Teacher Gender and Pay Effects on Ohio Student Performance

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Teacher Gender and Pay Effects on Ohio Student Performance

An Internship Report submitted in partial fulfillment of the requirements for the degree of Master of Science

By

Robert Clark Gibson
B.S., U.S. Air Force Academy, 1988

1993
Wright State University
July 20, 1993

I HEREBY RECOMMEND THAT THE INTERNSHIP REPORT PREPARED UNDER MY SUPERVISION BY ROBERT CLARK GIBSON ENTITLED Teacher Gender and Pay Effects on Ohio Student Performance BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science.

[Signature]
Faculty Supervisor

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Faculty Reader

[Signature]
Director, M.S. in Social and Applied Economics
Gibson, Robert C., M.S., Department of Economics, Wright State University, 1993, Teacher Gender and Pay Effects on Ohio Student Performance.

This investigation attempts to see if Card and Kreuger's retrospective findings that a significant positive relationship between higher ratios of female to male teachers and later increased earnings of workers extends to current test results of Ohio School Districts. One possible explanation for increased earnings later in life to be associated with a higher ratio of female teachers is that lack of alternative opportunities for females in the labor market before 1966 made it possible to hire more effective female teachers for a given salary. If the same conditions hold districts with higher ratios of teachers on their staff would be expected to have superior test scores.

Utilizing current Ohio School District micro data, this study measures classroom teacher gender ratios, average salary, experience, and education levels effects on student performance as measured in by composite index of 4th, 6th, 8th and 10th grade mean normal curve equivalent achievement test scores in reading, math, and language for 610 districts in 1990. Average family income in the district was used to control for differences in pupil backgrounds.

Contrary to the Card and Kruger results, an increase in female to male teachers ratio produced a statistically
insignificant, negative correlation (-.02) in Ohio pupil performance. Statistically significant correlation's with composite test scores included: teacher salaries (+.38), percentage of teachers with graduate degrees (+.21), district average family income (+.56), and the squared number of classroom teachers as a proxy for school district size (-11).
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I. INTRODUCTION

PURPOSE

This econometric analysis attempts to identify inputs into the educational process that contribute significantly to measured student achievement. Specifically, it will determine the significance of the relationship between characteristics of the teacher corps in each Ohio school district and its performance on standardized tests. These characteristics include: teacher pay; gender; educational level; and experience while controlling for possible differences between district size and family income effects on student characteristics that may influence test scores. The independent variables assessed are: the percentage of female instructors; average teacher salary; experience; the percentage of classroom instructors with graduate degrees and; the average family income of that district.

The current ground swell for educational reform has touched off a serious argument in educational policy circles about the effectiveness of just increasing the level of resources available. Reformers such as Chubb and Moe argue that the organizational setting within which teachers, parents and students operate has a more determining effect on outcomes than simple levels of resources. A study like this can make a contribution to this debate because it will explain differences in outcomes resulting from differences
in inputs taking place within the existing educational production function.

If output differences can be explained solely on the basis of quantity and quality of inputs within the current organizational framework then changing the organization makeup is not needed. If little of the observed differences are attributable to input differences than drastic reorganization such as educational choice and educational vouchers may have to be given serious consideration. This debate makes it more important than ever to identify those characteristics within the educational process that enhance students academic performance.

While case research abounds on socioeconomic, ethnic and demographic factors' influence on student performance, little consensus has been reached on an educational output model that focuses system-wide on what the students bring into the system as well as what they get out of the system. Indeed it is the political efforts to make the educational system more accountable in Ohio that have provided the output measures used in this study.

Although classroom instructors are just a part of the equation, no one denies that they are the primary source in the classroom for both information and motivation. Card and Krueger (1992) found that returns to education measured in terms of worker earnings were significantly related to the percentage of female classroom instructors and their level of education. This project tries to discern if the Card and
Kreuger effects are still present today using micro data from the Ohio State Board of Education Certified Staff File and Tests of Scholastic Achievement results from Ohio's 610 public school districts that currently have students.

The next section of this report provides a literature review, while Section III presents the methodology used to answer the investigative question. Results of various models are presented in Section IV. A discussion of the ramifications of the findings is presented in Section V. Conclusions are offered in Section VI.
II. BACKGROUND

LITERATURE REVIEW

This literature review investigates influences on the learning process of students affect test score performance and provides background on previous public school production efficiency research.

EDUCATIONAL OUTPUT

Perhaps the most comprehensive review of the current status of educational reform and analysis of the production and efficiency of public schools is provided by Eric Hanushek (1986). His seminal Journal of Economic Literature review article assesses a vast amount of research that has attempted to deal with measuring production efficiency of our public schools. It fills the chasm between educational research and the policy prescriptions that could improve its efficiency. His approach not only analyzes the numerous inputs that determine system efficiency, but also presents extensive research documentation to support his resultant policy guidelines.

Hanushek's raison d'être in this article comes from the highly influential "Coleman Report," mandated by the Civil Rights Act of 1964, and whose research into student
achievement determinants led to a slew of findings that concluded our public education process is in dire need of reform.

What makes Hanushek's article distinctive is his integration of social science research into a meaningful economic model that assesses the efficiency of the process as well as the "goodness" of each input in improving overall excellence. Hanushek's methodology is to look at the status of prevailing research in all areas relating to educational output and translate those findings into rational policy prescriptions to increase the quality of education in our public schools.

