Factors Affecting Increases in Economic Literacy Among High School Students

Minh Wendt, James West, Claudia Parliament*

Selected Paper prepared for presentation at the
American Agricultural Economics Association Annual Meeting
Portland, Oregon
July 30 - August 1, 2007

*Ph.D candidate, Ph.D graduate, and Professor,
Department of Applied Economics, University of Minnesota

This research was made possible through grants from the St. Paul Public Schools Foundation, Minneapolis Public Schools Learning Center for Economics, Excellence in Economic Education Federal grant administered by the National Council on Economic Education, and generous contributions from current and former members of the Board of Directors of the Minnesota Council on Economic Education.

1. Introduction

Widespread understanding of economic principles is necessary for individual and national success in a complex global economy. However, surveys indicate that most students do not know what a federal debt is, cannot identify the most widely used measure of inflation, and believe wages are set by government action. In short, they do not understand how our country's economy works.

"Economic education is essential for active citizenship and for the creation of a well-functioning, informed democracy," said Anne Krueger, First Deputy Managing Director of the International Monetary Fund, addressing the 2002 National Summit on Economic and Financial Literacy. "It's hard, if not impossible, to have any kind of meaningful debate on what government should or should not be doing without having a basic grasp of how markets work and of the tradeoffs involved in trying to meet unlimited wants with limited resources."

There is a clear need to improve the level of economic understanding among our citizenry. One means to improve economic understanding over time is to determine factors associated with increases in economic literacy among high school students. This research is designed to identify teacher, student, and school factors that affect student learning of economics. Once factors significantly affecting student performance are identified, policies can be put into place to increase student performance.

In comparison to other pertinent studies, this research uses a relatively large and extensive data set of teacher, school, and student information. Both teacher and student pre- and post-test scores are used to measure achievement and progress in economic understanding. Econometric models not previously reported for research on student learning of economics are used: survey OLS, random-effects, and fixed-effects models.

2. Literature Review

Factors affecting student's performance have been examined in numerous studies. Typically inputs such as teacher and school characteristics are measured against output, typically student performance. This conceptual framework has been adopted for a variety of inputs and outputs related to education. Family background, peers, quality of teachers, and school resources are inputs that have been examined, and not surprisingly, the findings differ with regards to the impact of these inputs in the production process (Coleman et al., 1966; Hanushek, 1986, 1997, 1998, 2002; Eide and Showalter, 1998; Lavy, 1998; Darling-Hammond, 1999; Angrist and Lavy 2001; Worthington, 2001; Rivkin et al., 2002; Rowe, 2003; Bishop and Wößmann, 2004; Hanushek et al., 2005).

Specifically focusing on student achievement in economics, a number of studies have examined the effects of teacher education, experience, and in-service professional development on student learning. Using the *Test of Economic Literacy* (TEL), a nationally normed and standardized test for high school students, Bosshardt and Watts (1990) determine that teacher education in economics combined with other factors including the size of the school and the quality of the students, are significant factors in explaining students' increases in TEL scores. In another study utilizing the TEL, Lynch (1990) found that there were benefits to students from increased teacher education, but not until more than one college-level of economics course was taken by the teacher. Becker, Green, and Rosen (1990) also find that teacher education significantly benefits students. Wetzel and O'Toole (1991) also assess student performance based on teacher's characteristics. They determine that teacher's academic background in economics translated to better student performance on the TEL. In a review of seventeen studies based on extensive data, Highsmith and Baumol (1991) show that an additional undergraduate course in economics taken by the teacher contributes substantially more to the performance in economics by the student than either an additional graduate course or an additional year of experience in teaching economics. In an international setting, research conducted by Walstad and Rebeck (2001) indicates a larger increase in the economic understanding of students of teachers who participated in economic education seminars offered by the National Council on Economic Education in Lithuania, Ukraine, Kyrgystan, and Poland.

Allgood and Walstad (1999) looked at longitudinal data to analyze the impacts of teacher education on student test scores over time for twelve participating teachers of economics. Using the *Test of Understanding in College Economics* (TUCE), a nationally normed and standardized test to measure teacher economic literacy and the scores on the Test for Economic Literacy (TEL) to measure student understanding, they found a significant relationship between scores on the TUCE and student increases on the TEL. Teachers scoring above the mean on the TUCE had students with significantly greater gains in TEL scores.

Student characteristics have also been studied to determine the impact on achievement in economics. Wetzel and O'Toole (1991) determine that student gender and plans to attend college were not found to be a significant variable affecting student performance on the TEL. However, other studies indicate gender has been shown to have an impact a student's TEL score (Walstad and Robson 1997; Ferber, Birnbaum, and Green, 1983; Lumsden and Scott, 1987). After finding significantly higher scores for males, Walstad and Robson (1997) looked into factors causing this result. A method was used to identify and eliminate questions that might create testing bias on the TEL. Students were then given a modified version of the TEL. The gender differences in scores decreased on the modified TEL but were still present. This suggests that question bias was not the only cause of the differences in test scores between genders. These differences can possibly be attributed to females performing relatively lower on multiple-choice tests, as shown in Ferber, Birnbaum, and Green (1983) and Lumsden and Scott (1987). Cultural and environmental influences, cognitive differences, or teaching methods could also be factors affecting the performance of female students. In contrast, Park and Kerr (1990), using a sample of 97 students of a college economics professor, found that effort and intelligence determine the grade while demographic variables are not significant. However, this study focuses solely on student's characteristics and does not control for other factors such as teacher and school characteristics.

