4.2	+0.4	High	4.0	+0.2	Medium
Related Material to Real Life Situations	4.2	+0.4	High	4.4	+0.6	High
Stimulated Students to High Intellectual Efforts	3.3	+0.3	High	3.5	+0.5	High
Introduced Stimulating Ideas About the Subject	3.5	+0.3	High	3.5	+0.3	High

Note: All items rated on a 5-point Likert Scale (1=Hardly ever; 5=Almost Always)

The authors also asked students to rate the effectiveness of the two primary instructional interventions for the course, news assignments and the group inflation and unemployment projects. Students rated on a 3-point scale (1-not useful, 2=somewhat useful, 3=very useful). Table 7 reveals that most students found the assignments at least somewhat useful, and that the assignments were perceived more favorably among students the second semester using the restructured course. In addition, there was little variance between sections in the same semester with the percentage breakdowns being very similar when each iteration was disaggregated by section.

Table 7 – Student Ratings of the Effectiveness of Two Classroom Assignments

	1st Implementation of Course Redesign			2nd Implementation of Course Redesign		
Instructional Assignment	**Not Useful (%)**	**Somewhat Useful (%)**	**Very Useful (%)**	**Not Useful (%)**	**Somewhat Useful (%)**	**Very Useful (%)**
News Assignments	10	50	40	4	31	66
Inflation & Unemployment	12	45	43	13	25	62

Table 8 – Number of Students Taking First Economics Course

Semester	**First Economics Course**		**Economics Course Taken Before**	
Traditional Design	25	78%	7	22%
1st Implementation of Course Redesign*	43	72%	17	28%
2nd Implementation of Course Redesign*	38	70%	16	30%

**Represents combined total of two classes*

As part of the business core curriculum, students are also required to take Principles of Microeconomics. Because it is possible students' prior experience

with the content will affect motivation, students in the macroeconomics classes were asked if this was the first economics course they had taken. The results (table 8) show that at least 70% of students in each semester were taking their first economics course.

DISCUSSION

The increase in student ratings of the effectiveness of the assignments might, the authors speculate, be attributed to two factors. First, the original course design in terms of presentation and assessment was familiar to both the instructor and students. Because a majority of students in all the treatments were taking their first economics course it cannot be asserted that the new structure caused an adjustment of student expectations. The new course design, however, did require students to take a more active role in learning than might be typical in previous courses. For the instructor, the changes in the new course resulted in expected glitches in implementation of the course. A second possible reason for the initial indication of effectiveness being lower than in the second implementation involved the grouping of students. In an attempt to improve the functioning and diversity across groups, the instructor grouped students based on GPA. Citing differences in learning styles, differences in schedules, and differences in effort, many students expressed dissatisfaction with the group process as revealed in peer evaluations of group projects. Students overwhelmingly requested that groups be self-selected; thus the instructor implemented this approach the following semester. The subsequent increase in scores may then be attributed to experience gained from having offered the course before and from allowing students to select their own groups.

The results of the study may indicate a need to further develop the course in the area of group processes. While studies have confirmed cooperative leaning methods to be effective for learning and in motivating students (Johnson and Johnson, 1989; Qin et al., 1995; Michaelsen, 1992), it has also been found that students must be actively taught group process strategies and techniques (Cottell, 1993; Feichtner and Davis, 1992; Michaelsen, 1992; Ravenscroft et al., 1995). In addition, many young college students have not had many productive experiences with group work (Feichtner and Davis, 1992). Although group work was a significant part of the course changes, little if no class time was spent developing group process skills, indicating a potential need for this support.

During the second semester of the new course design, the instructor also noted less need to lower the curve for exam grades. Furthermore, students on the whole seemed to perform better than the previous offerings of the course. In fact, the instructor was especially pleased by the outcome of the inflation and unemployment projects because of the quality of analysis displayed in the final reports. Thus, the active learning methods features in the course redesign may have reflected learning gains not otherwise revealed.

CONCLUSION

Motivating reluctant, novice learners is a challenge faced by all faculty members teaching introductory, required courses. Understanding the constructs of motivation and the instructional strategies to help increase student motivation is essential. The ARCS model provides faculty members a concrete, understandable method from which to design and build course modifications or interventions.

This paper has attempted to summarize the important literature on student motivation, describe a specific model for attending to student motivation, and provide an example of a course that was modified to increase perceived relevance and confidence. The process described is a positive example of scholarly teaching – teaching modifications that are informed by existing, relevant research, implemented and then thoughtfully and intentionally evaluated for continuous improvement.

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A RESPONSE OF HIGH SCHOOL TEACHERS TO THE ADOPTION OF STATE ECONOMIC STANDARDS

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ABSTRACT

This paper addresses the recent adoption of economics standards in the state of Indiana. The analysis is based on responses to a survey instrument that was designed to obtain information about the demographic profile of high school economics teachers, their coverage of topic areas included in the economics standards, and the critical challenges they face as high school economics teachers. We find that while virtually all teachers in our sample deviate from the standards, the magnitude of the deviation is small, and occurs in a predictable way. Most teachers appear to spend slightly less time on microeconomics (43.2% versus the mandated 50%) and international economics concepts (9.1% versus the mandated 12%) in favor of additional personal finance topic (19% versus 10%). As a result, the standards appear to be moderately successful in achieving its intended goal of creating convergence in content coverage in high school economics curricula.

INTRODUCTION

Two evident empirical trends in high school economics education are: the higher proportion of high school students who take an economics course and the substantial increase in the number of states that have adopted economics standards for inclusion in the high school curriculum. Between 1961 and 1994, the percent of high school students taking an economics course rose from 16 percent to 44 percent (Walstad, 1992; Walstad and Rebeck, 2000). The number of states that have adopted economics standards either voluntarily or as a result of mandates increased from 38 to 48 between 1997 and 2002 (NCEE, 2003). Moreover, between 1982 and 2002, the number of states that required that some type of economics course be offered in high schools increased from 7 to 17. Notwithstanding these trends,

assessments of the performance of students and adults in economic literacy indicate significant deficiencies in knowledge about economic concepts and current issues (Walstad and Soper, 1988). Unsatisfactory results in economic literacy raise many questions including issues surrounding the impact of economics standards on economic literacy.

Assuming that the standards are appropriate, one reason this discrepancy might occur is because high school teachers fail to follow the standards. Due to time constraints, perceived student interest, or other factors, teachers may deviate from the recommended amount of time spent on "core economic concepts", thereby reducing the economic literacy of their students. The Indiana standards, established in 2001, are based on the National Council on Economic Education (NCEE) national voluntary economic standards published in 1997. As such, Indiana provides an interesting case study (which may be applicable to other states) to determine whether or not high school teachers are, in fact adhering to these standards.

This paper addresses the recent adoption of economics standards in the state of Indiana. Our maintained hypothesis is that on average, teachers are adhering to the state standards. Analysis of our hypothesis is based on responses to a survey instrument that was designed to obtain information about the demographic profile of high school economics teachers, their coverage of the topic areas included in the economics standards and the critical challenges they face as high school economics teachers. While our study is not intended to provide conclusive evidence about the connection between the adoption of economics standards and student learning outcomes, it does provide a foundation for future research in this area. For example, if we fail to reject the null hypothesis, then the aggregate allocation of time spent on each content area of economics should not impact student literacy (assuming that the standards are appropriate) as teachers are adhering to the standards. As such, future research should investigate how content allocation *within each mandated area* impacts economic literacy. Alternatively, if we reject our null hypothesis, then future research specifically needs to address the magnitude of the tradeoff between aggregate content coverage and learning outcomes.

Analysis of the survey responses indicated that on average; about 43 percent of class time is spent teaching microeconomic topics. About 28 percent of class time is spent on teaching macroeconomic concepts, 9 percent of class time is spent on international concepts, while 19.5 percent is allotted to personal finance concepts. Virtually all teachers in our sample deviate from one or more of these guidelines; however, the actual magnitude of the deviation is small, and in most cases insignificant. On average, most teachers spend slightly less than the mandated

amount of time on microeconomics and international economics in favor for additional time for personal finance content. Additionally, we find no (jointly) significant differences in content coverage by instructor characteristics such as time constraints, perceived student interest, gender, teaching experience, and degree earned.

The next section provides background information on the adoption of economics content standards in Indiana. This is followed by a discussion of the data collection process and the demographic profile of the sample of high school teachers. The remaining sections provide our empirical methodology, our results, and concluding remarks.

ECONOMIC CONTENT STANDARDS

In 1993, the National Council on Economic Education updated its publication, *A Framework for Teaching the Basic Concepts* first published in 1977. The basic content concepts were subdivided into four categories: Fundamental Economic Concepts, Microeconomic Concepts, Macroeconomic Concepts, and International Economic Concepts. The Fundamental concepts were to be introduced at the K-4 grade levels, if they were not introduced then, then at the 5-8 grade levels, the Fundamental Concepts could be either introduced or re-taught along with the introduction of Micro- and Macro-economic topics. If none of the aforementioned topics were taught at the K-8 grade level, then at the 9-12 grade levels, those concepts would be reintroduced and or presented for the first time along with the International Concept area.

In 1997, the National Council on Economic Education in partnership with the National Association of Economic Educators and the National Foundation for Teaching Economics produced new standards for economics entitled, *The Voluntary National Content Standards in Economics.* These standards replaced the 1993 *Framework* and introduced 20 content standards along with benchmarks on attainment levels for students in grades 4, 8, and 12.

The adoption of economic content standards in Indiana represented the culmination of efforts that began in Fall 1998 with meetings involving teachers from elementary, secondary, and post-secondary institutions, state department of education specialists, and legislature personnel. These meetings focused on development of standards for English, math, science, and social studies for Elementary, Middle School, and High School grade levels. The social studies component consisted of standards for World History and Civilization, World

Geography, U.S. History, U.S. Government, Psychology, Sociology, and Economics. The foundation for the Economics standards was taken from the National Council on Economic Education's National Voluntary Standards published in 1997. The members of the Indiana's Education Roundtable for Economics took the 20 standards that were developed by the National Council and collapsed those standards into eight standards: Scarcity and Economic Reasoning, Supply and Demand, Market Structure, the Role of the Government, National Economic Performance, Money and the Role of Financial Institutions, Economic Stabilization, and Trade.

Within each standard, student achievement benchmarks were identified. In the final phase, recommendations from representatives of the financial sector led to the inclusion of personal finance[1] benchmarks in six of the eight standards. These standards and benchmarks were recommended by Indiana's Education Roundtable and adopted by the State Board of Education in 2001. Based on the benchmarks listed under the eight content standards for Indiana, the expected allocation of content coverage is 50 percent for Microeconomics, 28 percent for Macroeconomics, 12 percent for International economics concepts, and 10 percent for Personal Finance topics.

DATA COLLECTION

Using a list of both public and private high schools provided by the Indiana Department of Education (IDOE, 430 surveys -- 394 to public high school teachers and 36 to private high school teachers) were mailed in October 2003 to individuals designated by the IDOE as economics instructors. The survey instrument sought to obtain information on content coverage in the areas of Microeconomics, Macroeconomics, International Economics and Personal Finance. Teachers were asked to determine the number of class periods that they spent on each content area. The participants had the option of stating that their school corporation used either a "standard" 50 minute class periods or "block scheduling" of 90 minutes. If participants indicated that they used "block scheduling" we determined that one class in "block scheduling" equated to two classes for standard classes. The class periods were then added to determine the total amount of time that was spend on all issues. The amount of time within each topic area was divided by the total amount of time spent on all issues to determine the proportion of time allocated to each topic area. In addition, the survey asked respondents to report demographic information, educational attainment, areas of educational interest, economic subjects enrolled in

at undergraduate and graduate levels, teaching materials used, the amount of time spent in economic content areas, and two open ended questions areas; one consisting of their thoughts on changes that have occurred during the past 10 years in economics, the other challenges that they, as teachers, face in economics education.

Teachers were asked to complete and return the questionnaire within a two-week time frame. A self-addressed, stamped envelope was also included with the questionnaire. After two-weeks, a follow-up letter, questionnaire, and self-addressed envelope were sent to those teachers who had not responded. Of the 430 potential recipients, 103 individuals returned the questionnaire to the researchers, with 100 deemed useable. Three questionnaires were not used because those teachers did not include information about the length of time they spent on economic content areas. These teachers were contacted by telephone and were asked to reply to the teaching content area either via email, telephone interview, or completing another mailed questionnaire. None of the three individuals responded. That made a useable response rate of 23.3 percent.