Hanushek provides historical perspectives on several key predictor teacher variables that were used in this research study. He indicates an upward trend in teacher experience from 1960-83. The Ohio teacher data indicate that this trend is continuing. Hanushek shows a rapid increase in the percentage of teachers with Masters degrees or better. Ohio currently has a lower percentage of its teachers with masters degrees than for the U.S. as a whole in 1983. Comparison of these indices may indicate regional differences of teacher educational levels.

Also included was a slight gradual increase in the salaries of teachers using constant dollar analysis. This trend is also reinforced by this study. This meta-analytic approach successfully wound together all the major aspects of educational output research and discussed the
significance of commonly used predictor variables used in modeling and the views of current literature on this subject.

Hanushek reviewed 147 educational production function studies and presented the results in a tabular form extracted for use here:

**TABLE 1 - Review of 147 Studies**

<table>
<thead>
<tr>
<th>Significant</th>
<th>NOT Significant</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Studies</td>
<td>Total</td>
<td>Sign</td>
</tr>
<tr>
<td>Teacher/pupil ratio</td>
<td>112  9  14  89  25  43  21</td>
<td></td>
</tr>
<tr>
<td>Teacher Education</td>
<td>106  6  5  95  26  32  37</td>
<td></td>
</tr>
<tr>
<td>Teacher Experience</td>
<td>109  33  7  69  32  22  15</td>
<td></td>
</tr>
<tr>
<td>Teacher Salary</td>
<td>60  9  1  50  15  11  24</td>
<td></td>
</tr>
<tr>
<td>Expenditures/pupil</td>
<td>65  13  3  49  25  13  11</td>
<td></td>
</tr>
</tbody>
</table>

(Hanushek, p. 1161).

This review of 147 studies indicates that while the sign of the relationships are pretty much as expected, a large percentage of these studies end up with inconclusive results. Hanushek's review consisted of both within and between district evaluations using a variety of analysis techniques from correlations to multiple regression. He points out that regression techniques used by many included analysis of partial contribution to the coefficient of determination. This technique is useful but is subject to a great degree of fluctuation depending on the order of introduction. For this reason, this study utilized stepwise regression techniques which evaluate not only the marginal contribution but evaluate each variable independently for
addition into the model. This eliminates introduction-order bias.

Hanushek points out that variation in student performance (criterion variable) due to family differences requires that the analysis of the educational process include inputs not only in terms of expenditures, teacher education, and curricula, but require analysis of socioeconomic factors, such as parental income and educational levels, as primary determinants of process output. This study evaluated average family income as a predictor variable for socioeconomic differences.

The resultant policy implications are that schools need to stop paying for things that don't contribute to increased student performance. Hanushek says research has been unable to show conclusively that reduction in class size below the 30-40 student size or requirements for teachers to have advanced degrees will, in themselves, provide higher test scores for their students. Hanushek concludes that it is necessary to fully understand the process in order to evaluate its efficiency.

Hanushek's article, although not without criticism, provides us with one of the first comprehensive frameworks for evaluating the educational process in terms of economic efficiency. This allows policy makers to direct the educational process in the directions that will yield the greatest resultant student performance increase.
The scope of Hanushek's research is what made this article so important to educational research. His research over five years while working for the Office of Management and Budget (OMB) provided the comprehensive framework to systematically improve our schools.

TEACHER CHARACTERISTICS AND GENDER EFFECTS

Although educational literature provides characteristics of successful classroom instructors, few of the articles or journals equate these characteristics specifically with one gender. And quite possibly with good reason. Both sexes can possess the same trait and like techniques may work for one instructor and not the other. Maybe this is why much of the educational literature proposes a series of "roles" that the instructor, either male or female, can assume in the classroom.

One common point of agreement among educational literature is that students come to accept statements or facts "...because many other people, often 'authority figures' support them" (Schoefield, 1977). The idea that a classroom instructor acts as an authority figure can have varied effects on the students. Male teachers are often viewed as authority figures and tend to use more direct, authoritative teaching techniques. Silvernail points out that "direct styles can have a positive or negative affect on students" depending on their background and perceptions of the teacher (Silvernail, 1986).
Hurt and Scott provided the most useful details of teacher roles and their effects on students in *Communication in the Classroom* (Hurt, 1978). They suggest that students' perception of teachers in the classroom determines how willing they are to expose themselves to communication with the teacher. Without this interaction, learning is much more difficult. Teachers who are held in positive regard by their students receive greater attention from their students and are far more able to exert influence on student perceptions of the subject matter.

Hurt and Scott's analysis provides a framework of analysis for interpreting how individual teacher and student positions and perceptions can influence the learning process and ultimately their academic performance. They break down the student's perception of teachers into four major categories. These are credibility, attraction, homophily, and power. Gender often plays a role in these areas. Hurt states:

To be completely credible, therefore, a teacher needs to be perceived as competent, of high character, sociable, moderately composed, and moderately extroverted. If any of these dimensions is lacking, teacher credibility suffers and he or she will be much less effective in classroom communication with students (Hurt, p. 119).

Interpersonal attraction is no less critical. The areas of consideration are physical attractiveness, which has shown to be the "single most important perception in initial communication encounters," task attraction, which refers to the degree to which the student perceives it to be
desirable to establish a work relationship with the teacher, and social attraction, which is the degree to which the student perceives the teacher to be someone with whom they would like to spend time at a social level.