A variety of statistical methods have been used to examine the relationship between student achievement and the school, teacher, and student inputs that may affect student performance. Leppel (1984) used a Tobit model in examine the impact of student characteristics on student performance. Wetzel and O'Toole (1991) used a probit model to assess student performance based on teacher's characteristics. Park and Kerr (1990) used multinomial logit approach to identify the determinants of a student's course grade.

3. Research Design

This research examines inputs associated with student performance in economics. Student performance is measured terms of (1) achievement as measured by their final test scores and (2) progress as measured by change in pre- to post-test scores. Similar to previous research, this study examines the impact of teacher characteristics on student performance; however, it includes a more extensive set of student, teacher, and school attributes than previous research.

3.1 Data

Twenty-eight high school teachers representing 22 schools participated in the research. Several of the teachers included in the study teach more than one economics class in a given semester, and several of the teachers were included for more than one year. The data was collected over a period of three years, from fall 2003 to spring 2006.

These teachers completed a summer graduate course designed to increase their understanding of economics and to improve the methods they use to teach economics. As part of the course, the teachers were pre- and post- tested using the *Test of Understanding in College Economics* (TUCE), a standardized an normed test published by the National Council on Economic Education. The teachers provided information on gender, years of experience teaching economics, number of college-level economics courses taken, and graduate degrees.

These teachers then pre- and post-tested a total of 1,244 students using *Test of Economic Literacy* (TEL*),* a standardized and normed test published by the National Council on Economic Education to measure student understanding of economics at the high school level. The pre- and post-testing of students was embedded within the high school economics courses taught by the participating teachers. The test was taken online in the school's computer lab. Student information was collected on gender, race and ethnicity, and hours worked per week outside of school.

The TEL consists of 40 multiple-choice questions and covers four content categories: fundamental economic concepts, microeconomic concepts, macroeconomic concepts, and international economic concepts. There are two versions of the test, A and B. Form A was given to students during the first week of an economic course as a pre-test. Upon completion of the economics course, Form B was given as a post-test[1].

School information was collected from the Minnesota Department of Education. Data collected included percent of students on the free or reduced-price lunch program, percentage of special education students, and number of students at the school.

3.2 Analysis

The following models are estimated using two measures of student understanding of economics as dependent variables. A student's *achievement* is measured by the post-TEL score and a student's *progress* is measured by the change from the pre- to the post-test in the TEL score. Both measures will be analyzed as a dependent variable with an educational "production function" recognizing the educational process (Hanushek, 1986).

In all model specifications, the outcome of student *i* with teacher *j* at school *k*, Y_{ijk}[2], is a function of individual background variables X_{ijk}, teacher's characteristics, T_j, a vector of school resources, S_k, and a random error term. Both teacher's characteristics and school resources are assumed to not vary across students.

$$(1)\quad Y_{ijk} = \beta X_{ijk} + \delta T_{jk} + \gamma S_k + \varepsilon_{ijk}$$

If Equation (1) is correctly specified, ordinary least squares (OLS) estimation will yield consistent estimates of β, δ, and γ. However, it is well known that there are possible unobserved characteristics of school resources and teacher "ability" that affect student's outcomes. Examples might include school policies or teacher's skill and motivation that impact student's performance, but they are not reflected in the dataset and thus not observed. Therefore, Equation (2) is estimated

$$(2)\quad Y_{ijk} = \tilde{\beta} X_{ijk} + \tilde{\delta} T_{jk} + \tilde{\gamma} S_k + \upsilon_{ijk}$$

[1] For the analysis, the linear equating method was used to convert raw scores on Form A to the Form B scale (Walstad and Rebeck, 2001).

[2] That is, Y_{ijk} stands for both student's achievement, A_{ijk}, standardized Post test TEL score for student *i*, in class of teacher *j*, in school *k* and student's progress, P_{ijk}, standardized change of scores from Pre to Post-test TEL for student *i*, in class of teacher j, school *k*. These will be presented as 2 separate models in the result part.

where the error term now includes unobservable teacher's characteristics, $T_j^{'}$, and school's characteristics, $S_k^{'}$, as well as a random component. That is,

$\upsilon_{ijk} = \delta^{'} T_{jk}^{'} + \gamma^{'} S_k^{'} + \varepsilon_{ijk}$.

OLS estimation will yield consistent estimates of β, δ, and γ, as long as the unobservables are uncorrelated with observable ones (Woolridge, 2002). However, OLS might provide larger variances for these estimates, resulting in inefficient and imprecise inferences for the estimated coefficients of student, teacher, and school regressors.