TEACHER DEMOGRAPHICS

The data set contains information on 100 economics teachers from 97 public and 3 private high schools in Indiana. Table 1 gives the names and definitions for the primary variables uses in our analysis, while Table 2 provides a profile of the sample of the teachers. Table 3 provides additional summary statistics for the variables used in the empirical analysis.

Table 1: Variable Names and Description

Variable Name	Description
AGE	Age of teacher in years
TEXP	Years of teaching experience
ECEXP	Years teaching experience in economics
UNEC	Hours of undergraduate economics courses
GREC	Hours of graduate economics courses
PMICRO	Percentage of class periods spent on microeconomic topics
PMACRO	Percentage of class periods spent on macroeconomic topics
PINTER	Percentage of class periods spent on international topics

Table 1: Variable Names and Description	
Variable Name	Description
PPERF	Percentage of class periods spent on personal finance topics
GAP	Difference between actual allocation of class periods and allocation prescribed by state content standard
GENDER	1 if male
ECMAJ	1 if teacher undergraduate major is economics
INSERV	1 if teacher attended a program/workshop sponsored by the Indiana Council on Economic Education or a local Center for Economic Education
GRTR	1 if teacher completed a masters degree
NOTIME	1 if teacher indicated that time to meet standards/cover material is a major challenge
CORE 40	1 if respondent teaches a college prep economics class
STMOT	1 if a lack of student interest in economics is a primary challenge for teacher
ETEACH	Number of economics courses presently being taught

The average age of economics teachers is 46.6 years and they have been teaching economics for 12.9 years. Every teacher holds an undergraduate degree and 82 percent have a masters' degree. Only 6 percent of the sample majored in economics, 65 percent in social studies. Of those holding undergraduate degrees, 72 percent of the teachers received their degree before 1984. This is significant because prior to 1984, teachers only needed six hours of economic undergraduate course work in order to be certified to teach economics by the Indiana Standards Board (Indiana State Board of Education, 169 and 1984). (Even though only 6 hours of economics courses were required prior to 1984, the vast majority of teachers in our sample – 70 percent – earned more than 6 hours of economic credit. In fact 55 percent of the sample actually earned 12 or more credit hours in economics. Of the teachers who hold a Masters' degree 85 percent have that degree in Secondary Education with 44 percent emphasizing social studies, and 36 percent emphasizing economics. At the undergraduate level 95 percent and 93 percent of

the teachers responding stated that they had a course in either Microeconomics or Macroeconomics respectively; the primary courses taken at the graduate level were Advanced Microeconomics and Advanced Macroeconomics (16 percent). Along with the teaching of economics, 42 percent teach government and 37 percent teach U.S. history. The results of the questionnaire also reveal that 65 percent of the teachers teach "academic or Core 40" economics, 42 percent teach an "applied" economics course, 13 percent teach "A.P. economics" and less than 1 percent teaches "global economics."

Table 2: Teacher Demographics

Description	Percentage
Gender	
Male	75%
Female	25%
Age Distribution	
24 – 29	5%
30 – 39	17%
40 – 49	34%
50 – 59	38%
50 – 69	6%
Experience: Number of Years Teaching	
1 – 9	23%
10 – 19	16%
20 – 29	33%
30 – 39	24 %
40 – 49	4%
Experience: Number of Years Teaching Economics	
1 – 9	46%
10 – 19	28%
20 – 29	14%

Table 2: Teacher Demographics	
Description	Percentage
30 – 39	11%
40 – 49	1%
Undergraduate Degree	
B.A. or B.S.	100%
Year of Undergraduate Degree	
Before 1984	72%
After 1984	28%
Undergraduate Major	
Social Studies	63%
Business Ed.	14%
Economics	6%
Other	17%
Social Studies Supporting Area	
History	72%
Economics	72%
Government	59%
Western Civ.	37%
Sec. Social Studies 28%	
Geography	28%
Psychology	19%
Other	13%
Graduate Degree	
Master's Degree	82%
No Graduate Degree18%	
Year of Graduate Degree	
Before 1984	61%
After 1984	39%

Table 2: Teacher Demographics	
Description	Percentage
Graduate Major	
Secondary Ed.	69%
School Admin.	4%
Other	27%
Graduate Major: Percent with Emphasis Area	
Social Studies	44%
History	37%
Economics	36%
Government	20%
Business Ed.	17%
Sociology	15%
Psychology	12%
Political Science	11%
Geography	8%
Other	8%

A brief comparison of the survey results with the findings from a previous survey of high school economics teachers (Valentine and Quddus, 1998) indicated a number of changes. Since 1998 there has been a decrease of four percentage points from 79 percent to 75 percent in the number of males and a corresponding increase in percentage points of females teaching economics. The average age of the teachers increased by two years and the average number of years teaching and the average number of years teaching economics both rose by one year. The number of teachers who obtained their undergraduate degree prior to 1984 has increased six percentage points from 66 to 72 percent, while those holding an undergraduate degree in social studies declined from 84 percent to 62 percent. Those teachers possessing a Masters' degree decreased by one percentage point to 82 percent, however, those that had obtained their Masters' degree prior to 1984 increased seven percentage points. Of those holding Masters' degrees, there was an increase of 52 percentage points within the secondary education area and an increase of 17

percentage points within the social studies emphasis area. In addition, there was a decrease of 10 percentage points from 46 percent to 36 percent of those teachers who have a secondary education major with an economics emphasis.

EMPIRICAL METHODOLOGY

Our study operates under the null hypothesis of no difference between the proportion of (and mean/median) time suggested in the State mandates and those reported by the teachers in our data set. From a managerial perspective, we tentatively assume that the teachers in our sample are complying with the State standards. We utilize five basic measure of compliance. The first four are the proportions of time teachers report spending on the four core competency areas (microeconomic, macroeconomics, international economics and personal finance) treated individually. A fifth measure (defined as GAP) is constructed to measure divergence from the State standards based on each of the five measures taken jointly. This measure is constructed as the sum of the absolute deviations between the reported proportions and those suggested State standards. Thus, the larger the gap measure, the larger the disparity between the actual reported proportions and those proposed under the standards.

Table 3 reports summary statistics for our five measures of compliance. On average, about 43 percent of class time is spent teaching microeconomic concepts. About 28 percent of class time is spent teaching macroeconomic concepts, 9 percent is spent on international concepts, while 19.5 percent is allocated to personal finance concepts. The overall gap measure (GAP) has an average value of .336, which indicated that there is misalignment between teaching practice and the content standards.

Table 3 :Summary of Statistics for Variables used in the Analysis

Variable	Mean	Median	Std. Deviation
PMICRO	0.432	0.422	0.103
PMACRO	0.282	0.288	0.098
PINTER	0.091	0.091	0.046
PPERF	0.195	0.179	0.137
GAP	0.336	0.283	0.207
AGE	46.580 47.5	9.971	

Table 3 :Summary of Statistics for Variables used in the Analysis			
Variable	Mean	Median	Std. Deviation
GENDER	0.075	1	0.435
TEXP	20.900	22	11.456
ECEXP	12.910	10	9.874
ECMAJ	0.060	0	0.239
CORE 40	0.650	1	0.479
UNEC	11.970	12	6.389
GREC	3.020	0	4.662
NCEE	0.390	0	0.490
JA	0.400	0	0.492
ICEE	0.520	1	0.502
NOTIME	0.380	0	0.488
STMOT	0.320	0	0.469
ETEACH	1.220	1	0.462
PETEACH	0.639	0.667	0.293
INSERV	0.650	1	0.479
UNECDV	0.550	1	0.500
TEXPDV	0.640	1	0.482
PCTDV	0.600	1	0.492
SMALL	0.210	0	0.409
MID-SIZE	0.320	0	0.469
LARGE	0.230	0	0.423
EXTRA-LARGE	0.240	0	0.429
Number of Observations	100		

We formally test our null hypothesis using a stepwise approach. First, we conduct a series of simple hypothesis tests to determine whether the reported

proportions are (individually significantly different from the State mandated values. We also conduct a simple hypothesis test to determine whether the GAP mean is significantly greater than zero. Rejecting the latter indicates that respondents are not (on average) complying with the mandates jointly. Additionally, we conduct these simple hypothesis tests using the (nonparametric) sign test to determine whether teachers are complying with the mandates on the median, as well as the mean.

A drawback to these simple tests is that they do not control for other (we assume exogenous) factors that might impact whether or not teachers are complying with the state mandates. To the extent that our survey allows, we examine this possibility by conducting a series of additional tests. First, we create a series of cross-tabulations (with corresponding chi-square tests of independence) to determine whether these factors individually impact our four proportional measures. Because cross-tabulations require discrete data, we decompose each of our four proportional measures into two categories; those teachers who report that the proportion of time meets or exceeds State standards, and those whose proportion falls short of the standards.[2] For the GAP variable (which cannot easily be decomposed into discrete classifications) we utilize one-way (nonparametric) ANOVA to conduct a similar series of tests.

Lastly, we utilize regression techniques to determine whether these exogenous factors jointly impact compliance (or non-compliance).[3] Because none of our five compliance measures are likely to meet the criteria for consistent estimations via ordinary least square (OLS), we choose to utilize limited dependent variable techniques. For each of our four proportional measures, we employ a binary logit model, where the dependent variable of interest takes a value if one if the reported proportion meets or exceeds State guidelines and a zero otherwise.

Transforming the GAP variable is more problematic, because it is less easily categorized into discrete classifications. As before, we choose an approach that is both parsimonious and consistent with our prior analysis. Specifically, we sort the data from smallest to largest and create a series of binary variables that distinguish the observations based on quartiles. Each dummy variable gives a value of one if an observation falls into a particular quartile and zero otherwise. Since a higher value for GAP implies more extreme divergence from the standards, those observations in the first quartile are relatively close to full compliance, while those in the fourth quartile are not close to compliance.[4] Each of these dummy variables can be used as the dependent variable in a binary logit regression to determine whether the exogenous factors significantly and jointly impact compliance. Finally, we create a stepwise variable (or ordered ranking variable) that combines these four

dummy variables into a single, discrete variable. This metric gives a value of zero if an observation for GAP is in the first quartile, a value of one if it falls in the second quartile, and so on. This allows us to combine the information from the previous four regressions into a single equation, which can be estimated with an ordered logit model.

Our interpretation of these regression analyses is twofold. First, by examining the chi-square tests for model significance (where the null hypothesis is that the regression does not provide any additional information than the basic descriptive statistics and hypothesis tests); we can determine whether controlling for these exogenous factors jointly influence compliance. If we fail to reject the test for model significance, then the results presented in the simple hypothesis test can be interpreted as robust, even when controlling for these exogenous characteristics. Secondly, if we reject this hypothesis, we can examine the signs and significance of the coefficient estimates to determine which factors significantly influence compliance, holding the other regressors constant.

All regression equations utilize the same set of independent variables, which represent various teacher (and school) attributes and perceptions that have been identified as important influences on student achievement in the economics education literature. These include: CORE 40, NCEE, JA, ICEE, UNEC, NOTIME, STMOT, GENDER, TEXP, PCTDV, INSERV, SMALL, LARGE, and EXTRA-LARGE. The rationale(s) for including each independent variable are as follows. Teachers responsible for teaching college preparation economics class (CORE 40) are presumed to be more familiar with guidelines for topic coverage. Use of the National Council on Economic Education (NCEE), Junior Achievement (JA), and/or Indiana Council on Economic Education (ICEE) materials serve as another indication of the awareness of relevant information pertaining to economics content standards.

Undergraduate training in economics (UNEC) is expected to influence compliance since a greater awareness of content standards is likely to lead to a smaller gap between classroom instruction and the expected allocation implied by content standards. Teachers indicating time management issues (NOTIME) related to the implementation of content standards can be expected to be more sensitive to over or under-coverage of topics listed in the content standards. The importance of student effort and interest in economics has also been identified as a key determinant of the learning process, since student motivation can serve to undermine the learning process. Thus, perceived challenges in motivating students (STMOT) may

adversely affect the alignment of topic coverage with prescribed coverage in the content standards.

The experience of teachers, both overall and in economics instruction (TEXP and PCTDV) is predicted to have a favorable impact in adjusting to economics content standards, as should attending a workshop provided by one of the councils on economic education (INSERV). We have no priori expectations about the relationship between content coverage and gender or school size.

EMPIRICAL RESULTS

The results for the simple hypothesis test are contained in Table 4. Mean values indicate that teachers spend slightly less time teaching micro and international topics relative to the standards, and slightly more time teaching macro and personal finance topics. Analysis of the parametric tests indicates that the (mean) proportions of time spent teaching microeconomics, macroeconomics, and international economics topics are not statistically different from the State standards. However, the proportion of time spent teaching personal finance is significantly different (and above) the standard. The GAP variable is also significantly greater than zero at 95 percent confidence or better. These results imply that, at the mean, teachers are "shaving" the proportion of time spent teaching economics, particularly micro and international economics (such that they do not deviate too far from the standards), and re-allocating that time to personal finance topics.