Homophily is the degree of similarity between teacher and student on any given attribute or group of attributes. Research has shown that the greater the homophily between teacher and student, the greater the amount of communication and learning that occurs (Hurt,p.124).

Power refers to a teacher's ability to affect in some way the students' well-being, beyond the students' own control. Power can have adverse effects on classroom communication and learning when used in a coercive manner. The use of power in the classroom "tends to increase the likelihood that power will be needed later to insure conformity"(Hurt,p.125). While perceived legitimate power can be useful, perceived illegitimate power will cause the students to avoid influence from the teacher and cause disruption of communication within the classroom.

Only one role that teachers assume was mentioned in association with gender. This is the "Tough Guy" image, "often projected by the beginning teacher, particularly the beginning male teacher" with a resultant decrease in teacher student exchange. This does not necessarily imply poor learning, in fact, higher levels of learning may occur, but can result in poor teacher-student relations outside the classroom (Hurt,p.127).
This framework provides a criterion for evaluation instructor roles and characteristics and their relation to teacher gender. Teachers with greater experience may be better able to utilize these roles to the benefit of their students. Further research to attempt to link the presence of these characteristics to the gender of the instructor seems to be a missing part of educational research.

CARD AND KRUEGER PAPER

The David Card and Allen Krueger paper was the stimulus this research project. They found:

This paper estimates the effects of school quality--measured by the pupil/teacher ratio, average term length, and relative teacher pay--on the rate of return to education for men born between 1920 and 1949. Using earnings' data from the 1980 census, we find that men who were educated in states with higher-quality schools have a higher return to additional years of schooling. Rates of return are also higher for individuals from states with better-educated teachers and with a higher fraction of female teachers. Holding constant school quality measures, however, we find no evidence that parental income or education affects average state-level rates of return (Card and Krueger, p. 1).

In exploring teacher characteristics across regions and states, Card and Krueger found that with relative teacher wages held constant, "An increase in the fraction of male teachers in the state had a substantial negative impact on students returns to education" (Card, p. 24). They suggest that female teachers may have been paid less than their male counterparts during the period 1926-66 and the percentage of male teachers is "a proxy for lower-quality teachers." Its substantial and significant coefficient in regression
analysis "hardly changes" with the addition of controls for average teacher education and experience of teachers (Card, p. 24). Whether this pay differential was the cause of output differences is unknown and further confounded by current changes in the relative pay for women. Gains by women in the job market have led to an equaling effect on teacher wages and possible elimination of score differences due to teacher gender ratios.

Further analysis of their methodology in determining returns to education is not useful for this study since composite test scores will be used as an alternative to earnings data as a measure of returns to education.
III. METHODOLOGY

RESEARCH DESIGN

This econometric research design was formulated to empirically verify the relationship between educational output, teacher and family income effects. Educational output is measured by normalized composite test scores accumulated from standardized tests. Test score results were analyzed through correlation and regression techniques against the ratio of female to male classroom instructors, their average salary and experience, the percentage with graduate degrees, and average family income for each school district. The test scores and teacher demographic data collected were nearly the complete population of interest (Public School Districts, State of Ohio, 1990) and therefore are highly representative and generalizable. This very high availability of data and the processing power of SAS eliminated the need for sampling in this case.

LIMITATIONS OF THE STUDY

The limitations of this study are a result of its research design. Since this is a field study to identify relationships between educational variables, no cause and effect inferences can be made, only strength of association. Due to the dynamic nature of the education process, it is nearly impossible to account for all the variation in
teacher styles, educational background, and curricula within administrative data. Simple models cannot reasonably be expected to provide comprehensive analysis of a district's performance without more detailed evaluation made by experienced educators.

SUBJECTS

Subjects for this study include all classroom teachers in Ohio public schools during the 1990-91 school year as reported by each district to the Ohio State Department of Education. This certified staff data (computer file CS1OHIO.ASC) was compiled by the Ohio Department of Education. This file lists all instructors in Ohio's public school districts by position code, gender, experience, salary, and academic degree attained. Position codes describe the job the teacher performs in that district. The certified staff data lists position codes that range from 02 to 98. This study focuses on the classroom instructors only (position codes 50 through 60). Those codes were used as a sorting criterion to eliminate consideration of non-classroom instructors, such as physical education or music teachers. It is not the intent to infer that these other instructors do not contribute to student development, merely that they do not have duties to teach subjects that are tied directly to testable subject matter. This research assumes that classroom interaction in the testable subject matter is the most probable source for teacher affects to appear.
The certified staff data files' contents were inventoried, then sorted by district identification number (DISIRN) and position code (POSCD) for classroom instructors (50 through 60). For the classroom instructors in each district, their gender, average salary, average experience, and academic degree status was pulled from the certified staff data. In an effort to test external influences in the educational process, the average family income for each district was added from district computer file data assembled by Dr. John Treacy. The SAS programs to accomplish these tasks and the resultant output are discussed in Appendix B.

The student output measurements were limited to those grades and subjects required by Ohio law. This paper uses a composite index of 4th, 6th, 8th and 10th grade mean normal curve equivalent achievement test scores for each district. The second half of the education equation are all students in the State of Ohio. Choice of an appropriate educational output measurement device was critical. Comprehensive analysis of all students in Ohio is limited since test score data are not standardized yet to a point where we can assess every Ohio student at each grade level using identical instruments. Current testing initiatives appear to be moving toward that condition.
COMPOSITE TEST SCORES

This study utilized a composite index of mean normal-curved equivalent test scores from the Ohio Tests of Scholastic Achievement for reading, language skills, and math sections for 4th, 6th, and 8th grades, as an indicator of educational output for the district. While test scores provide a convenient measure of academic performance, they are not without limitations. Hanushek suggests that from an educational output and labor market perspective, "empirical evidence is inconclusive about the strength of the link between test scores and subsequent achievement outside of schools" (Hanushek, p.1154). This may explain the differences between the Card and Krueger study and this project's results. Their study based returns to education against subsequent earnings after completion of school instead of standardized test scores.