One possible solution to the problem of unobserved characteristics, $T_{jk}^{'}$ and $S_k^{'}$, is to add data or proxies for them. This might be done by including measures of teacher behavior or motivation, or other proxies for school resources. However, it is unlikely that any dataset will contain sufficient information to capture adequately $T_{jk}^{'}$ and $S_k^{'}$.

Under the assumption that the unobservables are uncorrelated with the regressors in our model, another possible solution is to use the following model to assess the effects of X_{ijk}, as well as common teacher- or school-specific factors:

(3) $Y_{ijk} = \beta X_{ijk} + \gamma S_k + \alpha_{jk} + \varepsilon_{ijk}$ or

(4) $Y_{ijk} = \beta X_{ijk} + \delta T_{jk} + \sigma_k + \varepsilon_{ijk}$

where α_{jk} in (3) or σ_k in (4) capture the influence of all factors linked to membership with teacher *j* or school *k,* respectively.

There are two ways to conceptualize and estimate α_{jk} or σ_k. In a fixed-effects (FE) model, they are considered a set of constants representing membership with a jth teacher or kth school, respectively[3]. In a random-effects (RE) model, the total effect of teacher or school is treated as constant across students but random across teachers or across schools.

---

3 Alternatively, one can transform the data by subtracting the teacher- or school-specific means ($Y_{.j}$ or $Y_{.k}$ and $X_{.j}$ or $X_{.k}$) from each student's observation for the dependent and independent variables. In other words, the fixed effect estimator assumes that no variables are constant across students within a teacher's cluster or a school. Variables that do not vary among students cancel out and are assumed to be part of the α_j or σ_k, respectively for teacher jth and school kth. The resulting regression is simply $Y_{ijk}^{*} = \beta X_{ijk}^{*} + \varepsilon_{ijk}^{*}$ where $\varepsilon_{ijk}^{*} = \varepsilon_{ijk} - \varepsilon_{i.k}$ for teacher jth or $\varepsilon_{ijk}^{*} = \varepsilon_{ijk} - \varepsilon_{ij.}$ for school kth

In other words, α_{jk} or σ_k is considered a random disturbance specific to j^th teacher or k^th school. Generalized least squares (GLS) method, suggested by Greene (2003), provides appropriate estimates of β and γ in equation (3) and β and δ in equation (4) and their standard errors. Particularly, a random-effects model can include covariates that do not vary across students within a teacher's or a school's cluster. A Hausman test can be used to determine the relative strength of the FE or RE model specification.

In all models, vector X of student characteristics includes:

- Gender (dummy variable, 1 for female);
- Race (dummy variable, 1 for White); and
- 20 or more hours working per week outside of school (1 for "yes").

Vector S of observed school characteristics includes:

- School size (measured by the number of students at school for current year);
- Percentage of students eligible for free or reduce-priced lunch; and
- Percentage of students with special education needs.

Vector T of observed teacher characteristics includes:

- Teacher knowledge of economics (measured by standardized test scores);
- Years of experience teaching economics (categorical data);
- Number of college level economics courses taken (categorical data);
- Masters degree in education (dummy variable, 1 for "yes"); and
- Gender (dummy variable, 1 for female).

Both teacher and student test scores are standardized by subtracting the sample mean from raw scores and dividing by the sample standard deviation. This standardization procedure avoids the discrete, bounded, and ordinal nature of raw test scores. An analysis using raw scores can lead to a prediction of values beyond the upper or lower bounds of the test instrument. Standardized test scores also make it easier to interpret results.

To measure a teacher's knowledge of economics, either post TUCE scores or the change in TUCE scores from pre- to post-testing could be used. A post TUCE score is measure of achievement or the stock of knowledge, and the change in TUCE scores is a measure of progress or "value added." The standardized change in TUCE scores provides information on the knowledge gained from the professional development experience.

Regressions using each measure of a teacher's knowledge were examined. Econometrically, there are two reasons for not using post-TUCE scores in our regressions. First, post-TUCE scores might be correlated with other observed teacher's characteristics, which create multicollinearity among explanatory variables. Second, and more importantly, it might generate an omitted variable bias as the post-TUCE score does not capture a teacher's interest, enthusiasm, commitment, or motivation to learn economics that are captured better by a teacher's increase in the TUCE score. When the change in TUCE scores is used in the analysis, the pre-TUCE score is also included to control for the teacher's pre-training stock of economic knowledge.[4]

Survey regression is the first estimation method used for the analysis. This method accounts for the clustering of associated student observations. Students in the same class taught by the same teacher will be considered clustered samples because they are likely to share similarities among members. Ordinary Least Squares (OLS) regression is not appropriate for this data because standard errors are not corrected for the clustering effect. To control for the clustering effect, a primary sampling unit (PSU) is indicated for each class in the sample. The use of a primary sampling unit is compatible with multivariate linear analysis. There are fifty-three classes of students, or PSU's, included in the data set.

The clustering design has proved to produce more precise estimates than assuming a simple random design (Woolridge, 2002). By controlling for the cluster effect of data sampling, a better estimate of the true population variance is obtained, which will have larger standard errors than estimates obtained from a simple random assumption for the same sample size. If simple OLS is used for the analysis, it might incorrectly result in more significant variables than the clustering method estimates.