The nonparametric tests presented in Table 4 not only reinforce the results of the parametric tests, but also do so with a higher degree of statistical significance. Approximately 80 percent of the teachers in the sample spend less time (relative to the State standards) teaching microeconomic and 74 percent spend less time on international economics. Conversely, this time is spent teaching personal finance. Moreover, as evidenced by the GAP variable, every teacher in the sample deviates from the standards to some extent. A plausible interpretation of the results is that while virtually all teachers in the sample deviate from the standards, they do so in a predictable fashion. Additionally, when they do deviate, they are careful (at least on average) about the magnitude (or proportion of total class periods) from which they deviate from the individual standards.

As a robustness check, we also ran a nonparametric test with the null hypothesis that the population median for the GAP variable was equal to the sample mean (0.336). The results show that we reject the null at better than 95 percent confidence. This finding provides two insights. First, it supports our earlier

assertion that teachers are deviating from the standards. Second, rejecting this test indicates (but does not conclusively prove) that the distribution of the GAP variable is non-normal. As such, when conducting analysis of variance on the GAP variable, it is necessary to resort to nonparametric techniques (i.e., the Mann-Whitney analog to ANOVA).

Table 4: Simple Hypothesis Tests for Convergence to State Standards

Parametric Tool for Convergence based on Mean Values					
Variable	Mean/Sample Portion	Hypothesized Value	Std. Error	Z-Stat.	
PMICRO	0.432	0.5	0.05	-1.36	
PMACRO	0.282	0.28	0.045	0.045	
PINTER	0.091	0.12	0.032	-0.892	
PPERF	0.195	0.1	0.03	3.167**	
GAP	0.336	0	0.021	16.232**	
Non-Parametric (Sign) Tests for Convergence based on Median Values					
Variable	Hypothesized Median	No. Above	No. Equal	No. Below	Z-Stat.
PMICRO	0.5	19	80	1	-6.131**
PMACRO	0.28	54	46	0	0.800
PINTER	0.12	26	74	0	-4.800**
PPERF	0.1	75	25	0	5.000**
GAP	0.336	35	65	0	-3.000**
GAP	0	100	0	0	10.000**

** indicates statistical significance at 5% or better

Table 5 presents the cross-tabulations and chi-square tests of independence between our proportional variables and exogenous variables. We find no significant relationship (i.e., we fail to reject the null hypothesis of independence) between failing to meet (or meeting/exceeding) the standards and whether or not teachers used NCEE or JA materials, the number of undergraduate credit hours in economics earned by each teacher, perceived lack of student interest, gender, years of teaching experience, the percent of that experience spent teaching economic, whether the teacher attended an economic education workshop, and the size of the school.

Table 5: Cross-Tabulations and Chi-Square Tests of Independence													
		PIMCRO			PMACRO			PINTER			PPERF		
Variables		Does Not MeetStandards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total
Core 40	No	29	6	35	22	13	35	27	8	35	4	31	35
	Yes	51	14	65	24	41	65	47	18	65	21	44	65
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2 Statistics		.0275			6.16**			0.276			5.289**		
NCEE	No	50	11	61	31	30	61	47	14	61	14	47	61
	Yes	30	9	39	15	24	39	27	12	39	11	28	39
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2 Statistics		.0378			1.463			0.756			0.35		
JA	No	50	10	60	29	31	60	44	16	60	17	43	60
	Yes	30	10	40	17	23	40	30	10	30	8	32	40
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2 Statistic		1.042			0.329			0.035			0.889		
ICEE	No	39	9	48	23	25	48	37	11	48	8	40	48
	Yes	41	11	52	23	29	52	37	15	52	17	35	52
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2 Statistics		0.09			0.137			0.456			3.319*		
UNEC	<12hrs.	36	9	45	22	23	45	31	14	45	10	35	45
	≥12hrs	44	11	55	24	31	55	43	12	55	15	40	55
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2Statistics		0			0.275			1.111			0.337		

Table 5: Cross-Tabulations and Chi-Square Tests of Independence													
		PIMCRO			PMACRO			PINTER			PPERF		
Variables		Does Not MeetStandards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total
NOTIME	No	53	9	62	26	36	62	45	17	62	15	47	62
	Yes	27	11	38	20	18	38	29	9	38	10	28	38
	Total	80	20	100	46	64	100	74	26	100	25	75	100
χ^2 Statistics		3.067*			1.085			0.171			0.057		
STMOT	No	56	12	68	33	35	68	49	19	68	17	51	68
	Yes	24	8	32	13	19	32	25	7	32	8	24	32
	Total	80	20	100	46	54	100	74	26	100	25	75	100
GENDER	Female	20	5	25	11	14	25	25	5	25	7	18	25
	Male	60	15	75	35	40	75	54	21	75	18	57	75
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2 Statistics		0			0.054			0.642			0.160		
TEXP	≤15 yrs	28	8	36	20	16	36	26	10	36	9	27	36
	>15 yrs	52	12	64	26	38	64	48	16	64	16	48	64
	Total	80	20	100	46	54	100	74	16	100	25	75	100
PCTDV	<=50%	34	6	40	17	23	40	30	10	40	12	28	40
	>50%	46	14	60	29	31	60	44	16	60	13	47	60
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2 Statistics		1.042			0.329			0.035			0.889		

Table 5: Cross-Tabulations and Chi-Square Tests of Independence

Variables		PIMCRO			PMACRO			PINTER			PPERF		
		Does Not MeetStandards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total	Does Not Meet Standards	Meets or Exceeds Standards	Total
INSERV	No	29	6	35	16	19	35	28	7	35	6	29	35
	Yes	51	14	65	30	35	65	46	9	65	19	46	65
	Total	80	20	100	46	54	100	74	26	100	25	75	100
χ^2 Statistics		0.275			0.002			1.008			1.773		
SIZE	Small	18	3	21	11	10	21	17	4	21	3	18	21
	Mid-	27	5	32	16	16	32	22	10	32	5	27	32
	Large	17	6	23	8	15	23	17	6	23	9	14	23
	X-L	18	6	24	11	13	24	18	6	24	8	16	24
	Total	80	20	100	46	54	100	74	24	100	25	75	100
χ^2 Statistics		1.719			1.716			0.999			6.124		

* indicates statistical significance at the 10% level

** indicates statistical significance at the 5% level

We do, however, find a number of factors that significantly influence whether a teacher fails to meet the standards. First, respondents who do not teach a Core 40 course are more likely to exceed the personal finance standard and less likely to meet or exceed the macro standard than those who do teach a Core 40 course. Additionally, teachers who do not use materials sponsored by the Indiana Council on Economic Education are more likely to spend too much time on personal finance topics. Perhaps more importantly, teachers who indicated that time is not a major factor in covering all of the standards are more likely *not* to meet those standards. The implications of the latter is that the breadth and depth of content teachers are expected to cover under the standards is not a significant determinant

of whether those standards are met. That is, the standards do not appear to be taxing in terms of the amount of time necessary to meet them. It remains to be seen from more detailed analysis whether this preliminary finding is upheld.

Table 6 contains the results from a series of nonparametric ANOVA (Mann-Whitney) tests for the GAP variable. Unlike the cross-tabulations that examined compliance for each of the core competency areas individually, the Mann-Whitney test indicated whether certain factors jointly influence compliance with the standards. The tests indicate that two of the factors outlined in Table 5 significantly influence joint compliance. Specifically, teachers administering a Core 40 course exhibit less deviation from the standards than those not teaching such a course, and those teachers who use National Council on Economic Education materials exhibit less deviation from the standards than those who do not use such materials. The first of these results upholds the findings from our cross-tabulation analysis, while the latter is a new result arising from aggregating compliance (or a lack thereof) across all four areas.

Table 6: Mann-Whitney Tests

Dependent Variable: GAP				
Decomposed by:	n	Mean	Std. Deviation	Test Statistics
CORE 40				
No	35	0.435	0.274	-2.464**
Yes	65	0.283	0.134	
NCEE				
No	61	0.379	0.229	-2.226**
Yes	39	0.271	0.146	
JA				
No	60	0.331	0.209	-0.654
Yes	40	0.344	0.206	
ICEE				
No	48	0.345	0.175	-0.866
Yes	52	0.323	0.233	
UNEC				
<=9 hrs	45	0.371	0.262	-0.391

Table 6: Mann-Whitney Tests				
Dependent Variable: GAP				
Decomposed by:	n	Mean	Std. Deviation	Test Statistics
> 9 hrs	55	0.308	0.144	
NOTIME				
No	62	0.357	0.236	-0.586
Yes	38	0.303	0.145	
INTEREST				
No	68	0.350	0.207	-1.526
Yes	32	0.307	0.206	
GENDER				
Female	25	0.361	0.237	-0.354
Male	75	0.328	0.196	
TEXP				
<= 15 yrs	36	0.338	0.208	-0.417
> 15 yrs	64	0.336	0.208	

The regression results are reported in Tables 7 and 8. We begin by examining the chi-square tests for model significance. Clearly, we fail to reject the null hypothesis (that controlling for the exogenous characteristics provides no additional information than the simple descriptive statistics) with 95 percent confidence for every equation in Tables 7 and 8. Thus, we conclude that our simple hypothesis tests from Table 4 are robust, even when controlling for these variables jointly. In other words, when taken in tandem, none of the exogenous characteristics are significant determinants of compliance with the state standards. Given the sparse number of significant coefficient estimates, this result is not surprising. However, it is interesting (merely as an exercise) to note that the few significant coefficient estimates do coincide with some of our previous findings. For example, teachers administering a Core 40 course are more likely to meet or exceed the macroeconomics standards and are also less likely to have extreme GAP values (indicating divergence from the standards taken jointly).

Table 7: Logit Regression Results

Dependent Variable	PMICRO		PMACRO		PINTER		PPERF	
	Dummy Variable		Dummy Variable		Dummy Variable		Dummy Variable	
Variable	Estimated Coefficient	T-Stat	Estimated Coefficient	T-Stat	Estimated Coefficient	T-Stat	Estimated Coefficient	T-Stat
Constant	-4.532	-2.866**	-1.166	-1.136	-2.010	-1.768*	-1.474	-2.203**
CORE 40	0.459	0.718	1.415	2.720**	0.114	0.210	0.663	1.099
NCEE	-0.165	-0.246	0.405	0.753	0.664	1.154	0.537	0.969
JA	0.493	0.843	0.732	1.449	-0.181	-0.343	-1.131	-1.178
ICEE	-0.072	-0.076	0.150	0.195	-0.495	-0.600	-0.032	-0.728
UNEC	-0.023	-0.480	-0.008	-0.219	-0.003	-.0.089	-0.574	-0.912
NOTIME	1.733	2.170	-0.628	-1.135	-0.726	-1.237	-0.699	-1.060
STMOT	1.664	1.991**	0.673	1.117	-0.892	-1.391	0.355	0.553
GENDER	-0.190	-0.271	-0.598	-1.016	0.522	0.810	0.002	0.087
TEXP	0.039	1.340	0.050	2.232**	0.020	0.907	1.289	1.250
PCTDV	0.892	0.857	-0.680	-0.817	0.728	0.794	0.083	0.085
INSERV	-0.275	-0.303	-0.481	-0.655	0.820	1.014	0.048	0.055
SMALL	0.083	0.094	0.268	0.416	-0.652	-0.881	-0.797	-1.051
LARGE	0.959	1.205	0.612	0.911	-0.397	-0.561	-0.727	-0.953
EXTRA-LARGE	0.924	1.179	0.017	0.026	-0.521	-0.745		
Unrestricted Log-Likelihood				-43.676	-59.535	-53.694	-47.766	
Restricted Log-Likelihood				-50.040	-68.994	-57.306	-56.234	
Chi-Square Statistic (14 degree of Freedom)				12.73	18.92	7.22	16.94	
Number of Observations				100	100	100	100	