Several research findings do provide credibility to test scores as educational output measuring device. Hanushek believes that test scores are valued in and of themselves. Both teachers and parents perceive that they are important, albeit imperfect, measures of education. The requirement for Ohio High School students to pass the basic (9th grade) proficiency test in 1994 to receive a diploma attests to the weight parents and educators are now giving to these important, albeit imperfect, measures of educational output. Follow-on research could compare test
score data from these proficiency tests to the same teacher data.

Another aspect of test score relevance relates to their selection value. Hanushek emphasizes "test scores have an important use in selecting individuals for further schooling and thus may relate directly to the 'real' outputs through the selection mechanism." Whether it be selections by colleges or high school diplomas conferred after 1994, test scores have long been critical selection devices. The numerous potential measures of educational output suggest that test scores must be considered in combination with other measures where possible. Hanushek does suggest that the effectiveness of test scores in measuring the gains to education probably varies at different points in the schooling process. Specifically, test scores might be more appropriate in the earlier grades, where emphasis tends to be more on basic cognitive skills -- reading and arithmetic -- than in the later grades. (Hanushek,p.1154)

For this reason, composite test scores for grades 4, 6, and 8 were utilized to test the relationship between process inputs and test scores. Further reinforcing educational process similarity at all levels, Hanushek remarks that "from an economics perspective, distinctions between elementary and secondary schooling seem small." This suggests that test scores applied in the earlier years of education, and given the same quality of testing device, are more useful indicators of educational output than other
secondary school output measures such as the Scholastic Aptitude Test (SAT) or perhaps even the required high schools proficiency exams.

The composite test scores utilized for this project are listed in "Measuring Ohio's Public Education Output," appendix 1, by state rank, district name, and composite score. The composite score was calculated by summing the reading, language, and math scores for grades 4, 6, and 8 by district.
IV. RESULTS

DESCRIPTIVE STATISTICS

Descriptive statistics are presented in Table 2. This comparison shows that, in general, larger districts have lower test scores, but a higher percentage of female instructors and teachers with advanced degrees. Larger districts also are related to higher average salary, more experience, and a higher average family income. Very Large school (such as Cleveland City) test score performance, based on teacher and income influences, behaves uniquely when compared to the rest of the state. Identification of the confounding factor that changes the relationship in large city schools is the key to improving the test score results of large school districts.

********** TABLE 2 - STATEWIDE DESCRIPTIVE STATISTICS******

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST SCORE</td>
<td>610</td>
<td>53.52</td>
<td>5.51</td>
<td>38.78</td>
<td>73.00</td>
</tr>
<tr>
<td>% Female Teachers</td>
<td>610</td>
<td>66.73</td>
<td>5.06</td>
<td>46.67</td>
<td>92.59</td>
</tr>
<tr>
<td>Average Salary</td>
<td>610</td>
<td>$29,905</td>
<td>$3,641</td>
<td>$21,025</td>
<td>$41,165</td>
</tr>
<tr>
<td>Average Experience</td>
<td>610</td>
<td>14.61</td>
<td>1.89</td>
<td>7.00</td>
<td>20.82</td>
</tr>
<tr>
<td>% Graduate Degrees</td>
<td>610</td>
<td>41.59</td>
<td>13.40</td>
<td>3.85</td>
<td>83.33</td>
</tr>
<tr>
<td>Avg Family Income</td>
<td>610</td>
<td>$26,738</td>
<td>$9,976</td>
<td>$16,767</td>
<td>$133,855</td>
</tr>
<tr>
<td>Teachers per District</td>
<td>610</td>
<td>127.97</td>
<td>238.16</td>
<td>10</td>
<td>3140</td>
</tr>
</tbody>
</table>

*******************************************************************************
The results of TABLE 2 indicate an apparently large but deceptive variance in the number of female teachers. The 92.59% female was a relatively small district and most do fall between 60 and 70 percent female for significant districts. Average salaries were also very tight with a few exceptions being those districts with very high average family incomes. They produced high salaries but weren't large enough in numbers to significantly affect the mean for all 610 districts. The percentage of teachers with graduate degrees did vary rather significantly. It appears that larger districts have a higher premium on advanced education than smaller districts but some smaller wealthy districts also lead the pack in high percentages with advanced academic degrees. Teacher experience varied less than expected and seemed to be higher in less urban areas where alternate employment opportunities may be sparse. Average family incomes were spread out rather evenly with the majority lying between the $18,000 to $35,000 with most of the exceptions coming from wealthy urban areas and suburbs.

GENDER AND PAY

Evidence of pay discrimination between similarly trained and experienced teachers due to sex is a frequent complaint. Initial findings indicate an insignificant, slightly negative (r=-.04) correlation between higher percentages of female instructors and higher average salaries. This suggests that female salaries are fairly
equivalent to men in the teaching profession. The breakout by sex is below.