A survey ordered probit is the second estimation method used to estimate factors affecting student performance. Probit model specifications convert test scores into a categorical variable indicating the probability of attaining a test score level. The use of

[4] We also tried using only the post-TUCE scores as an independent variable, but the results were not as robust.

the cumulative probability function provides a transformation based on the assumption of a normal distribution of student scores. Standardized scores provide a natural method to divide scores into three categories: scores one standard deviation (SD) or more below the mean, scores within one SD around the mean, and scores one SD or more above the mean. Probit analysis has been used in other studies of student performance in economics (Spector and Mazzeo, 1980; Wetzel and O'Toole, 1991).

Finally, FE and RE model specifications are used to capture the impact of teacher's or school's unobserved characteristics on student's outcomes. Tests of model appropriateness are discussed in the next section.

As reported in Table 4, there is no statistical difference in student's raw scores between this data sample and the TEL norming sample (Walstad and Rebeck, 2001). Thus the regression to the mean econometric problem identified by Becker et al (1990) is assumed to be minimal.

4. Results

4.1. Factors Affecting Student Achievement as Measured by Post-Test Scores

4.1.1 OLS and Ordered Probit models

Table 1 shows the results of the survey OLS and the ordered probit estimations. Both methods indicate a statistically significant effect of a teacher's change in TUCE scores on student achievement in economics. Other teacher characteristics such as the number of college-level economics classes taken and a Masters degree in education are also estimated to significantly impact student post-TEL scores, although more modestly. These results support previous studies (Becker, Green, and Rosen, 1990; Bosshardt and Watts, 1990; Angrist and Lavy, 2001; Walstad and Rebeck, 2001).

The results are robust in terms of signs and significant levels of the estimated coefficients on the teacher variables for both estimation methods. For the survey OLS model, a one standard deviation increase in a teacher's change of TUCE score is estimated to induce a 0.35 standard deviation increase in their students' post-test scores.

That is, a 3.6 point change in teacher's TUCE scores translates to 2.6 point increase in a student's post-test score, all else equal.

Teacher experience, as measured by number of years teaching economics, is not estimated to significantly affect student's achievement. This result is in contrast to the findings of Hanushek, et al. (2005) who found teaching experience, as measured by the number of years teaching, to be the only relevant link between teacher characteristics and student achievement.

Teacher gender was not found to be a significant factor impacting student test scores. These results are in line with previous studies (Highsmith and Baumol 1991; Robb and Robb, 1999).

With respect to school characteristics, the number of students in a school is estimated to have a small but statistically significantly impact on students' post-TEL score. This variable might be a proxy for a teacher's opportunity to specialize in economics within a large school. The percentage of special education students is estimated to have a significant and negative impact on student post-TEL scores. The other school variable, percentage of students qualified for reduced price lunch, is not estimated to significantly impact a student's post-TEL score.

Student characteristics are estimated to have a significant impact on achievement. Based on the survey OLS estimated coefficients, White students are estimated to score 0.23 standard deviation (1.74 points) above other ethnic or racial groups. Students who work more than twenty hours per week are estimated to score 0.15 standard deviation (1.15 points) below their peers. As expected, a student's prior knowledge of economics as measured by pre-test scores is estimated to reflect significantly in their post-TEL score.

This research supports other studies that found there is no relationship between student gender in economics understanding (MacDowell, et al, 1977; Bosshardt and Watts, 1990) or there are inconclusive results in both *understanding* and *learning* economics (Siegfried, 1979). This research does not support studies that found significantly higher TEL scores for males (Walstad and Robson, 1997; Ferber et al, 1983; Lumsden and Scott, 1987). Part of these differences could be due to the use of different estimation methods and/or set of control variables.

4.1.2 Fixed-effects and Random-effects models

Table 3 contains FE and RE specification in modeling student's achievement. F-tests show that FE specification of the model is better than standard OLS which implies the FE specification is stronger than survey OLS. Lagrange multiplier tests indicate that RE specification is also superior to OLS. Finally, Hausman tests suggest that RE specifications is more appropriate for these data than FE models.

The results of FE and RE models for schools are shown in columns 1 and 2 and FE and RE models for teachers are displayed in columns 3 and 4. With the exception of the change in TUCE score teacher variable, the other teacher's characteristics are not statistically significant in teacher random-effects model (column 4) However, these teacher characteristics are significant in the school random-effects model (column 2). These results indicate that unobserved teacher characteristics do not affect student's achievement. The results also indicate unobserved school characteristics play an important role in explaining student's achievement in economics. In contrast to the estimated results of the survey OLS and ordered probit models, the RE and FE models for schools indicate teaching experience has a significant impact on student performance. The results indicate that after two years the experience of teaching economics has a positive impact on student achievement.