* indicates statistical significance at the 10% level

** indicates statistical significance at the 5% level

Table 8 Logit Regression Results

	GAP Ranking Ordered		GAP Bottom Q Dummy Variable		GAP Second Q Dummy Variable		GAP Third Q Dummy Variable		GAP Top Q Dummy Variable	
	Estimated Coefficient	T-Stat.	Estimated Coefficient	T-Stat.	Estimated Coefficient	T-Stat.	Estimated Coefficient	T-Stat.	Estimated Coefficient	T-Stat.
Constant	2.837	2.927**	-2.913	-2.198**	-1.415	-1.185	-1.576	-1.392	0.840	0.709
CORE 40	-0.762	-1.814*	0.301	0.514	0.657	1.148	0.509	0.877	-1.343	-2.371**
NCEE	-0.230	-0.491	-0.221	-0.364	0.477	0.763	0.398	0.669	-0.933	-1.404
JA	0.467	1.045	-0.544	-0.954	-0.026	-0.047	0.015	0.027	0.544	0.929
ICEE	-0.450	-0.662	0.521	0.573	0.370	0.418	-0.917	-1.076	-0.193	-0.203
UNEC	0.009	0.267	-0.051	-1.080	0.040	0.980	0.005	0.123	-0.011	-0.253
NOTIME	-0.810	-1.661*	0.496	0.758	0.420	0.682	-0.022	-0.038	-0.921	-1.453
STMOT	-1.388	-2.875**	1.083	1.666*	0.761	1.190	-0.546	-0.816	-1.482	-1.968**
GENDER	0.145	0.298	-0.076	-0.119	0.530	0.770	-0.313	-0.497	0.026	0.041
TEXP	-0.009	-0.433	0.004	0.181	-0.020	-0.845	0.034	1.422	-0.026	-1.039
PCTDV	-0.326	-0.434	0.797	0.831	-0.811	-0.873	0.377	0.365	-0.277	-0.285
INSERV	0.309	0.462	-0.260	-0.292	-0.121	-0.144	0.195	0.249	0.433	0.483
SMALL	0.212	0.333	0.920	1.054	-0.983	-1.326	-0.460	-0.654	0.755	1.015
LARGE	-0.637	-0.982	1.951	2.373**	-1.579	2.0733**	-0.239	-0.338	0.089	0.107
EXTRA LARGE	-0.511	0.841	1.940	2.343**	-1.229	-1.664*	-0.763	-1.012	0.427	0.562
Unrestricted Log-Likelihood		-129.267		-48.467		-51.029		-52.754		-47.012
Restricted Log-Likelihood		-138.629		-56.234		-56.234		-56.234		-56.234
Chi-Square Statistic (14 dof)		18.73		15.53		10.41		6.96		18.44
Number of Observations			100							

* indicates statistical significance at the 10% level ** indicates statistical significance at the 5% level

The regression also indicates that teachers working in larger schools are more likely to adhere to the State standards (as evidenced by the logit regression for the GAP, first and second quartile dummy variables). Greater teacher experience also has a positive impact on whether the macroeconomics standard is met. Perhaps most intriguing is the finding that teachers reporting that student motivation is a major challenge are more likely to adhere closely to the standards, both overall (as evidenced by the GAP regressions) and to the microeconomics standard individually.

CONCLUSION

From a policy perspective, our findings present a surprisingly optimistic picture about the response of high school teachers to the adoption of state economic standards. We find that while virtually all teachers in our sample deviate from the standards, the magnitude of the deviation is small and occurs in a predictable way. Most teachers appear to spend slightly less time on microeconomics (43.2% versus the mandated 50%) and international economics concepts (9.1% versus the mandated 12%) in favor of additional personal finance (19% versus 10%). Moreover, our regression analysis indicates that this finding is robust to many exogenous factors that are purported to influence a teacher's decisions over course content. As a result, the standards appear to be moderately successful in achieving its intended goal of creating convergence in content coverage in high school economics curricula.

Successfully aligning economics instruction with state standards is dependent upon altered teacher behavior. The findings of this paper suggest that there may be interventions that can lead to altered behavior by teachers. The lack of significance of demographic factors suggests that these interventions may be workable under various demographic profiles of teachers of economics courses. A key focus of these interventions would be to build awareness of standards coverage through curriculum planning as well as through the activities such as the NCEE, upon which the Indiana standards are based. It may also be useful for educators to be aware of the extent to which standards have been adequately implemented in the classroom, prior to the proposed economics assessment of high school students (such as the 2006 National Assessment of Educational Progress (NAEP) Economics Assessment.

Given our findings that teachers behave in a predictable fashion, changing the standards themselves may be another viable way to achieve the goal. For

example, if policy makers want exactly 50% course content in microeconomics, they may actually want to increase the microeconomics standard (for example, to 56%) and reduce the personal finance standard (to say, 8%) knowing that teachers will deviate from the standard, but only marginally so. Future work that empirically estimated the magnitude of this tradeoff (between personal finance and microeconomics/international economics) would provide valuable information about the effectiveness of such a policy.

The underlying motivation for this paper comes from the hypothesis that deviations between actual content coverage and state mandates may contribute to a lack of economic literacy in high school students. The results of our analysis do not support this claim, as teachers appear to be (for the most part) adhering to the standards. However, the aggregate nature of our data does not allow us to answer the question definitively. Instead, it provides direction for future research. If teachers are spending the correct proportion (or something close to the correct proportion) of time on each content area, the determinants of economic literacy should focus not on *what* is being taught, but *how* it is being taught. Additionally, while teachers may be spending an appropriate amount of time on each content area, the allocation of time spent on individual topics within each area may not be appropriate to ensure that students grasp the major concepts central to economic literacy. As such, future research is necessary to identify the allocation of time spent on individual concepts. This allows policy makers to subsequently create standards at the level of the concept, and not the subject area, which enhance economic literacy.

ENDNOTES

[1] Within Indiana's Economic standards, the following standards and benchmarks can be associated with personal finance issues. Standard 1, "Scarcity and Economic Reasoning", two benchmarks can be identified as those dealing with personal finance: (1) "Formulate a savings or financial investment plan for a future goal" and (2) "Predict how interest rates will act as an incentive for borrowers and savers." In Standard 2, the "Supply and Demand" benchmark deal with personal finance reads, "Explain how financial markets, such as the stock market, channel funds from savers to investors." In Standard 4, "Role of Government", the personal finance benchmark statement reads, "Identify taxes paid by students." In Standard 5, "National Economic Performance", the personal finance benchmark statement

reads, "Analyze the impact of inflation of students' economic decisions." Standard 6, "Money and the Role of Financial Institutions", identifies four benchmarks that deal with personal finance: (1) "Explain the role of banks and other financial institutions in the economy of the United States", (2) "Compare and contrast credit, savings, and investment services available to the consumer from financial institutions", (3) "Research and monitor financial investments, such as stocks, bonds, and mutual funds", and (4) "Formulate a credit plan for purchasing a major item comparing different interest rates." Standard 7, "Economic Stabilization" has a benchmark that reads, "Articulate how a change in monetary or fiscal policy can impact a student's purchasing decisions."

[2] As the results in Table 4 show, only one reported value is exactly equal to the state standards. As such, including the observations who exactly meet the standards with those who exceed the standards (as opposed to including them with those who do not meet the standards) causes little loss of generality. Also, we chose to use cross-tabulations (as opposed to an approach such as the Mann-Whitney test) because we believe that it expresses the same information, yet it is also more consistent with the coming regression analysis.

[3] Because our survey does not provide data to control for all important determinants of compliance, our results may suffer from omitted variable bias. As such, our intent in Table 7 and 8 is simply to perform an exploratory analysis with the data at our disposal.

[4] The Mann-Whitney test employed to analyze the GAP variable prior to the regression analysis essentially operated by ranking the data and comparing rakings across the treatment variable(s). As such, our decision to categorize the GAP variable by quartiles is consistent with our previous analysis

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ECONOMICS ARTICLES

MODELING MARKETS FOR SPORTS MEMORABILIA

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ABSTRACT

A simple hedonic pricing model is developed for baseball cards, of the type often used successfully to model prices for artworks. The model is constructed based on insights contributed by both the sports psychology and finance literatures and is estimated for a dataset of twelve well-known players observed at eight points in time over a span of twenty years. Tobit estimates explain most differences among baseball card prices. Batting average and number of World Series appearances had significant positive impacts on price, but surprisingly, rookie cards tended to be worth relatively less than non-rookie cards. Results suggest famous players' cards generally are extremely attractive investment instruments.

INTRODUCTION

The economic literature on appreciation of non-financial investment assets has generally found low rates of return accompanied by high risk. Assets studied have included real estate, artworks, wines, and sports memorabilia. Sports memorabilia comprise an especially promising subject for further study.

Although sports memorabilia may be collected solely for its financial aspects, often collectors seek to identify with their heroes by collecting associated memorabilia. This is one metric in motivating athletes that is seldom examined (White et al 1998), and also motivates non-athletes who seek to emulate athlete behavior in a more general way. Although athletic performance and ability seem to characterize most of the athletes whose memorabilia is most prized by collectors, demonstrated ability to overcome adversity seems to make athletes especially valued as role models, both to other athletes and to collectors who do not also compete. Several baseball players in the sample examined here are famous for overcoming injuries or playing with pain over long careers, including Dimaggio and Mantle.

One essential feature rendering sports memorabilia more favorable subjects is the relative homogeneity of collectibles such as baseball cards, a feature clearly not shared by artwork or real estate. All cards of a certain issue should have their value determined by characteristics intrinsic to the card, such as a card's age, condition, and scarcity, and characteristics extrinsic to the card, such as the particular player's records, fame, and popularity. Intrinsic characteristics are generally properties of the whole issue and are shared by all cards of a given year printed by a given manufacturer, assuming that equal numbers of each player were printed. Obscure player's cards will be sought to complete sets of a given issue, and famous or star player's cards will face additional demand to complete sets or enhance partial sets of star player or team cards.

This paper develops a simple hedonic pricing model for baseball cards, of the type often used successfully to model auction prices for artworks. The model is estimated for an illustrative sample of cards for several different years. The paper is organized as follows: a review of the literature is followed by a development of the hedonic pricing model, a discussion of the data used, a brief introduction to the statistical methodology, presentation of the empirical results, and finally the conclusion.

LITERATURE

Several categories of scholarly literature were reviewed to develop the background necessary for this study. First the sport psychology literature on fan identification and behavior is used to develop an explanatory framework for a basic theory of why collectors demand sports memorabilia in the first place. Next, we discuss possible career characteristics players might possess which might plausibly enhance the desirability of associated memorabilia. A discussion of issues related to sports injury is provided next. We argue that athletes are especially prized as role models because they overcome obstacles, and that injury constitutes the most common and archetypal obstacle faced by athletes. An athlete's memorabilia will be more prized by collectors if the athlete either successfully overcame injury, or even if they failed to do so, but faced the obstacle with superior courage and character. Finally, after establishing reasons for a base demand for sports memorabilia, we turn to a discussion of purely financial considerations, drawing on the established literature on the investment demand for sports memorabilia and related assets, including artwork.

Identification and Fan Motivation

Fans provide the basic demand for sports memorabilia, at least initially. This section discusses the sports psychology literature addressing fan motivation in attending sports events and buying memorabilia, and in identifying with particular teams. In many situations, fans cannot purchase memorabilia unless they attend a sporting event (Jarrell and Mulligan 2002), so attendance, team identification, and base demand for memorabilia are inextricably linked.

On the most basic level, divorced from any financial investment considerations, memorabilia seems to be valued for its association with the sport activity, particularly if the memorabilia in question is particularly old and no longer resembles contemporary equipment, such as obsolete golf balls and clubs. On a higher level, memorabilia is associated with the success of the player or even the team. Fans value their association with winning teams more highly (End et al 2003a), and this presumably confers more value on associated memorabilia; fans desire the items in order to bask in reflected glory (BIRG) (Cialdini et al 1976; Cialdini and Richardson 1980; Lee 1985; Wann and Branscombe 1990; Wann et al 1993; End et al 1997; 2003b). An additional source of demand for memorabilia is fans' strong identification with certain teams and players (Tajfel and Turner 1986; Hirt et al 1992; Murrell and Dietz 1992; Wann and Branscombe 1993; Wann, Tucker, and Schraeder 1996; Dietz-Uhler and Murrell 1999). This effect is enhanced if the team enjoys success, but is present to some extent even for losing teams.

Though fan identification with teams and players can be negatively impacted by poor performance or sudden reversal of fortune (Mann 1974; Wann and Dolan 1994), demand for memorabilia such as baseball cards is generally not affected by such reversals. Much of the value possessed by a baseball card is based on the player's established performance. A record-holder's card probably does not fall in value when their record is surpassed. A famous player's later cards are always highly desired, even if their performance falters late in their career.

Motivations among Memorabilia Collectors

We turn next to the sport psychology literature about motivation of athletes, as opposed to fans. We attempt to draw conclusions from this literature about why memorabilia collectors might identify particularly strongly with certain athletes, and thus why associated memorabilia would be especially prized.