************TABLE 3 - GENDER STATISTICS***************

SEX = Female

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary</td>
<td>55791</td>
<td>$31239.51</td>
<td>7264.25</td>
<td>$0</td>
<td>$53487.00</td>
</tr>
<tr>
<td>Experience</td>
<td>55791</td>
<td>14.08 yrs</td>
<td>8.14</td>
<td>0</td>
<td>52.0</td>
</tr>
</tbody>
</table>

SEX = Male

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary</td>
<td>23323</td>
<td>$33453.96</td>
<td>7182.13</td>
<td>$0</td>
<td>$55000.00</td>
</tr>
<tr>
<td>Experience</td>
<td>23323</td>
<td>16.56 yrs</td>
<td>8.46</td>
<td>0</td>
<td>43.0</td>
</tr>
</tbody>
</table>

The T-Test provided an interval estimate for the difference between the means of male and female salaries excluding experience and education factors:

$X_1 - X_2 \pm Z_{0.05}(S_{X_1-X_2})$

$33453.96 - 31239.51 \pm (1.96)(2211.679 + 945.839)^{1/2}$

$2214.45 \pm (1.96)(56.19)$

$= ($2104.32, $2324.58)

Excluding experience and educational factors, male salaries are between $2104 and $2324 higher than female salaries.

How much is an extra year of experience or an advanced degree worth? To conclude this, a regression was run with average salary as the dependent variable and average experience and percent advanced degree as independent variables. The results show that:
For each additional year of experience, salaries in Ohio rose $656.48. Similarly, for a one percent increase in teachers with graduate degrees, salaries rose $100.22. To truly measure the differences in gender pay, these factors must be included:

GENDER COMPARISONS

<table>
<thead>
<tr>
<th>Teacher Sex</th>
<th>Avg Salary</th>
<th>Avg Experience</th>
<th>% Grad Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>$33453.96</td>
<td>16.564 yrs</td>
<td>54.20%</td>
</tr>
<tr>
<td>Female</td>
<td>$31239.51</td>
<td>14.079 yrs</td>
<td>40.43%</td>
</tr>
<tr>
<td>Difference</td>
<td>$ 2214.45</td>
<td>2.485 yrs</td>
<td>13.77%</td>
</tr>
</tbody>
</table>

If we take into account the 2.485 extra years experience male teachers have on average along with their 13.77% advantage in percentage with graduate degrees, the pay difference should be:

\[
\text{Experience} \times \text{rate} + \% \text{Grad degree} \times \text{rate} = \text{salary difference}
\]

\[
2.485(656.48) + 13.77(100.22) = $3,011.38
\]

After adjusting for experience and education, the difference between male and female salaries is less than 3% of total salary. This evidence suggests that once differences in education and experience are accounted for that there is little difference between male and female teacher pay. This new evidence of pay evening between the sexes may have eliminated the effect of gender ratios on test scores since higher quality teachers now cost the same as their male counterparts.
RESULTS BY DISTRICT TYPE

*****TABLE 5 - DISTRICT TYPE RESULTS*****

<table>
<thead>
<tr>
<th></th>
<th>MEAN</th>
<th>Mean %</th>
<th>Mean #</th>
<th>Average</th>
<th>Average</th>
<th>% ADV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>SCORE</td>
<td>FEMALE</td>
<td>Teachers</td>
<td>Salary</td>
<td>Exper</td>
</tr>
<tr>
<td>CITY</td>
<td>192</td>
<td>54.21</td>
<td>67.64</td>
<td>242.10</td>
<td>$32378</td>
<td>15.18</td>
</tr>
<tr>
<td>EX VILL</td>
<td>49</td>
<td>54.19</td>
<td>66.25</td>
<td>80.37</td>
<td>$29326</td>
<td>14.56</td>
</tr>
<tr>
<td>LOCAL</td>
<td>369</td>
<td>53.08</td>
<td>66.32</td>
<td>74.92</td>
<td>$28695</td>
<td>14.31</td>
</tr>
</tbody>
</table>

The Mean Average Family Income is $28,895 for cities, $27,628 for Exempted Villages, and $25,497 for Local School Districts. City schools in Ohio have the highest test scores, a higher percentage of female teachers, higher average salary, experience and percentage of teachers with graduate degrees. Although very large districts perform poorly, it does appear that there may be an optimum size for school districts. It appears suburban-type city schools are able to operate more efficiently due to less bureaucracy in their management and greater resources dedicated directly to classroom instruction instead of the bureaucracy.

PEARSON CORRELATION COEFFICIENTS

The resultant correlation matrix for composite test score data, percent female teachers, average salary, average experience, percentage with graduate degrees, and average family income by district are listed in TABLE 4.
**TABLE 6 - Resultant Correlations**