4.2 Factors Affecting Student Progress as Measured by Change in Scores

4.2.1 OLS and Ordered Probit models

Table 2 shows results for both the survey OLS and the ordered probit estimations, with student progress as the dependent variable. Both methods indicate a statistically significant effect of a teacher's change in TUCE scores on a student's increase in tests scores. Other teacher characteristics such as the number of college-level economics classes taken and a Masters degree in education are also estimated to significantly impact the increase of a student's TEL score, although more modestly.

For the survey OLS results, a one standard deviation increase in a teacher's change of TUCE score is estimated to induce a 0.43 standard deviation increase in pre- to post-TEL scores. That is, a 3.6 points change in teacher's TUCE scores translates to 2.8 points change in a student's scores.

Teacher experience as measured by number of years teaching economics is not estimated to affect student's progress. However, as in the previous model, the opposite signs on the experience and the square of experience variables indicate that student learning is not a linear function of a teacher's experience teaching economics. The gender of the teacher does not impact student increases in TEL scores.

With respect to impact of school characteristics on increases in student learning, both the survey OLS and ordered probit methods estimate the same sign and significance of impact as estimated in the first model. The number of students in a school is estimated to have a small but statistically significantly impact on a student's increase in TEL score. The percentage of special education students is estimated to have a significant and negative impact on student increases in TEL scores. The percentage of students in the school who are eligible for reduced price lunch is not estimated to significantly impact a student's progress in learning economics.

Student characteristics are again estimated to have a significant impact on student performance. Based on the survey OLS estimated coefficients, white students are estimated to gain 0.3 standard deviation (2 points) above other ethnic or racial groups. Students who work more than twenty hours per week are estimated to be 0.19 standard deviation (1.2 points) below their peers. A student's prior knowledge of economics as measured by pre-test scores is estimated to significantly lower their increase in TEL score.

4.2.2 Fixed-effects and Random-effect models

Table 4 contains FE and RE specification in modeling student's progress. As with student's achievement models above, F-tests show that FE specification of the model is better than standard OLS. Lagrange multiplier tests indicate that RE specification is superior to an OLS. Hausman tests suggest that a RE specifications are more appropriate for these data than are FE models.

Columns 1 and 2 display results for *school* FE and RE specifications and columns 3 and 4 for *teacher* FE and RE. As in the case of student's achievement, these results imply unobserved school characteristics play an important role in explaining differences in students' progress, while unobserved teacher's characteristics are not significant. Again, in contrast to the OLS and Probit models, the school FE and RE models indicate teaching experience has a significant and non linear impact on student learning. The results indicate it takes three years of teaching economics before a teacher has a significant impact on student progress.

5. Summary and Policy Implications

This research documents a significant link between teacher characteristics and student learning. Both models analyzing factors affecting student's performance and all four estimation methods indicate that an increase in a teacher's knowledge of economics, as measured by the change in TUCE scores after a week-long, professional development course, significantly impacts student understanding of economics. It does not matter whether student learning is measured in terms of achievement or progress.

The results also indicate that teacher education and experience have a significant impact on student learning. A teacher's knowledge of economics, as measured by the number of college level economics courses taken, and holding a Master's degree in Education have a smaller but statistically significant impact on student performance in learning economics. With unobserved school characteristics controlled, a teacher's experience teaching economics is found to significantly impact students' performance.

With respect to student characteristics, student gender is not found to statistically impact either student increases in TEL scores or in final TEL scores. In contrast to some earlier studies, females are on equal grounds in terms of learning economics. Students who work more than 20 hours per week are estimated to be at risk in learning economics. Students who consider themselves White are found to have significantly higher TEL scores and higher increases in TEL scores than students who consider themselves Black, Hispanic, Native American, or other.

With regards to school characteristics, no relationship between the number of students on free and reduced lunch and student learning in economics is found. However, the percentage of special education students is estimated to have a significant negative impact on both measures of student performance. The size of the student body has a small, but statistically significant impact on student learning in economics. This could be the result of a teacher's ability to specialize in economics within a school with a larger student body.

The policy implications of this research indicate that funds to support professional development offerings in economics content and effective methods to teach economics should be considered using a cost benefit analysis at the national, state, and school district level. Current policies can be found at all three levels to support professional development in economics education. The question is whether the cost of the professional development is lower than the social benefits obtained with higher student achievement in economics.

Given the statistically significant impact on student performance with additional course work in economics, another policy implication of this research includes the consideration of additional course work in economics for teacher licensure. Such a policy requires a careful examination of the inherent trade-offs in the mix of required courses for social studies licensure. If additional course work is required, it will be tied to a reduction in other course work requirements. Alternatively, social studies licensure could be broken into fields of specialization rather than encompassing all of the social studies as it currently stands in many states.

At the school district level, incentives to complete a Master's Degree in Education or course work in economics may be justified. The increase in payroll expense for a teacher with a Master's Degree in Education or increased course work in economics may be offset by the estimated significant increases in student performance.

Future research needs to include additional school variables because both the FE and RE models imply that unobserved school characteristics play an important role in explaining the variations in student's performance. Variables that could be considered in future work include: time spent in an economics course, whether or not economics is required or elected, the school's salary range for teachers, and expenditure per pupil.