The goal perspective approach to explaining motivational processes among athletes (Duda 1989, 1992) emphasizes the differences in how athletes define success and judge their overall performance. Ames (1984, 1992) identifies two principal goals athletes seek, task orientation and ego orientation. We suggest here that similar motivating factors vicariously influence memorabilia collectors. Task-oriented collectors value memorabilia associated with a particular athlete based on the athlete's performance and achievement, but always taking into account extraordinary obstacles the athlete may have overcome. These collectors seek inspiration from the athletes they admire, and attempt to apply lessons learned from the athletes' live experience to problems faced by the collectors, normally outside the arena of athletic competition. These collectors particularly value memorabilia associated with athletes who are perceived as having demonstrated superior courage and character, in addition to those who have been particularly successful.

In contrast, ego-oriented collectors seek memorabilia associated with athletes and teams which are most famous or most popular. These collectors seek to bask in the reflected glory and are less likely to seek memorabilia associated with a fine athlete from a team with which they do not identify. The two goal orientations have supported the discovery of divergent behavioral patterns in athletes (Duda 1992, 1993). While we suggest that price data for sports memorabilia will not be sufficiently rich to distinguish between the two motivational paradigms for collectors, we believe both motivators exist in addition to purely financial factors to which collectors respond.

Athletic Injury: The Archetypal Hardship

The impact of injury on athletes has been extensively studied (Granito 2001). Although injury is not the only obstacle athletes have to overcome, it is the one most universal experience with which non-athletes can empathize, thus we argue that an athlete's injury response is one of the most important factors determining the value of associated memorabilia. Several studies found that athletic injuries at all levels of competition contribute to a variety of physical, physiological, and psychological hardship against which athletes struggle (Grossman and Jamieson 1985; Brewer and Petrie 1995; Leddy, Lambert, and Ogles 1994; Smith et al 1993). A significant literature in sport psychology research focuses on the psychological and emotional impact of athletic injuries (Heil 1993; Taylor and Taylor 1997; Pargman 1999).

The cognitive appraisal approach to explaining how athletes respond to injury emphasizes the athlete's perception of the injury (Brewer 1994; Wiese-Bjornstal et al 1998). This perception is influenced by interactions among personal factors such as physiological aspects of the injury and personal characteristics of the athlete, among situational factors including sport related factors, social aspects of competition and training, and among environmental factors (Wiese-Bjornstal and Shaffer 1999; Granito 2001). Wiese-Bjornstal et al (1998) emphasize that athletes' response to injury is dynamic and can change over time. Athlete response to injury depends on a large number of hypothesized variables (Wiese-Bjornstal et al 1988; Wiese-Bjornstal, Smith, and LaMott 1995). Evans and Hardy (1995) suggest that conventional quantitative research methodologies may fail to capture the full complexity of injury recovery. The cognitive appraisal approach offers an explanation for individual differences in responses to injury (Brewer 1994).

This range in injury recovery success helps explain why different athletes are more admired, and why their memorabilia is more desired by collectors, independently of the athletes' levels of achievement. Rose and Jevne (1993) and Shelley (1999) document the experience of injury and recovery, finding a four-phase process which is potentially arduous and protracted: 1) injury, 2) acknowledging the injury, 3) dealing with the impact, and 4) achieving a physical and psychosocial outcome, which might consist of recovery, adaptation, or acceptance of the injury. This process can be considered analogous to a standard archetype for how individuals in all walks of life face and overcome adversity. Bianco, Malo, and Orlick (1999) document a similar injury recovery process. Because athletic injury is such a direct metaphor for the hardships we all face, it is small wonder that non-athletes identify with, and strive to emulate, the athletes they admire. Evidence suggests the most competitive athletes, who identify most strongly with their sport, have an enhanced psychological response to injury (Brewer 1993).

Shelley (1999) found athletes' perceptions about injury change over the course of the process and emphasized the importance of the influence of coaches, teammates, and family members on athletes' emotional response. Social interactions seem to be an important part of a successful emotional response to injury and the frustrations of recovery (Udry et al 1997b; Zimmerman 1999). Cultural aspects and social influences impact the way an athlete experiences and talks about pain and injury (Young and White 1999). Since pain influences an individual's emotional state (Udry et al 1997a; Taylor and Taylor 1998; Heil and Fine 1999), it can impact an athlete's ability to overcome injury, and render their recovery that much more admirable. Certain athletes are particularly admired for their ability to play with

pain, in particular Dimaggio and Mantle. Athletes can perceive benefits from injury, because it provides relief from the stress of competition and the pressure to perform, and often find rehabilitation stressful (Gould et al 1997a). Rehabilitation may be inherently painful, or an athlete may feel pressured to demonstrate rapid progress in order to return to competition.

Financial Aspects of Collecting Memorabilia

This section discusses some of the relevant economic literature on pricing sports memorabilia and other non-financial investment assets, such as artwork. Stoller (1984) provides a valuable analysis of the Fleer v. Topps antitrust case as well as a discussion of the underlying economics of the baseball card business. The loss of Topps' monopoly power in 1980 and the introduction of competition (Stoller 1984, p. 23) may have caused the collapse of a speculative bubble in card prices. Stoller (1984, p. 19) documents a 31.6 percent annual return on Topps cards.

Nardinelli and Simon (1990) and Andersen and La Croix (1991) both found that a player's race significantly affected the price paid for baseball cards on the secondary market. These studies focus on the secondary market for sports memorabilia to isolate consumer discrimination from co-worker and employer discrimination. McGarrity, Palmer, and Poitras (1999) found little evidence of racial discrimination in the market for baseball cards, using a dataset with constant supply and where effects from speculative demand are largely removed by considering only retired players, and using a variety of econometric specifications to allow assessment of robustness of results. Fort and Gill (2000) study racial discrimination in baseball card markets using continuous, non-binary racial perceptions of market participants, as reported by surveys. They find evidence of discrimination against black and Hispanic hitters and against black pitchers, but not Hispanic pitchers. Gill and Brajer (1994) use baseball card prices to demonstrate monopsony exploitation of non-free-agent players. Comparison of the distribution of salaries among free-agent and non-free-agent players with the competitive secondary market prices of their baseball cards, shows that non-free-agent salaries are systematically depressed.

The literature on pricing artwork has significant implications for sports memorabilia markets. Ekelund, Ressler, and Watson (2000) examine how an artist's death affects the demand for that artist's work. They find a clustered rise in artwork's values immediately around the time of the artist's death. This phenomenon has two implications for the sports memorabilia market. The supply of baseball cards is effectively frozen for a particular player when the player retires from the

game, rather than at death. Ancillary memorabilia, including autographs, can continue to be supplied until the player's death however, and it seems plausible for death to induce an interest and nostalgia-generated increase in card prices as well.

Rengers and Velthuis (2001) study determinants of artwork prices based on characteristics of the artwork, artist, and gallery. This approach generalizes fairly readily to baseball cards, which have characteristics attributable to the player, team, year of issue, and card issuer. Reneboog and Van Houtte (2002) find that artworks significantly underperform compared with financial assets, owing the very high risk of investing in art, the heterogeneity of artworks, high transactions costs, and high costs of insurance, transportation, security, and resale. It is particularly worth noting that none of these negative features generally applies to sports memorabilia. Baseball cards of a given player, issue, and condition are always non-unique, homogeneous assets.

MODEL

This section develops the model tested in the results section in the context of three kinds of data which might be used to estimate a model: time series data, cross-sectional data, and panel data. Only the cross-sectional model is tested in this paper.

Time Series Models

Time series data measure characteristics of an individual member of a population or sample, or of the sample or population as a whole, as they evolve over time. As more time elapses, more data are observed and more subtle models can be estimated. An optimal timing model is used to express the value of any asset that appreciates over time. The value V of an asset at any point in time is an exponential function of the initial value K and the time elapsed t during which the asset appreciates:

$$V = K\, e^{vt} \quad [= K \exp(t^{1/2})]$$

Alternatively, the simpler formulation $V = K\, t^n$ can be used. This class of models is broadly applicable to many different assets, including wine, agricultural crops, renewable natural resources such as lumber forests, and non-renewable natural resources such as petroleum deposits. The important characteristic of the *K*

t^n term is that it can grow at an increasing or decreasing rate, depending on whether n is greater or less than one. Sports memorabilia should increase in value at a decreasing rate: formulating the model this way allows for testing whether $n < 1$.

Adapting this model to sports memorabilia, certain differences must be noted. Unlike wines, baseball cards and other sports memorabilia do not acquire chemical changes as they age which improve their taste, quality, and desirability. In fact, the chemical changes to which sports memorabilia are subject over time normally detract from their desirability, and collectors attempt to prevent or delay chemical changes.

Nevertheless, cards appreciate in value in a fashion similar to wine, though for different reasons. The supply of cards of a particular brand, player, and year is initially limited. Only so many of a particular card were ever printed. Surviving copies appreciate in value as some of the initially limited supply are lost, destroyed, or decay in condition as time passes. This gradual diminution of the supply of cards is similar to what happens as vintage wines are consumed, mature forests are harvested for lumber, or petroleum deposits are pumped out of the ground.

The prices of sports memorabilia are also affected by changes in demand. Demand normally increases with an increasing population, and in addition, demand for sports memorabilia increases with interest in the particular sport or athlete, as well as interest in the memorabilia for its own sake and as investment assets. Demand effects can occasionally be negative, as documented for the collapse of baseball card prices caused by the end of monopoly pricing in 1980 (Stoller 1984, p. 23), but fortunately that has been an exceptional event.

Sports memorabilia have unique characteristics which call for generalizing the standard optimal timing model. Though old baseball cards of comparable significance, condition, and quality are generally more valuable than newer cards, the career performance and general fame of the player make a card more sought after and therefore more valuable. All cards of a given issue had the same price when new, and appreciate over time. A rookie card of an average player appreciates much less than that of a more well-known player. A rookie card of a presumed hot-prospect may appreciate rapidly early on, but plateau or even decline in value as the player's career fails to achieve its initial promise. Some players' cards are especially desirable due to tragically brief careers.

To capture these kinds of effects, the exponent of the optimal timing model is augmented with a multiplicative vector of exponentially-weighted factors S. These factors include the player's career longevity, records held, retirement, hall-of-fame induction, and death. Including the factors which distinguish average from

well-known players is accomplished mathematically by inserting the product of each factor variable, each weighted by its own exponent:

$$V = K\,S\,t^{n} \quad [= K \prod(S_i^{a})\,t^{n}) = K \prod(A^{a}B^{b}C^{c}\ldots)\,t^{n}]$$

Taking natural logarithms of both sides,

$$\ln A(t) = \ln K + a \ln A + b \ln B + c \ln C + \ldots + n \ln t$$

This is the equation of interest for time series estimation. This can also be considered a generalized hedonic price equation, and the reduced form of supply and demand functions in the same arguments.

$$P_{it} = \sum_t a_t X_t + \sum_t b_t Z_t + e_{,}$$

where X and Z are vectors of observable characteristics, both intrinsic and extrinsic to a specific card. Extrinsic characteristics are associated with specific players and vary across cards of a specific issue.

Cross-sectional Models

Cross-sectional data provides a description of an entire population or sample at a given point in time. Cross-sectional estimation is appropriate when researchers want to distinguish among factors which influence population behavior or characteristics but do not have observations at many different points in time. Time series estimates would allow for estimating the price and the return as functions of the explanatory variables. Cross-sectional estimates only allow for computing the return between two observed cross-sections. Cross-sectional estimates can also be useful to investors, because they can be used to evaluate the likely change in price whenever one of the explanatory variables changes, for example, if a current player improves his batting average, or appears in the World Series, or if a retired player is elected to the Hall of Fame.

Building on the significant literature studying race as a determinant of sports memorabilia prices, we include dummy variables for race in the specification. Batting average is included as the single most important measure of a player's performance. Note that earned run average would be used for pitchers, who would generally have to be priced with a separate model. Rookie cards are commonly

thought to be more desired by collectors, and generally to be rarer, especially for famous players. If rookie cards are valued in any way differently from ordinary cards, including a dummy variable for rookie card status should improve the model's forecasting performance.

The player's age serves as a proxy for the age of the card, and generally cards of older players should be more valuable. Death is measured with a dummy variable, as is hall-of-fame status. The number of World Series appearances improves the desirability of a player's cards, though a player's team is more likely to make it to the World Series the better the player's performance, as captured by batting average, for example. The number of years elapsed from the start, and from the end, of a player's career, like age, proxies for age of the card. Because the difference of these two variables gives the player's career longevity, if longevity has a positive impact on card price, the expectation is that the more years elapsed from the start, and the fewer elapsed from the end, the higher the price. This effect can be washed out by the general phenomenon that older cards are more valuable.