Pearson Correlation Coefficients / Prob > [R] under Ho: Rh=0 / N =610

<table>
<thead>
<tr>
<th></th>
<th>Test Scores</th>
<th>% Female</th>
<th>Average Salary</th>
<th>Average Experience</th>
<th>% Graduate</th>
<th>Avg Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Scores</td>
<td>1.00</td>
<td>-0.02</td>
<td>0.38*</td>
<td>0.15*</td>
<td>0.21*</td>
<td>0.56*</td>
</tr>
<tr>
<td></td>
<td>(.0000)</td>
<td>(.5921)</td>
<td>(.0001)</td>
<td>(.0003)</td>
<td>(.0001)</td>
<td>(.0001)</td>
</tr>
<tr>
<td>% Female</td>
<td>-0.02</td>
<td>1.00</td>
<td>-0.04</td>
<td>-0.29*</td>
<td>-0.04</td>
<td>0.07</td>
</tr>
<tr>
<td>Teachers</td>
<td>(.5921)</td>
<td>(.0000)</td>
<td>(.3402)</td>
<td>(.0001)</td>
<td>(.3780)</td>
<td>(.1047)</td>
</tr>
<tr>
<td>Average Salary</td>
<td>0.38*</td>
<td>-0.04</td>
<td>1.00</td>
<td>0.49*</td>
<td>0.51*</td>
<td>0.47*</td>
</tr>
<tr>
<td></td>
<td>(.0001)</td>
<td>(.3402)</td>
<td>(.0000)</td>
<td>(.0001)</td>
<td>(.0001)</td>
<td>(.0001)</td>
</tr>
<tr>
<td>Average</td>
<td>0.15*</td>
<td>-0.29*</td>
<td>0.49*</td>
<td>1.00</td>
<td>0.39*</td>
<td>0.08</td>
</tr>
<tr>
<td>Experience</td>
<td>(.0003)</td>
<td>(.0001)</td>
<td>(.0001)</td>
<td>(.0000)</td>
<td>(.0001)</td>
<td>(.0541)</td>
</tr>
<tr>
<td>% Graduate</td>
<td>0.21*</td>
<td>-0.04</td>
<td>0.51*</td>
<td>0.39*</td>
<td>1.00</td>
<td>0.28*</td>
</tr>
<tr>
<td>Degree</td>
<td>(.0001)</td>
<td>(.3780)</td>
<td>(.0001)</td>
<td>(.0001)</td>
<td>(.0000)</td>
<td>(.0001)</td>
</tr>
<tr>
<td>Avg Family</td>
<td>0.56*</td>
<td>0.07</td>
<td>0.47*</td>
<td>0.08</td>
<td>0.28*</td>
<td>1.00</td>
</tr>
<tr>
<td>Income</td>
<td>(.0001)</td>
<td>(.1047)</td>
<td>(.0001)</td>
<td>(.0541)</td>
<td>(.0001)</td>
<td>(.0000)</td>
</tr>
<tr>
<td>District</td>
<td>-0.07</td>
<td>0.18*</td>
<td>0.29*</td>
<td>0.06</td>
<td>0.12*</td>
<td>0.04</td>
</tr>
<tr>
<td>Size</td>
<td>(.0891)</td>
<td>(.0001)</td>
<td>(.0001)</td>
<td>(.1240)</td>
<td>(.0028)</td>
<td>(.3039)</td>
</tr>
<tr>
<td>District squared</td>
<td>-0.11*</td>
<td>0.12*</td>
<td>0.12*</td>
<td>0.01</td>
<td>.03</td>
<td>-0.02</td>
</tr>
<tr>
<td>Size squared</td>
<td>(.0089)</td>
<td>(.0042)</td>
<td>(.0034)</td>
<td>(.7784)</td>
<td>(.5288)</td>
<td>(.6175)</td>
</tr>
</tbody>
</table>

*Significant at alpha=.01 (p<.01)
**Significant at alpha=.05 (p<.05)

**CORRELATION DISCUSSION**

Pearson correlation coefficients calculated proved to be insignificant relating TEST SCORE with the percentage of female teachers, and significant for average salary, percentage with graduate degrees, squared size of the district and average family income at a 99% confidence level. These results show an insignificant negative correlation (r=-.02) between the percentage of female
instructors and test scores, the opposite finding of the Card and Krueger research! Significant positive correlations existed between test scores and the average salary of classroom instructors \((r=0.38)\), the percentage of classroom instructors with graduate degrees \((r=0.21)\), and a strong relationship with average family income \((r=0.56)\)!

This conclusion is also different from the Card and Krueger study which found no relationship between average family income affects on returns to earnings output.

Other significant intercorrelations exist between average experience and salary \((r=0.49)\), and average experience with percentage female teachers \((r=-0.29)\)! This would suggest that female teachers in Ohio Schools are less experienced than their male counterparts. Speculation as to this cause might include women entering the work force later due to a variety of reasons and possibly leaving the profession more easily if not the primary wage earner.

Those teachers possessing advanced graduate degrees were associated with a higher average salary \((r=0.51)\), usually more experienced \((r=0.39)\), and worked in districts with higher average family incomes \((r=0.28)\). This may suggest that the more highly qualified educators migrate to districts with higher average salaries which may increase the quality of education that students coming from higher average family income districts receive.
REgression ANALYSIS

Stepwise regression was used to select those predictor variables that contributed significantly to explanation of test score variation. Each predictor variable must have a significance level of at least .15 for entry into the model. The resultant regression model included only average family income, average teacher salary, and the number of teachers in each district (proxy for district size). Its form is

\[
\text{SCORE} = 37.66 - .00343 \text{ NUM} + .000315 \text{ AVGSAL} + .000257 \text{ AVGFAMIN}
\]

The negative sign on the beta coefficient for the size of the district indicates that test scores decrease as district size increases. This is intuitive since most of the very large districts often have the lowest scores in the state.

The positive signs on average salary and average family income indicate that increases in those variables result in increasing composite test scores. The plots of average family income against the composite tests scores suggests a threshold where income affects become significant. At average family incomes below the $30,000 level, the score distribution appears evenly distributed. For incomes above $30,000, test scores are all well above average and increase nearly linearly with further increases in income.