Table 1: Results for student's achievement, OLS and Order Probit models

Variables	Student's Standardized Post-test TEL score	
	OLS	**Ordered Probit**
Teacher		
Standardized Change in TUCE scores	0.35 (0.08)***	0.47 (0.12)***
Standardized Pre-test TUCE scores	-0.03 (0.11)	0.01 (0.16)
Years Teaching Economics	-0.08 (0.08)	-0.17 (0.11)
Years Teaching Economics Squared	0.01 (0.01)	0.02 (0.01)*
Female	0.17 (0.11)	0.18 (0.16)
Number of college economics courses	0.11 (0.04)**	0.16 (0.07)**
Masters in Ed.	0.15 (0.07)**	0.17 (0.10)*
School		
Number of students in school	0.02 (0.01)**	0.03 (0.01)**
Percent of special education students.	-1.45 (0.28)***	-1.87 (0.45)***
Percent of students on free/reduced lunch	0.11 (0.26)	0.04 (0.39)
Student		
Work 20+ hours per week	-0.15 (0.06)***	-0.27 (0.10)***
Female	-0.04 (0.05)	-0.14 (0.09)
White	0.23 (0.07)***	0.38 (0.12)***
Pre-test scores	0.58 (0.03)***	0.84 (0.07)***
Constant	-0.70 (0.39)*	n/a
R-squared	0.48	
F(14, 39)	79.03	21.10
Observations	1,244	1,244

*Significant at 10% level, ** significant at 5% level, *** significant at 1% level
Standard error in parentheses

Table 2: Results for student's progress, OLS and Ordered Probit models

Variables	Student's Standardized Change from Pre- to Post-test TEL score	
	OLS	**Ordered Probit**
Teacher		
Standardized Change in TUCE scores	0.43 (0.10)***	0.49 (0.12)***
Standardized Pre-test TUCE score	-0.03 (0.14)	0.05 (0.14)
Years Teaching Economics	-0.10 (0.10)	-0.07 (0.11)
Years Teaching Economics Squared	0.02 (0.01)	0.02 (0.01)
Female	0.22 (0.14)	0.19 (0.15)
Number of college economics courses	0.14 (0.06)**	0.17 (0.07)**
Masters in Ed.	0.19 (0.09)**	0.31 (0.10)***
School		
Number of students in school	0.03 (0.01)***	0.03 (0.01)**
Percent of special education students.	-1.82 (0.36)***	-2.36 (0.42)***
Percent of students on free/reduced lunch	0.13 (0.33)	0.12 (0.45)
Student		
Work 20+ hours per week	-0.19 (0.07)***	-0.26 (0.09)***
Female	-0.04 (0.06)	-0.11 (0.08)
White	0.30 (0.09)***	0.23 (0.11)**
Pre-test scores	-0.44 (0.04)***	-0.53 (0.07)***
Constant	-0.88 (0.49)*	n/a
R-squared	0.28	
F (14, 39)	26.70	13.55
Observations	1,244	1,244

*Significant at 10% level, ** significant at 5% level, *** significant at 1% level
Standard error in parentheses

Table 3: Results for student's achievement, Fixed- and Random-Effects models

	School Fixed Effects	School Random Effects	Teacher Fixed Effects	Teacher Random Effects
Teacher				
Standardized Change in TUCE scores	1.89 (0.61)***	0.29 (0.05)***	--	0.26 (0.09)***
Standardized Pre-test TUCE scores	0.51 (0.52)	-0.01 (0.09)	--	-0.03 (0.14)
Years Teaching Economics	-0.29 (0.16)*	-0.09 (0.05)*	--	-0.07 (0.10)
Years Teaching Economics Squared	0.11 (0.03)***	0.02 (0.01)***	--	0.01 (0.01)
Female	--	0.11 (0.09)	-1.52 (0.69)**	0.06 (0.16)
Number of college economics courses	0.29 (0.17)*	0.07 (0.04)*	--	0.09 (0.06)
Masters in Ed.	-1.95 (1.11)*	0.21 (0.09)**	--	0.17 (0.16)
School				
Number of students in school	-0.10 (0.05)**	0.02 (0.01)***	--	0.02 (0.01)**
Percent of special education students.	--	-1.44 (0.31)***	--	-1.20 (0.50)**
Percent of students on free/reduced lunch	7.05 (5.16)	0.09 (0.32)	--	0.10 (0.49)
Student				
Work 20+ hours per week	-0.13 (0.05) **	-0.16 (0.05)***	-0.13 (0.05)**	-0.14 (0.05)***
Female	-0.01 (0.04)	-0.03 (0.04)	-0.01 (0.04)	-0.02 (0.04)
White	0.22 (0.06)***	0.21 (0.06)***	0.24 (0.06)***	0.24 (0.06)***
Pre-test scores	0.63 (0.02)***	0.61 (0.02)***	0.63 (0.02)***	0.62 (0.02)***
Constant	0.20 (1.38)	-0.54 (0.28)*	0.34 (0.24)	-0.64 (0.45)
F (12, 1214)	69.07		160.71	
Wald χ^2		869.88		843.70