A hedonic pricing model is often specified in a less restrictive exponential form, and then estimated in its linear logarithmic transformation. However, because several of the right-hand-side variables are dummies, which can only take on values of zero or one, the model is specified here in levels.

$$P = a + bBLK + cHSP + dBA + eR + fA_{nn} + gD_{nn} + hHOF_{nn} + iWS_{nn} + jS_{nn} + kE_{nn}$$

This is the model which is estimated in the results section. Card price is thus asserted to be a function of the player's race, batting average, rookie card status, age, death, hall of fame status, number of world series appearances, and career longevity as captured in years elapsed from start and from end of career. The variables are described in Table 1. The race, rookie card, death, and hall-of-fame status are measured with dummy variables which take on values of zero or one depending on whether the relevant condition is satisfied, as described in table 1.

Panel Data Models

Panel data is the term applied to data which describes the cross-section of the population or sample, but where each characteristic is observed at many points in time. Thus panel data represent a cross between time-series and cross-sectional data. These data are also called pooled time-series and cross-sectional data. Kmenta

(1971, pp. 508-517) discusses panel data estimation. Although panel estimation should provide the best results, it also calls for the most intense computational and data resources. Mulligan, Jarrell, and Grube (2003) present and interpret panel estimates.

Table 1: Variables in the Hedonic Pricing Model

P	= card price in current dollars from the Price Guides
BLK	= 1 if player is black = 0 otherwise
HSP	= 1 if player is Hispanic = 0 otherwise
R	= 1 if card is a rookie card = 0 otherwise
BA	= player career batting average
A*nn*	= player age at year of Price Guide
D*nn*	= 1 if player was deceased prior to year of Price Guide = 0 otherwise
HOF*nn*	= 1 if player was in Hall of Fame prior to year of Price Guide = 0 otherwise
WS*nn*	= number of world series appearances prior to year of Price Guide
S*nn*	= number of years from start of career to year of Price Guide
E*nn*	= number of years from end of career to year of Price Guide = 0 for players who were still playing during year of Price Guide

Price Guides from 1982, 1983, 1984, 1985, 1988, 1993, 1999, and 2002. *nn* indicates variables that change from one Price Guide to the next, and serves as a placeholder for the year, e.g., A82, A83, etc.

DATA

This section documents the data used to estimate the model. A sample of twelve well-known players, listed in table 2, was chosen to obtain illustrative estimates of the model. Prices for one card for each player were taken from the Price Guides for eight different years over a twenty-year span from 1982 to 2002.

One significant difference between these data and the auction prices used in empirical examinations of artwork prices should be noted. Artworks are unique and each auction price for a given artwork records a unique transaction at a unique point in time. In contrast, the Price Guide observations of card price in a given year are taken from dealer surveys. There is never any specific, single exchange which can be documented at the listed price.

Table 2: Sample of Baseball Cards				
Player	Years Played	Teams	Card Issuer and Year	Card #
Aaron, Hank	1954-76	MLN ATL MIL	1954 Topps	128
Bench, Johnny	1967-83	CIN	1968 Topps	247
Brett, George	1973-93	KCR	1975 Topps	228
Carew, Rod	1967-85	MIN CAL	1967 Topps	569
Fisk, Carlton	1969-93	BOS CHW	1972 Topps	79
Jackson, Reggie	1967-87	KCR OAK BAL NYY CAL	1969 Topps	260
Mantle, Mickey	1951-68	NYY	1952 Topps	311
Musial, Stan	1941-63	STL	1948 Bowman	36
Robinson, Jackie	1947-56	BRO	1949 Bowman	50
Rose, Pete	1963-86	CIN PHI MON	1963 Topps	537
Williams, Ted	1939-42 & 1946-60	BOS	1950 Bowman	98
Yastrzemski, Carl	1961-83	BOS	1960 Topps	148

Generally, the Price Guide is used as an authority for dealers to price and update their inventory. Many transactions occur at the price listed in the Price Guide because it is widely accepted as an authoritative source. However, the listed card price is logically prior to the prices of actual transactions. In the art market, in contrast, the auction price is logically prior to any compilation of art values. A further difference derives from the fact that there are many identical copies of a given card, even in the same grade of condition, but an artwork is always absolutely unique.

METHODOLOGY

This section explains the statistical estimation technique used in the results section. Because the left-hand-side variable, baseball card price, cannot be negative, a censored estimation technique is employed, introduced in econometrics by Tobin (1958) and called the Tobit model. If left-hand-side variables are limited in some way, ordinary least squares estimates are asymptotically biased (Kennedy 1993, p. 232). Ordinary least square estimation can provide negative estimates of the left-hand-side variable, which can never be negative in reality, a shortcoming avoided through censored estimation.

McDonald and Moffitt (1980) showed that Tobit estimates combine properties of standard linear regression, namely the predicted value of the left-hand-side variable and its changes for observations beyond the relevant limits, with properties of the probit estimator, namely the probabilities and changes in the probabilities of being outside the limits. Tobit estimates are obtained through maximizing the likelihood function (Greene 1981, p. 508).

Descriptions of the Tobit estimation procedure are provided by Abramovitz and Stegun (1972, p. 299), Amemiya (1981), Greene (1981), Maddala (1983, pp. 151-155), Davidson and MacKinnon (1993, pp. 537-542), and (Judge et al pp. 783-785). Hall (1984) reviews software available for Tobit estimation. The Tobit model is an iterative, restricted maximum likelihood estimate.

Estimates are reported below for sample datasets taken from eight different annual Price Guides. The estimate did not converge for some years, or yielded a near-singular matrix or a negative standard error, probably because the model devours nearly all available degrees of freedom; eleven coefficients, including the constant, are estimated on twelve observations of each variable. These problems vanished when one variable was omitted from the specification. Including more cards in the sample would probably avoid these estimation problems.

RESULTS

This section presents the results of econometric estimation. Tables 3 through 10 present estimated Tobit models for cross sectional data samples taken from eight different Price Guides.

Table 3: Tobit Model of Baseball Card Prices				
1982 Data Cross Section				
	Coefficient	Std. Error	z-Statistic	Prob.
C	-3642.540	360.2244	-10.11186	0.0000
BLK	412.3077	69.14140	5.963253	0.0000
HSP	-245.1361	48.18435	-5.087462	0.0000
BA	9732.350	974.7919	9.984028	0.0000
R	-491.6519	30.37142	-16.18798	0.0000
A82	56.47143	12.96109	4.356997	0.0000
D82	-264.7751	86.78959	-3.050770	0.0023
HOF82	-141.8288	131.5777	-1.077909	0.2811
WS82	156.3141	7.421117	21.06342	0.0000
S82	-64.62543	15.39043	-4.199067	0.0000
E82	-19.12512	3.730426	-5.126792	0.0000
R-squared	0.998321	Mean dependent var	178.8333	
S.D. dependent var	435.0034	Akaike info criterion	10.93275	
Sum squared resid	3494.350	Schwarz criterion	11.41765	
Log likelihood	-53.59649	Hannan-Quinn criter.	10.75322	

This model was estimated over a sample of twelve well-known players. Very high R-squares and adjusted R-squares are impressive, but may be due more to small sample properties than any particularly sterling qualities of the specification. Nevertheless, high R-squares suggest the model should serve investors and collectors as a useful tool.

Race coefficients are positive and significant for black players in the sample for 1982, 1983, 1984, 1993, and 2002, but not significant in 1985, 1988, and 1999, suggesting race became less important in determining card price over

time, though clearly the positive effect on price remains in the 2002 dataset. In contrast, the race coefficient is negative and significant for the lone Hispanic player, Rod Carew in 1983, 1984, 1993, not significant in 1985, 1988, 1999, and becomes positive and significant in 2002. This is likely a small sample characteristic which results from the relatively higher prices initially paid for cards of very famous non-Hispanic players in the sample, and the relatively rapid appreciation of the Rod Carew card.

Table 4: Tobit Model of Baseball Card Prices

1983 Data Cross Section

	Coefficient	Std. Error	z-Statistic	Prob.
C	-3516.604	910.7125	-3.861377	0.0001
BLK	511.4870	191.1275	2.676156	0.0074
HSP	-266.6450	125.0442	-2.132407	0.0330
BA	10881.65	2679.818	4.060592	0.0000
R	-471.2385	75.38311	-6.251248	0.0000
A83	34.36457	32.34181	1.062543	0.2880
D83	-425.1508	251.7122	-1.689036	0.0912
HOF83	-268.5695	359.6466	-0.746760	0.4552
WS83	158.4635	19.75503	8.021424	0.0000
S83	-43.76523	38.61433	-1.133393	0.2570
E83	-12.61742	9.396278	-1.342810	0.1793
R-squared	0.989107	Mean dependent var	179.8417	
S.D. dependent var	434.6804	Akaike info criterion	12.72936	
Sum squared resid	22640.95	Schwarz criterion	13.21426	
Log likelihood	-64.37613	Hannan-Quinn criter.	12.54983	

Table 5: Tobit Model of Baseball Card Prices				
1984 Data Cross Section				
	Coefficient	Std. Error	z-Statistic	Prob.
C	-2500.287	367.8762	-6.796544	0.0000
BLK	311.0981	78.05443	3.985656	0.0001
HSP	-173.5807	51.84731	-3.347922	0.0008
BA	8363.918	1064.941	7.853881	0.0000
R	-412.8758	29.58992	-13.95326	0.0000
A84	8.240391	2.254256	3.655481	0.0003
D84	-117.4760	98.94498	-1.187287	0.2351
HOF84	-238.9534	134.0693	-1.782313	0.0747
WS84	142.8158	8.011905	17.82544	0.0000
E84	-31.29713	4.034931	-7.756546	0.0000
R-squared	0.998729	Mean dependent var	195.6667	
Adjusted R-squared	0.986020	S.D. dependent var	389.8842	
S.E. of regression	46.09906	Akaike info criterion	10.81732	
Sum squared resid	2125.123	Schwarz criterion	11.26182	
Log likelihood	-53.90394	Hannan-Quinn criter.	10.65275	

Batting average has a very strong positive impact on card price. The coefficient is always positive and significant and almost always an order of magnitude greater than any other coefficient, except in 1988. Rookie card status always has a negative impact on price, which is always statistically significant except in 2002. This is probably a small sample effect. Player age has a positive and significant impact on price in 1982, 1984, 1985, 1988, 1993, and 1999, but not significant in 1983 or 2002.

Table 6: Tobit Model of Baseball Card Prices				
1985 Data Cross Section				
	Coefficient	Std. Error	z-Statistic	Prob.
C	-1121.022	189.0700	-5.929136	0.0000
BLK	-5.327959	39.55047	-0.134713	0.8928
HSP	-22.53180	25.55713	-0.881625	0.3780
BA	2895.855	520.7312	5.561133	0.0000
R	-324.4782	16.26105	-19.95432	0.0000
A85	13.28342	1.335820	9.944018	0.0000
D85	350.0922	51.12925	6.847199	0.0000
HOF85	222.6048	68.23334	3.262405	0.0011
WS85	79.80095	4.030060	19.80143	0.0000
E85	-40.01059	2.190951	-18.26175	0.0000
R-squared	0.999029	Mean dependent var	143.4167	
Adjusted R-squared	0.989320	S.D. dependent var	268.1490	
S.E. of regression	27.71181	Akaike info criterion	9.641930	
Sum squared resid	767.9447	Schwarz criterion	10.08643	
Log likelihood	-46.85158	Hannan-Quinn criter.	9.477361	

Deceased players' cards generally sell for more than those of still-living players, at least for this limited sample. This outcome is not surprising in light of the empirical literature on artwork valuation, which shows death of the artist has a positive impact on the value of his or her work. Death is different for card valuation, however, as a player stops generating new card issues when he retires, rather when he dies. Death is statistically significant and negative only for 1982, significant and positive for 1985, 1988, 1993, and 1999, and not significant for 1983, 1984 and 2002. The significant positive coefficient on death in 1982 indicates that in that

year, for this sample of players, the living players' cards were worth more than dead players'. The result may have been reversed later on as more star players in the sample passed on.