The F-statistic is significant (108.07) which tells the model as a whole predicts variation better than the mean. The Coefficient of Determination \( R^2 \) tells us that 34.85% of the variability \( (R^2= .3485) \) in test scores are explained by
variations in district size, teacher wages, and relative family affluence. Its residual plot shows no signs of having some other type of relationship such as log linear, exponential, etc.
V. CONCLUSION

With the extremely large data set for this project, we can be very confident that relationships exist between composite test scores, average teacher salaries, percent with graduate degrees, and average family income in the State of Ohio. These results differ from those in previous studies and may result from the use of test scores as the sole measure of educational output. Although no cause and effect relationships can be determined from this data, the significance of the Pearson correlation coefficients and the resultant plot show some relationship between their variations.

Ohio Certified Staff data also shows that salaries, when taking into account experience and level of education, are nearly equal between the sexes for teachers. Increased employment opportunities for women after the 1966 Card and Kreuger analysis timeframe may now mean that districts get the same kind of talent per dollar spent regardless of teacher gender.

The type of district that the student is educated in also influences test scores. In general, very small districts and very large districts perform below average. Identifying the optimum size of a school district may also increase the returns to education.

We are able to say at this point composite test scores vary significantly with the teacher characteristics of
average teacher pay, level of education, and district average family income for the State of Ohio in 1990-91.
Data collection for this project consisted of gathering composite test scores and Ohio certified staff data (CS-1). CS-1 data were provided to Wright State University by the Ohio Education Association. The file (CS1E91.RMS) was loaded onto Wright State University's SYS$DISK2, its contents identified, downloaded to a common area as "ECON$780:CS1OHIO.ASC."

INSTRUCTOR GENDER RATIOS

The certified staff (CS-1) data collection form provided position codes for the specific job that the teacher performs. This file was then sorted by district (a SAS requirement prior to performing frequency evaluations) for classroom teacher position codes 50 through 60 in each district. SAS program code and output are discussed in Appendix B. The sort procedure specified in SCHOOLSRT.SAS eliminated all but classroom instructors from consideration and provided instructor gender frequencies, average salary, average experience, and percentage with graduate degrees by district. The file DEMO.SAS was used to extract the average family income data from the NMDIST.SAS data file, also on the Wright State System. The SAS program SCHOOLCOR.SAS
performed the correlation and regression analysis on the data and provided plots of the predictors against the test score data as a diagnostic evaluation tool.

These SAS programs are listed below and the results are included as schoolsrt.lis, demo.lis, and schoolcor.lis in appendix B.

**DISTRICT TEST SCORE DATA**

The composite test score data was input into SCHOOLCOR.SAS by district identification number along with percentage female instructor data, average salaries, average experience, percentage with graduate degree, average family income, district type, county, and name. Composite test score and teacher characteristic data was available for 610 of the 612 districts. Two districts were eliminated from consideration since they consisted of only one teacher and had no associated test scores.

**DATA PREPARATION AND ANALYSIS**

With the associated data linked together by district identification number (DISIRN), the following SAS commands were issued to accomplish desired output:

PROC PRINT (to print the data),
PROC PLOT (to plot the data on a frequency plot),
PROC UNIVARIATE (to do a complete univariate analysis between test scores and instructor characteristics),
PROC CORR (to provide Pearson correlation coefficients), and PROC STEPWISE (to perform a stepwise regression analysis).
Several SAS programs were run to accomplish the required econometric analysis.

**SKL.SAS**

This program used the PROC CONTENTS procedure to identify the fields and contents of SYS$DISK2:[CLASS_DATA.ECON780]. It provided the necessary fields and files to be used for gathering the appropriate data in the research project. The output of this program is provided under the filename SKL.LIS;1.

**SCHOOLSRT.SAS**

This program retrieved the required certified staff data from the ECON$780:CS1OHIO.ASC file, assigned data labels, sorted the data by the Ohio School District Information Retrieval Number (DISIRN) for each district, and produced frequency tables by sex and level of education for classroom instructors along with their average salary and experience. These classroom instructors have position codes (poscd) of 50 through and including 60. The SAS program is as follows:

```
FILENAME IN 'ECON$780:CS1OHIO.ASC';
options pagesize=60 linesize=80 nodate;
DATA;
  INFILE IN missover;
  INPUT sex $ 43 disirn 58-62 poscd 74-75 salary 112-116
```
degree $ 123 exper 129-130;
IF poscd <50 OR >60 THEN DELETE;
PROC SORT;
by disirn;
PROC FREQ;
   TABLES DISIRN*SEX DISIRN*DEGREE/ nopercent;
   TITLE 'Classroom Instructors by District';
PROC MEANS;
by disirn;
   var salary exper;
   TITLE 'Average District salary and experience';
*******************************************************************************
The output of this program is included as Appendix C under the filename SCHOOLSRT.LIS.

DEMO.SAS
This program retrieved average family income (AVGFAMIN) data out of the Ohio Education Associations' file: OEA_DISTRICT.DAT. It classified the data by district information retrieval number (DISIRN) and printed it for inclusion into schoolcor.sas.
*******************************************************************************

DEMO.SAS
*****************************************************************************************
FILENAME IN "ECON$780:OEA_DISTRICT.DAT;1';
options pagesize=60 linesize=80 nodate;
DATA DIST;
   INFILE IN missover;
   INPUT AVGFAMIN 59-64 DISIRN 299-302;
PROC PRINT data=dist;
*****************************************************************************************

SCHOOLCOR.SAS
This program provides an output listing of the composite test score, percent female classroom instructor, average salary, average experience, percentage with graduate degree, county, district type, district name, and average family income data by district. It also plots the scores
(score) against the predictor variables as a diagnostic analysis tool. The program then performs the SAS
UNIVARIATE, CORrelation, and STEPWISE regression procedures on the data. The results are discussed in the following section.