*Significant at 10% level, ** significant at 5% level, *** significant at 1% level
Standard error in parentheses

Table 4: Results for student's progress, Fixed- and Random-Effects models

	School Fixed Effects	School Random Effects	Teacher Fixed Effects	Teacher Random Effects
Teacher				
Standardized Change in TUCE scores	2.36 (0.76)***	0.36 (0.07)***	--	0.32 (0.11)***
Standardized Pre-test TUCE scores	0.64 (0.64)	-0.01 (0.11)	--	-0.03 (0.18)
Years Teaching Economics	-0.36 (0.20)*	-0.12 (0.07)*	--	-0.09 (0.13)
Years Teaching Economics Squared	0.13 (0.04)***	0.02 (0.01)***	--	0.02 (0.02)
Female	--	0.14 (0.11)	-1.90 (0.87)**	0.08 (0.20)
Number of college economics courses	0.36 (0.21)*	0.09 (0.05)*	--	0.11 (0.09)
Masters in Ed.	-2.44 (1.39)*	0.26 (0.11)**	--	0.22 (0.20)
School				
Number of students in school	-0.13 (0.06)**	0.02 (0.01)***	--	0.02 (0.01)**
Percent of special education students.	--	-1.79 (0.38)***	--	-1.50 (0.63)**
Percent of students on free/reduced lunch	8.82 (6.45)	0.11 (0.40)	--	0.13 (0.62)
Student				
Work 20+ hours per week	-0.16 (0.07) **	-0.19 (0.07)***	-0.16 (0.07)**	-0.17 (0.07)***
Female	-0.01 (0.05)	-0.04 (0.05)	-0.01 (0.05)	-0.02 (0.05)
White	0.27 (0.08)***	0.26 (0.07)***	0.30 (0.08)***	0.29 (0.08)***
Pre-test scores	-0.38 (0.03)***	-0.41 (0.03)***	-0.38 (0.03)***	-0.39 (0.03)***
Constant	0.25 (1.73)	-0.67 (0.35)*	0.43 (0.29)	-0.81 (0.56)
F (12, 1214)	27.58		36.56	
Wald χ^2		350.71		210.69

*Significant at 10% level, ** significant at 5% level, *** significant at 1% level
Standard error in parentheses

Table 5: Summary of Variables

Variables	Mean	SD	Min	Max
Teacher				
Years of teaching	6.48	6.22	1	31
Years of teaching economics	1.93	1.77	0	9
Has Masters in Education	0.42	0.49	0	1
Number of college econ taken	2.62	1.70	1	6
Pre-TUCE scores	30.74	8.37	16	43
Post-TUCE scores	36.28	7.68	21	45
Change TUCE scores	5.54	3.65	-2	12
School				
Number of students	1761	988	202	3112
Percent special education	0.12	0.12	0.05	0.84
Percent free/reduced lunch	0.19	0.17	0.04	0.71
Student				
Pre-TEL scores	19.01	7.19	3.05	37.73
Post-TEL scores	23.88	7.56	5	40
Change of TEL scores	4.87	6.42	-15.45	26.85
Work 20+	0.17	0.38	0	1
Female	0.43	0.49	0	1
White	0.76	0.43	0	1

Table 6: Mean Statistics for TEL Norming Sample and Research Sample

Sample	Form A	Form B
TEL Norming Sample (3rd ed.)	19.05 (7.99)	24.71 (7.66)
Sample size	3,288	3,955
Research Sample	19.01 (pre) (7.20)	23.88 (post) (7.56)
Sample size	1,244	1,246

Standard error in parentheses

T-test of the null hypothesis that there is no difference in the mean values between TEL and MCEE cannot be rejected, which means there is no difference between mean values of TEL Form A and pretest, and between TEL Form B and post-test.

REFERENCES

Allgood, S. and Walstad, W. The Longitudinal Effects of Economic Education on Teachers and Their Students. *Journal of Economic Education*, 30(2) 99-111, 1999.

Angrist, J. and Lavy, V. Does Teacher Training Affect Pupil Learning? Evidence from Matched Comparisons in Jerusalem Public Schools. *Journal of Labor Economics*, 19(2) 343-369, 2001.

Becker, W., Green, W., and Rosen, S. Research on High School Education. *Journal of Economic Education,* 21(3) 231-245, 1990.

Bishop, J. and Wößmann, L. Institutional Effects in a Simple Model of Education Production. *Education Economic* 12(1) 17-38, 2004.

Bosshardt, W. and Watts, M. Instructor Effects and Their Determinants in Pre-College Economic Education. *Journal of Economic Education*, 21(3) 265-276, 1990.

Coleman, J., Campbell, E., Hobson, C., McPartland, J., Mood, A., Weinfeld, F., and York, R. Equality of Educational Opportunity. Washington, D.C.: U.S. Government Printing Office, 1966.

Darling-Hammond, L. Teacher Quality and Student Achievement: A Review of State Policy Evidence. *Center for the Study of Teaching and Policy*, University of Washington, 1999.