Table 7: Tobit Model of Baseball Card Prices

1988 Data Cross Section

	Coefficient	Std. Error	z-Statistic	Prob.
C	-16888.58	6427.465	-2.627565	0.0086
BLK	1672.837	1003.078	1.667703	0.0954
HSP	-658.5319	698.8496	-0.942309	0.3460
BA	29512.94	12756.28	2.313601	0.0207
R	-2089.132	387.4653	-5.391793	0.0000
A88	592.2054	297.6067	1.989893	0.0466
D88	1108.047	1763.161	0.628443	0.5297
HOF88	81.24800	1720.452	0.047225	0.9623
WS88	603.7357	96.71123	6.242664	0.0000
S88	-763.7149	383.8863	-1.989430	0.0467
E88	109.8458	109.2591	1.005369	0.3147
R-squared	0.984770	Mean dependent var	742.9167	
S.D. dependent var	1818.894	Akaike info criterion	16.13852	
Sum squared resid	554255.8	Schwarz criterion	16.62343	
Log likelihood	-84.83114	Hannan-Quinn criter.	15.95899	

Hall of Fame status has a negative but statistically insignificant effect in 1982, 1983, 1984, but its impact becomes positive and significant in 1985, 1993, 1999, and 2002, and is positive but insignificant in 1988. Insignificant coefficients for many years probably result from multicollinearity; Hall of Fame status should have a positive impact on card price, but that impact is likely captured better by two

other variables included in the model, batting average and the number of World Series appearances.

Table 8: Tobit Model of Baseball Card Prices				
1993 Data Cross Section				
	Coefficient	Std. Error	z-Statistic	Prob.
C	-45258.40	5130.998	-8.820584	0.0000
BLK	2246.530	604.2588	3.717827	0.0002
HSP	-2268.757	920.8260	-2.463828	0.0137
BA	120963.4	9041.685	13.37841	0.0000
R	-7969.344	767.4725	-10.38388	0.0000
A93	318.0706	88.38023	3.598889	0.0003
D93	7865.327	2787.320	2.821824	0.0048
HOF93	6467.120	875.5687	7.386193	0.0000
WS93	2352.526	94.24879	24.96081	0.0000
E93	-843.0741	117.7661	-7.158887	0.0000
R-squared	0.996144	Mean dependent var	2543.333	
Adjusted R-squared	0.957583	S.D. dependent var	6768.140	
S.E. of regression	1393.917	Akaike info criterion	17.44062	
Sum squared resid	1943005.	Schwarz criterion	17.88512	
Log likelihood	-93.64374	Hannan-Quinn criter.	17.27605	

The number of World Series appearances is always positive and significant as expected. Two variables are included to capture time elapsed from each player's period of professional activity, and career longevity: years elapsed from the beginning and end of the player's career. These variables broadly capture the relative age of the card as well. Years since the start of the player's career is

negative and significant in 1982 and 1988, and negative but insignificant in 1983. Years since the start of the player's career was omitted from the 1984, 1985, 1993, 1999, and 2000 regressions because the Tobit model would not converge without removing one variable from the model. Statistically significant negative coefficients are surprising, and may be due to multicollinearity with player age and years since the end of the player's career.

Table 9: Tobit Model of Baseball Card Prices

1999 Cross Section

	Coefficient	Std. Error	z-Statistic	Prob.
C	-24163.55	3930.125	-6.148290	0.0000
BLK	1112.228	821.5341	1.353842	0.1758
HSP	1004.742	921.0848	1.090824	0.2754
BA	35945.08	14140.94	2.541916	0.0110
R	-3937.315	956.3839	-4.116877	0.0000
A99	368.5283	80.12773	4.599260	0.0000
D99	11184.69	2907.367	3.847017	0.0001
HOF99	2425.958	722.4471	3.357973	0.0008
WS99	1014.841	236.4284	4.292380	0.0000
E99	-511.8389	63.85813	-8.015250	0.0000
R-squared	0.990732	Mean dependent var	2177.083	
Adjusted R-squared	0.898056	S.D. dependent var	5631.749	
S.E. of regression	1798.142	Akaike info criterion	17.81578	
Sum squared resid	3233315.	Schwarz criterion	18.26028	
Log likelihood	-95.89468	Hannan-Quinn criter.	17.65121	

Years since the end of the player's career is negative and significant in 1982, 1984, 1985, 1993, 1998, and 2002, and statistically insignificant in 1983 and 1988. This means there is an aura effect which elevates the value of cards for players who have recently retired, and that as more years pass, card price declines, or at least grows less rapidly. Multicollinearity may also account for this outcome.

Table 10: Tobit Model of Baseball Card Prices

2002 Data Cross Section

	Coefficient	Std. Error	z-Statistic	Prob.
C	-26918.56	9566.457	-2.813848	0.0049
BLK	1942.812	711.5880	2.730249	0.0063
HSP	1754.909	988.9637	1.774493	0.0760
BA	60821.88	9669.695	6.289948	0.0000
R	-2708.483	3498.638	-0.774153	0.4388
A02	168.1110	112.5893	1.493134	0.1354
D02	2308.123	3814.893	0.605030	0.5452
HOF02	3744.651	1170.177	3.200071	0.0014
WS02	1799.813	161.5804	11.13881	0.0000
E02	-345.4981	121.2549	-2.849354	0.0044
R-squared	0.985945	Mean dependent var	2004.583	
Adjusted R-squared	0.845395	S.D. dependent var	5060.267	
S.E. of regression	1989.689	Akaike info criterion	17.73438	
Sum squared resid	3958864.	Schwarz criterion	18.17887	
Log likelihood	-95.40626	Hannan-Quinn criter.	17.56981	

CONCLUSION

A conceptual framework to explain the demand for sports memorabilia was developed from the sports psychology and finance literatures, and used to construct a formal hedonic pricing model. This model was estimated on a sample of twelve baseball cards with prices observed in eight years over a twenty-year period. This model was estimated separately for each of the eight years and performed extremely well in explaining differences among baseball card prices. Race had a positive but diminishing effect on card price for black players. For the only Hispanic player, the effect of race was initially negative but became positive in the last year estimated. Race effects should not be taken as overturning the results of earlier researchers, as they may be due to small sample properties.

Batting average and player age have positive impacts on price, but surprisingly, rookie cards tend to be worth relatively less than non-rookie cards. A player's death generally increases the value of his cards, but in at least one year, 1982, the reverse was found to be the case. Hall of Fame status only began to have a significant and positive impact on card value starting in 1985; before that it was not significant. World Series appearances also add to the value of a player's cards. Career longevity, as measured by years since the start and end of a player's career gave ambiguous results, but results suggest that retirement adds to the value of a player's cards, though years since retirement detracts from card value. Years since the start of a player's career also detracts from card value, at least where that variable was included in the model.

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A REASSESSMENT OF THE RELATIONSHIP BETWEEN INCOME INEQUALITY AND POVERTY

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ABSTRACT

The paper challenges the belief that income inequality causes poverty. The state data set instead of international database is used to investigate whether or not a rise in income equality causes an increase or decrease in poverty rate. The methodology suggested by Learner (1983) and Levine et al (1991) is used to test the robustness of income inequality coefficient estimates by specifying and altering a set of other conditioning variables which explain poverty. The study finds support for the hypothesis that income inequality may cause economic growth and hence reduce poverty.

INTRODUCTION

One of the goals of the American economic system is equity. Indeed, if there is one area in which the role of government has expanded more rapidly, it is in the realm of income and wealth redistribution. And still, nothing arouses more emotions than the issues related to equity. While there is no scientific and objective way to define equity, it is generally accepted that government should not consciously engage in macroeconomic policies which make the income and wealth distribution more unequal.

Arguments in favor of more equal income distribution include: Reduced tension and envy between classes, higher economic growth, better resource allocation, reduced concentration of political power, greater equality of opportunities in social, political and economic arena, and a more cohesive society. As expected, income distribution also affects the poverty rate. Opinions on this subject, however, are mixed: Some scholars think that the income inequality accentuates poverty (Persson and Tabellini, 1994), others (Williams 1999, Kray

2002) believe that the relationship between income inequality and poverty is inverse.

The purpose of this study is to investigate the empirical relationship between poverty and income inequality. The policy implications of the study are significant. If the inverse relationship between poverty rate and income inequality is supported by data, it could shed new light on the conservative view- point that shift in income in favor of the rich is not necessarily at the expense of the poor. Indeed a macroeconomic policy which redistributes wealth and income away from the rich may be counter- productive in that it would shrink the size of pie and hurt the very poor that the policy seeks to protect. Similarly, the study would further support the conservative doctrine that tax break for the rich is good for everybody including the poor.

The case for an inverse relationship between income inequality and poverty can be made based on historical evidence. During the period of Industrial Revolution in Britain, rising income inequality was followed by falling poverty rates. During this period the wage gap between the skilled and unskilled workers widened. Jeffrey Williams (1999), for example, reports that the real wages of blue-collar workers nearly doubled between 1819 and 1851, but during the same period, the number of people in abject poverty declined dramatically. Similarly, in the United States, during the period of railroad construction, the concentration of income and wealth increased sharply because of a dramatic increase in the wages of engineers and machinists, but during the same period the inflation adjusted wages of the unskilled workers also increased at the annual rate of 1.8 percent. During the seven -year periods, 1993- 2000, the U.S Census data shows that whereas the poverty rate declined from 14 percent to less than 10 percent, the percentage of income claimed by top fifth of households increased to 49.7 percent in 2000 from less than 49 percent in 1993. Indeed, during this period, the Pearson Correlation between income inequality and poverty is .867 and is significant at .001 level.

Similarly, at the global level, over the last 30 years, the income inequality has increased within and across countries (Barro, 2002). Curiously enough, during the same period the number of people living in poverty has also declined. However, the correlation between the poverty and income inequality rate begs more questions than it answers. First, correlation does not indicate causality. Second, the correlation could be sensitive to the selected time period. Third, it is difficult to say how robust the correlation would be if some other conditioning variables are included. Last but not the least, correlation suggested by the time series data may not be confirmed by cross-section data. These questions provide the road map for this paper. First, we

would investigate how and why the income inequality might cause a decrease in poverty rate. Second, we would use the Learner's sensitivity model to investigate if the sign and robustness of the correlation coefficient would change by inclusion of the other conditioning variables. Finally, we would use the cross-section data from states within the United States to confirm the relationship between poverty and income inequality.

The causal relationship between income distribution and poverty hinges on how economic growth is related to each of the two variables. In other words, it begs answers to two fundamental but related questions: Does the income inequality cause economic growth and does growth cause a reduction in poverty? Based on the cross-country evidence, Kray (2002) concluded that growth causes almost a proportional increase in income of the poor. However, there are a few exceptions also. For example, the poor in India did not benefit much notwithstanding a rapid increase in growth rate during the 1990's. However, Kray (2002) feels there is evidence to suggest that eventually growth rate does trickle down. Of course, the poor can gain more if conscious macroeconomic policies are designed to solve the problem of poverty. However, Jenkins and Knight (2002) argue based on their study of Nigeria that it is difficult to balance the macroeconomic policies that promote economic growth and reduce income inequality and poverty. The logic of their arguments can be summarized as follows: economic growth depends on, among other factors, accumulation of human capital, physical capital, inventions and innovations. The rate at which individuals accumulate physical and human capital and invent and innovate depends on the economic incentives. If the fiscal and regulatory policies and environment (including political institutions and rule of law) were such that a large part of the fruits of individual efforts are confiscated, individual would not initiate and/or participate in activities that promote economic growth. In as much as the incentives depend on retention of fruit of efforts, too much concern for distributional conflicts can produce economic policies that militate against the incentives for pro-growth activities.

Following Keynes (1957), some economists argue that individual saving rate is sensitive to income level and, therefore, an increase in income inequality would increase individual saving rate. Indeed, based on the Keynesian presumptive relationship between the level of income and individual rate of saving, Barro (1999) posits "a redistribution of resources from rich to poor tends to lower the aggregate rate of saving in an economy". Accordingly, in a closed economy, cetris paribus, greater income inequality would encourage more savings, investment and hence economic growth.

Unequal distribution of assets in an economy may also have a favorable effect on economic growth through the credit markets. Creditors incur substantial set-up costs and, therefore, may favor entities and individuals with a large concentration of assets. Greenwood and Jovanovich (1990) and Piketty (1997) argue that the more imperfect the credit market is and the more lax the bankruptcy laws are, the greater the predilection of creditors for individuals with large asset base.

Persson and Tabellini (1994), however, argue that pro-income inequality policies do not by itself generate economic growth and that income inequality instead of being conducive is, in fact, harmful to economic growth. Their study is predicated on both historical panel data and post war cross-section data from 38 growth episodes. The coefficient of income equality is negative and statistically significant even when other conditional variables are changed.

Alesine and Perotti (1994) and Benhabib and Rustichini (1996) contend that glaring and rampant income and wealth inequality is a breeding ground for socio-political unrest and, therefore, tends to divert scarce resources to activities, which are inimical to economic growth.