******************************************************************************
SCHOOLCOR.SAS
******************************************************************************
options pagesize=60 linesize=80 nodate;
PROC FORMAT;
   value $TYPE 'C'='CITY' 'E'='EX VILLAGE' 'L'='LOCAL';
PROC FORMAT;
   value $CNTY
       'ADA'='ADAMS' 'ALL'='ALLEN' 'ASH'='ASHLAND' 'AST'='ASHTABULA'
       'ATH'='ATHENS' 'AUG'='AUGLAIZE' 'BEL'='BELMONT' 'BRO'='BROWN'
       'BUT'='BUTLER' 'CAR'='CARROLL' 'CHA'='CHAMPAIGN' 'CLA'='CLARK'
       'CLE'='CLERMONT' 'CLI'='CLINTON' 'COL'='COLUMBIANA'
       'COS'='COSHOCTON' 'CRA'='CRAWFORD' 'CUY'='CUYAHOGA'
       'DAR'='DARKE' 'DEF'='DEFIANCE' 'DEL'='DELAWARE'
       'ERI'='ERIE' 'FAI'='FAIRFIELD' 'FAY'='FAYETTE'
       'FRA'='FRANKLIN' 'FUL'='FULTON' 'GAL'='GALLIA' 'GEA'='GEauga'
       'GRE'='GREENE' 'GUE'='GUERNSEY' 'HAM'='HAMILTON' 'HAN'='Hancock'
       'HAO'='HARDIN' 'HAR'='HARRISON' 'HEN'='HENRY' 'HIG'='HIGHLAND'
       'HOC'='HOCKING' 'HOL'='HOLMES' 'HUR'='HURON' 'JAC'='JACKSON'
       'JEF'='JEFFERSON' 'KNO'='KNOX' 'LAK'='LAKE' 'LAW'='LAWRENCE'
       'LIC'='LICKING' 'LOG'='LOGAN' 'LOR'='LORAIN' 'LUC'='LUCAS'
       'MAD'='MADISON' 'MER'='MERCER' 'MIA'='MIAMI' 'MOE'='MONROE'
       'MON'='MONTGOMERY' 'MOR'='MORGAN' 'MOW'='MORROW'
       'MUS'='MUSKINGUM' 'NOB'='NOBLE' 'OTT'='OTTAWA' 'PAU'='PAULDING'
       'PER'='PERRY' 'PIT'='PICKAWAY' 'PIK'='PIKE' 'POR'='PORTAGE'
       'PRE'='PREBLE' 'PUT'='PUTNAM' 'RIC'='RICHLAND' 'ROS'='ROSS'
       'SAN'='SANDUSKY' 'SCI'='SCIOTO' 'SEN'='SENeca' 'SHE'='SHELby'
       'STA'='STARK' 'SUM'='SUMMIT' 'TRU'='TRUMBull' 'TUS'='TUSCARIWAS'
       'UNI'='UNION' 'VAN'='VAN WERT' 'VIN'='VINTON' 'WAR'='WARREN'
       'WAS'='WASHINGTON' 'WAY'='WAYNE' 'WIL'='WILLIAMS'
       'WOO'='WOOD' 'WYA'='WYANDOT';
DATA SCORECOR;
   INPUT DISIN 1-4 SCORE 6-9 .2 PERCFEM 11-14 .2 NUM 16-19
      AVGSAL 21-27 .2 AVGEXPER 29-33 .3 PADVDEG 35-38 .2
      AVGFAMIN 70-75 CNTY $ 40-42 TYPE $ 44 DISNAM $ 46-68;
   NUMX=NUM*NUM;
   INDEX=SCORE-(37.664+.000257*avgfamin+.000315*avgsal-
                  .00344*num);
   FORMAT TYPE $TYPE.;
   FORMAT CNTY $CNTY.;
PROC UNIVARIATE data=scorecor;
    var score percfeml num avgsal avgexper padvdeg avgfamin;
    title 'Descriptive statistics for Ohio Test Scores and Teachers';
PROC PLOT data=scorecor;
    plot score*percfeml score*num score*avgsal score*avgexper
         score*padvdeg score*avgfamin score*numx2;
PROC CORR data=scorecor;
    title 'Correlation matrix for data';
PROC STEPWISE;
    model score=percfeml num avgsal avgexper padvdeg avgfamin
         numx2;
PROC PRINT data=scorecor label;
    var disnam type disirn cnty score percfeml avgsal avgexper
         padvdeg avgfamin;
PROC PRINT;
    var disnam cnty index;
********************************************************************************

The univariate and correlation results of this program are included in Appendix C as SCHOOLCOR.LIS. The next section of this report discusses the results and analysis of these SAS models.
APPENDIX C
SAS OUTPUT

1. SKL.LIS
2. SCHOOLSRT.LIS
3. SCHOOLCOR.LIS
4. DEMO.LIS
BIBLIOGRAPHY


____. Instructions for Preparing Form CS-1 Report of Certified Staff. Ohio Department of Education. 1989-90.