Eide, E. and Showalter, M. The Effect of School Quality on Student Performance: A Quantile Regression Approach. *Economics Letters*, 58 345-350, 1998.

Ferber, M., Brinbaum, B., and Green, C. Gender Differences in Economic Knowledge: A Reevaluation of the Evidence. *Journal of Economic Education*. 14(2) 24-36, 1983.

France, J., Summary, R., Vasegh-Daneshvary, N.. The Impact of Economic Education Courses on the Retention of Knowledge of Secondary and Primary School Teachers. *Journal of Economic Education,* 10(4) 346-354, 1989.

Greene, W. *Econometric Analysis*. 5th ed. Upper Saddle River, New Jersey: Pearson Education Inc., 2003.

Gustafsson, J-E. What do we know about effects of school resources on educational results? *Swedish Economic Policy Review*, 10, 77-110, 2003.

Hanushek, E. The Economics of Schooling: Production and Efficiency in Public Schools. *Journal of Economic Literature,* 24(3) 1141-1177, 1986.

________. Assessing the effects of School Resources on Student Performance: An update. *FRBNY Economic Policy Review* 1998.

________. Conclusions and Controversies about the Effectiveness of School Resources. *Educational Evaluation and Policy Analysis* 19(2) 141-164, 1997a

________. Publicly Provided Education. *NBER Working Paper No.8799*, 2002.

Hanushek, E., Kain, J., O'Brien, D., and Rivkin, S. The Market for Teacher Quality. *NBER Working Paper No. 11154,* 2005.

Health, J. An Econometric Model of the Role of Gender in Economic Education. *American Economic Review,* 79 (2) 226-230, 1989.

Highsmith, R. and Baumol, W. Education in Economics: Evidence on Determinants of Effectiveness. *American Agricultural Economics Association*, 73 (5) 1378-1385, 1991.

Lavy, V. Disparities between Arabs and Jews in School Resources and Student Achievement in Israel. *Economic Development and Cultural Change*, 47(1) 175-192, 1998.

Leppel, K. The Academic Performance of Returning and Continuing College Students: An Economic Analysis. *Journal of Economic Education,* 15 (1) 46-54, 1984.

Lumsden, K., and A. Scott. The Economics Student Reexamined: Male-Female Differences in Comprehension. *Journal of Economic Education,* 18(4) 365-375, 1987.

Lynch, G. J. The Effect of Teacher Course Work on Student Learning: Evidence from the TEL. *Journal of Economic Education*, 21 (3) Summer 1990.

MacDowell, M., Senn P., and Soper, J. Does Sex Really Matter? *Journal of Economic Education*, 9 28-33, 1977.

National Council on Economic Education. Literacy survey: results from *The standards in economics survey.* New York: National Council on Economic Education, 1999.

Park, K., and Kerr, P. Determinants of Academic Performance: A Multinomial Logit Approach. *Journal of Economic Education*, 21(2) 101-111, 1990.

Rivkin, S.G., E.A. Hanushek, and J.F. Kain. Teachers, schools, and academic achievement. *NBER Working Paper No. 6691*, 2001.

Robb, R., and Robb, A. Gender and the Study of Economics: The Role of Gender of the Instructor. *Journal of Economic Education,* 30(1) 3-19, 1999.

Rowe, K. The Importance of Teacher Quality as a Key Determinant of Student's Experiences and Outcomes of Schooling. *Keynote address at ACER Research Conference*, Melbourne 19-21 October 2003.

Siegfried, J. Male-Female Differences in Economic Education: A Survey. *Journal of Economic Education,* 10(2) 1-11, 1979.

Soper, J., and Walstad, W. *Test of Economic Literacy: Examiner's manual.* 2nd ed. New York: Joint Council on Economic Education, 1987.

Spector, L. and Mazzeo, M. Probit Analysis and Economic Education. *Journal of Economic Education*, 11(2), 37-44, 1980.

Walstad, W. B. Economics Instruction in High Schools. *Journal of Economic Literature*, 30(4), 2019-2051, 1992.

Walstad, W.B. and D. Robson. Differential Item Functioning and Male-Female Differences on Multiple-Choice Tests in Economics. *Journal of Economic Education*, 28 (2), 155-171, 1997.

Walstad, W.B. and J.C. Soper. A Report Card on the Economic Literacy of U.S. High School Students. *American Economic Review*, 78(2), 251-256.

Walstad, W.B and K. Rebeck. *Test of Economic Literacy: 3rd Edition Examiners Manual*, National Council on Economic Education, 2001.

Walstad, W.B and K. Rebeck. Teacher and Student Economic Understanding in Transition Economies. *Journal of Economic Education,* 32 (1), 58-67, 2001.

Wetzel, James N. and Dennis M. O'Toole. A Qualitative Response Model of Student Performance on a Standardized Test. *Atlantic Economic Journal*, 19 (3), 18-26 1991.

Wooldridge, J. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: The MIT Press, 2002.

Worthington, A. An Empirical Survey of Frontier Efficiency Measurement Techniques Education. *Education Economics* 9(3) 245-268, 2001.