Croix and Doepke (2003) findings support the Persson and Tabellini conclusion. Croix and Deopke hypothesize that the fertility rates are income sensitive; poor parents tend to have more children than the rich. Since poor parents have more children, they tend to expend less money on education per child. The educational differential among the children of the rich and poor affects the accumulation of human capital and hence has an unfavorable effect on economic growth. If one assumes that the fertility differential and hence education levels are income sensitive, as income inequality increases the weight assigned to families with lower average education would increase. This will adversely affect the accumulation of human capital and hence economic growth.

However, the recent data does not support Persson - Taelline and Croix - Doepke conclusion. The experience of the United States clearly indicates that in the 1990's, the so called New Economy period, the wage increase of managers and CEO's far exceeded the wage increase for workers and judged by any standard or measure the rich became richer. But did the poor become poorer? During the same period, the country experienced an inordinate growth rate and a poverty rate plummeted to its lowest level recorded in the history of this country. The percentage of poor declined steadily from 13.5 percent to 9.6 percent. It is difficult to generalize, however. The two decades between 1973 and 1993 have witnessed a widening gap between rich and poor, low growth rate and increase in number of

people in poverty. The period between 1960 and 1973 was marked by a steady decline in income inequality, rising growth rate and declining poverty rate. Needless to say, the debate regarding the income distributional effects on economic growth and poverty are still unsettled. Barro (1999) after a comprehensive review of literature concludes, "the theoretical ambiguities do, in a sense, accord with empirical findings, which tend not to be robust".

From a theoretical standpoint why would rising income inequality cause a decline in poverty rates? There seems to be three distinct reasons: First, spurt in technological change always create new fortunes and at the same time improve the wages and living conditions of those who are at the bottom of income scale. This was true during the Industrial Revolution in Britain and railroad construction and recent computer and Internet revolution in the United States. Second, higher skill levels required by new technology creates a demand for both more technical and advanced education. An increase in the quantity and quality of education creates a wider disparity among the skilled and unskilled workers and contributes to greater income inequality. However, a better educated labor force also causes a decline in poverty. The poverty rate among college educated persons is barely 3.2 percent compared to 9.2 percent among those who have high school education. Third, massive influx of immigrants also contributes to a decline in poverty and more wage disparity. The immigrants generally (particularly Asians) have greater differences in education level (and hence in income) compared to native population.

METHODS

In what follows, we use the methodology suggested by Learner (1983) and Levine et al (1991) to test the robustness of income inequality coefficient estimates by specifying and altering a set of other conditioning variables which explain poverty. It is assumed that the income inequality coefficient is statistically robust if it's *a priori* sign and statistical significance are insensitive to alternations in the conditioning set of variables.

The initial regression model includes the following:

$$(1) \qquad P_i = a + b_1 U_i + b_2 Y_i + b_3 W_i + E_i$$

Where P_i is the poverty rate, U_i is unemployment rate, Y_i is per capita income, W_i is the percentage of woman head of household in state$_i$ and E_i is error term.

Next, the robustness of the income inequality coefficient was tested by adding and altering a set of generally accepted variables in poverty literature. Equation 2 represents a general model that includes the following:

(2) $P_i = aS+b_1I+b_2 P+E$

Where P_i is the poverty rate; S stands for a set of variables, which are generally included in most empirical studies on the determinant of poverty. These variables include U_i is unemployment rate, Y_i is per capita income, W_i is the percentage of woman head of household in state$_i$ (see equation 1). "I" represents the variable of interest, in this case, a measure of inequality represented by the income gap between the richest 20 percent and the poorest 20 percent of the population in state$_i$ and "P" represents a pool of other potential variables, which are identified by researchers on poverty. The list of "P" variables include the following: percentage of population over 65(over65), the percentage of population employed in agriculture (AE), percentage of population employed in manufacturing (ME), and fertility rate (F) and "E" represents the error term. Most studies on poverty also include "education," because poverty and education are inversely related. However, since income and education are highly correlated, we excluded education variable in our model.

The cross- section data from 50 states within United States was used to retest the hypothesis that the incidence of poverty is inversely related to the income inequality. Our predilection for state data instead of the international data is based on the established fact that "that the international data are marred by incomplete coverage, biases and errors of measurement (Srinivasan,1994, Fields 1989, Barro 1999). In the same vein Janvey and Sadouler (1995) lament that 'in general, the levels of poverty and inequality remain difficult to compare across countries because they often correspond to different concepts".

The cross-section data for 50 states are derived from the Institute of Economic Policy study entitled, Pulling Apart: State by State Analysis of Income Trends: State Specific Fact Sheets, and historical poverty and income inequality tables from the Census Bureau.

We prefer income gap to Geni Coefficient as a measure of income equality for the following reasons: (1) it is at best misleading to try and capture the whole income distribution represented by the Lorenz curve by one number- the value of Geni

coefficient); (2) the Geni coefficient is more sensitive to changes in income distribution in the middle than to changes in income distribution at the either end; (3) distribution of income described by the Geni coefficient is ordinal rather than cardinal. Admittedly, the cardinal distribution has its own problems. The cardinal measure presumes that any change in inequality resulting from transfer between two individuals depends not on their rank in income distribution, but on their income shares.

However, our preference for income gap over Geni Coefficient may not matter because Barro (1999) cross -country study of 76 countries reveals that Geni value is " particularly highly correlated" with the highest quintile share in income.

ANALYSIS AND RESULTS

A multiple regression equation was formulated (see equation 1) to assess the relationship between the above referenced poverty determinants and percentage of people in poverty in each state.

$$(1) \qquad P_i = a + b_1 U_i + b_2 Y_i + b_3 W_i + E_i$$

A priori one would expect that:

$b_1 > 0$. While there are working poor, the poverty rates are directly related to the level of unemployment.

$b_2 > 0$. The incidence of poverty tends to be higher among those states that have low per capita income. Poorer the state, the more the number of people who are likely to be poor.

$b_3 < 0$. Feminization of poverty is well established. Disproportionate numbers of families with women head of the households tend to be poor.

Other conditioning variables are:

Percentage of people employed in agriculture (AE) > 0. More poor people live in the rural than in urban areas and their primary employment tends to be in agriculture than in manufacturing sector.

Percentage of people employed in manufacturing (ME) < 0. Since wage rate in manufacturing tends to be higher than that of the agricultural sector, an increased employment in manufacturing sector would reduce the percentage of poor people.

Fertility rates (F) < 0. If one assumes that the fertility differential and hence education levels are income sensitive, as income inequality increases the weight assigned to families with lower average education would increase. This will adversely affect the accumulation of human capital and hence poverty rate.

Table 1 shows that 48.1 percent of the variation in the average rate of growth of per capita real GDP is explained by the variables included in the model 1. The F- test indicates that the equation is statistically significant at .05 level. Signs of all the variables are what were expected a priori. The critical t-values indicate that all the explanatory variables are statistically significant at .05 level.

Next, we include in our model the "I" (interest) variable i.e. the income gap between the richest fifth and the poorest fifth of population—a cardinal measure of income inequality (see model 2). It is noteworthy that all the vital statistics show an improvement: R^2 jumps from .481 to .641, F statistic increases from 14.498 to 20.490 and is statistically significant at 0.05 and 0.01 levels. Income gap- a measure of income inequality- is inversely related to poverty rate and is statistically significant at 0.05 level.

Next, we test the robustness of income inequality coefficient by adding and altering a set of generally accepted variables in poverty literature. The equation 2 stipulates a general model:

$$(2) \qquad P_i = aS+b_1I+b_2 P+E$$

Based on the above equation, six (6) regression models are presented (see Table 1). Whereas the regression Model 1 includes only "S" variables; model 2 adds "I" interest variable to model 1, and models 3 through 6 include all the variables included in model 2 plus possible combinations of "P" variables. Based on these regression models, the highest and the lowest coefficient values of the interest variable "I" (income inequality), which cannot be rejected at the 0.05 significance level are identified. If the statistical significance and the sign of the coefficient of income inequality measured by income gap remains in tact at the extreme bounds, and is not sensitive to the inclusion of a combination of "P" variables, it can be stated with confidence that income inequality variable coefficient is robust. A perusal of the regression models 3 through 6 indicates that neither the sign nor the statistical significance of the income inequality coefficient is affected by addition of a set of conditioning variables. It is, indeed, interesting to note that whereas other variables

were proven to be fragile (see for example, the variable WmHH), the income inequality coeffcient maintained its robustness when conditioning variable were changed.

Table 1

	Variable	Coeffcient	t	R^2	F	White Test F- Prob
Model 1	Unemp(U)	.410	3.658	.481	14.498	.6714*
	Income percapita(Y)	-.452	- 4.004			
	WmHH	.263	2.387			
Model 2	Unemp(U)	.241	2.432	.641	20.490	.5999
	Income percapita(Y)	-.451	- 4.004			
	WmHH	.263	2.387			
	Income gap	-.503	- 4.523			
Model 3	Unemp(U)	.227	2.097	.651	13.698	.8567
	Income percapita(Y)	-.474	- 4.763			
	WmHH	.023	.213			
	Income gap	-.503	- 4.523			
	GDP growth rate	-.114	1.145			
Model 4	Unemp(U)	.227	1.842	.754	13.158	.8005
	Income percapita(Y)	-.397	- 3.547			
	WmHH	.190	1 .713			
	Income gap	-.503	- 4.523			
	Perct Emp Agri	-.166	1.707			
	Perct Emp Manu	.549	.595			

Table 1

	Variable	Coeffcient	t	R^2	F	White Test F- Prob
Model 5	Unemp(U)	.167	1.671	.754	13.158	.5071
	Income percapita(Y)	-.498	- 5.466			
	WmHH	.137	2.344			
	Income gap	-.399	-3.842			
	Fertility rate	-.020	.234			
Model 6	Unemp(U)	.249	2.332	.641	16.063	.5835
	Income percapita(Y)	-.447	- 4.608			
	WmHH	.021	.194			
	Income gap	-.497	-3.304			
	Over 65	.032	.223			

* Variables included in all the models and taken together.

In an extreme bound analysis multicollinearity could conceivably inflate the range of coefficients. However, the correlation matrix (see Table 2) shows that multicollinearity is not a problem. Admittedly, even if the income inequality coefficient is robust, the regression analysis at best indicates an associative relationship it does not conclusively prove that income inequality is the cause of variance in poverty. However, there is an intuitive reason that income inequality is the cause and not the effect of reduction in poverty. Our measure of income inequality is predated (1999) compared to the poverty rate data (2003). It is, therefore, logical to argue that the poverty rate in 2003 could not have affected the income distribution three years before. Cross-section data is often subject to heteroscedasticity. The White test not only test for heteroscedasticity, but also for model misspecification. The null hypothesis presumes that the errors are both homoskedastic and independent of the regressors and that the linear specification of the model is correct. The test statistic would be significant if these conditions are fulfilled. On the other hand, a non-significant test statistic indicates that none of the three conditions are violated. Table 1 (see the last column) attests that our presumption regarding the three conditions is correct.

Table 2: Pearson Correlation

	WHH	FERT	OVER 65	AE	ME	PER CAPITA INC	IN GAP	GROWTH RATE	UNEMP
WHH	1.00	.198	.264	-.045	.091	.014	.453	.021	0.60
FERT	.198	1.00	.482	.063	.046	.401	.222	.580	.247
OVER 65	.264	.482	1.00	-.070	.266	.281	.261	.037	.262
AE	-.045	-.063	-.070	1.00	.068	-.325	.016	-.148	-.093
ME	.091	-.046	.166	-.068	1.00	.042	-.302	.014	.205
PER CAP INC	-.014	.401	.281	-.325	-.205	1.00	.163	-.114	.467
IN GAP	.453	.222	.261	.016	-.302	.163	1.00	-.113	.413
GROWTH RATE	.021	.196	.264	-.045	.148	.114	.113	1.00	0.60
UNEMP	-.060	.247	.252	-.093	-.205	.467	.413	-.183	1.00

The results of this paper are consistent with Burro's (1999) surprise findings that that income inequality is positively related to economic growth in rich countries and negatively related to economic growth of poor countries.

SUMMARY AND CONCLUSIONS

International data yields dubious relationship among income equality, economic growth and poverty. We use state cross-section data because poverty and income inequality "remain difficult to compare across countries and sometimes across years within a country" (Janvey and Sadoulet, 1995).The study finds support for the hypothesis that income equality may cause economic growth and hence reduce poverty. The coefficient of income inequality as an explanatory variable maintained its robustness (negative sign and statistical significance at its extreme bounds) even when it was combined with other conditioning variables. Further research would require an empirical investigation of the path(s) by which the income distribution affects the poverty level.

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