
Teacher Compensation and Student Outcomes

A District Examination in
Kentucky

Logan Rupard

Martin School of Public Policy and
Administration

Capstone Project

Spring 2014

Table of Contents

Executive Summary.....	2
Introduction.....	3
Literature Review.....	5
Data Description.....	9
Model.....	11
Analysis and Findings.....	13
Discussion.....	14
<i>Limitations</i>	14
<i>Recommendations</i>	15
Conclusions.....	16
References.....	18

Executive Summary

Teacher effectiveness is an often examined topic in our educational policy arena today, especially when it comes to its effects on student outcomes. Teachers are often considered one of the most important factors in affecting student outcomes. Because the quality of teachers attracted to the teaching profession is presumed to be influenced by their compensation, we are interested in measuring how teacher compensation and student outcomes are related. This study will examine not only current compensation, but include pension compensation as well. By combining both current salaries and pension payments as a unit for total compensation, this paper will examine the effects of total teacher compensation on student outcomes. While not the main goal of this paper, the discussion will include an examination of locales, as defined by the NCES, and The Federal classification of Appalachian Counties to further the spectrum of this analysis.

This paper examines these questions examining panel data for county school districts in the state of Kentucky. The data is from The Kentucky Teachers Retirement System (KTRS), Kentucky Department of Education (KDE), and the National Center for Education Statistics (NCES) from the years 2008-2013. The data from the KTRS is obtained on a county basis, while the data from both the KDE and NCES are at the district level. This is obviously not perfect, but it is what is available. For those counties with two or more districts, the county district is always used. A model is then used to answer the research question of this paper; consisting of various variables responsible for school characteristics, district locale, year, and test scores.

The paper finds that while both compensations (controlled for inflation) and average composite ACT scores have risen over the examined time period, this trend is spurious and is not causal. While this may not be the case nationwide, the analysis has shown that in the state of Kentucky, increased compensation is not increasing test scores on a district level. This paper does find that the number of board certified teachers are useful in increasing test scores for the districts. Policies focused on attracting these individuals may be a worthwhile undertaking for the state of Kentucky.

Introduction

Research has concluded that the dynamic of teacher quality and student achievement may be the most important relationship in schooling.¹ While teacher quality is highly important, teachers themselves are widely varied and have their own set of characteristics. Compensation is an often important discussion when dealing with teacher performance. Teachers' salaries in public schools are fairly consistent. In Kentucky, the state sets minimum salaries and districts are able to adjust accordingly. All salary schedules are then posted and made public. In Kentucky, public school teacher salaries are based on qualifications and the number of years of experience. Previous research has focused solely on current salary as a means for teacher compensation. This examine will use both current salary and the pension plans that teachers are automatically enrolled in to more accurately reflect actual compensation. The pension equation for state teachers can be seen in Equation 1, it is expressed as:

$$(1) \text{ Monthly Pension Payments} = \text{number of years of experience} \times 2.5\% \times \text{Average salary of highest years}$$

The compensation equation can be seen below, in Equation 2:

$$(2) \text{ Salary} = \text{Rank/qualification} \times \text{number of years of experience}$$

These two equations are the basis of compensation in the state of Kentucky. These two equations will then be used to accurately measure the complete compensation available to k-12 educators. Currently, these two variables, qualifications and experience, are the only determinants of teachers' salaries and pensions. Policymakers and administrators understand that maximizing student performance is an important discussion in the field of education. The method to achieve this is a much more difficult discussion; does identifying specific teacher

characteristics maximize student outcomes, or could compensating teachers more lead to higher outcomes? Often heard is the argument of increasing teacher pay to increase teacher quality. That without competitive compensation relative to other professions, possible teachers will choose other more financially rewarding careers. This paper plans to explore the link of teacher compensation, with the inclusion of pension payments, to student outcomes.

Most current research has tended to focus on current compensation as it relates to teacher performance and student outcomes. While teachers are earning a salary, they also contribute to a pension plan while employed and they will eventually receive in the future. Teacher pension systems are a major component of the costs associated with K-12 education and should be included when examining compensation. This paper will examine the effects of both forms of compensation, current salary as well as pension plans, to measure how teacher compensation affects student outcomes. These two forms of compensation, salary and pension payments will be used as a variable, “total compensation”.

Teachers, their retention and effectiveness, are two large concerns when it comes to operating any education system. State pension systems are often out of the control of the districts, and of little concern to them. They fall under control of the state teacher retirement system, which is controlled by the state government. While employed, teachers and their districts contribute portions of their salary to KTRS. Once retired, teachers draw from this system, with zero financial responsibility for the districts they once worked in. Retention, on the other hand, is something that districts may find of great importance to them. Attracting, and eventually retaining, highly qualified individuals is something that districts continually strive to achieve. Teacher quality is an important part of educational research and should be considered when

considering district policies and action. Increasing salary schedules is often employed tactic, whether it works or not, will be explored within this research.

Literature Review

Teacher quality is essential to student outcomes. There is accompanying literature that finds teachers' measure of cognitive ability to be among the most important determinants of student achievement. Students of the highest quality teachers perform better than those with lower ranked teachers. The highest cognitively advanced females, based on standardized test scores, are no longer choosing to go into teaching. The market for women has expanded to include relatively higher paying professions compared to teaching, a major contributor to this trend. Average female teachers are scoring below the average female college graduate. Studies have suggested that the relationship between academic abilities and entry into teaching has weakened over time. Women in the top deciles of cognitive ability are now much less likely to become teachers.²

Districts, being spurred by Race to the Top and the Teacher Incentive Fund, are beginning to experiment with compensation based on teacher performance. Districts are also engaging in examining the effects on outcomes when making decisions about tenure and promotion. Value-added models are often the tool of choice for the districts. Value added models are equations, which vary in implementation, used to evaluate success of teachers. Even though value-added models are the most popular method, they still often face opponents due to narrow focus on test scores and the fact that they are restricted to a small percentage of teachers. With

the inclusion of subjective principal ratings paired with the objective value-added measures, it creates an alternative worth considering opposed to the current system of teacher compensation.¹

The importance of teacher quality in determining student outcomes is now well established. The simplest summary of research into teacher quality is that some teachers are dramatically more effective than others. Society is likely to be better served by paying more attention to retention decisions, and by rewarding the teachers we want- those who are effective and who meet current areas of need. Finding and retaining quality teachers is particularly important given the rate of retirements and, commensurately, the huge numbers of teachers who must be hired over the next decade. Single salary schedules are too broad and unable to have any real effect with attraction and retention of the desired educators.³

Relatively low teaching salaries are not a thing of recent times. Many teachers throughout history have received minimal compensation. The National Education Association (NEA) presented historical data revealing that in forty-four of forty-eight cities, salaries of elementary teachers were below those of laborers. With the average age close to forty in 1913, teachers had been unable to save over their working period. During the Progressive Era, the teaching profession remained relatively young, due to the fact that many teachers could not commit to a lifetime of teaching. Young women often left the profession to marry, or were attracted to other more lucrative professions. This attraction has only increased since then. During World War II, many districts experienced shortages of teachers, necessitating the need to bring older women back into the profession. This shortage led to increased salaries, but increased teacher performance failed to follow. Educators eventually found turnover rates expensive, due to the training and hiring practices, as well as being socially undesirable. Between 1890 and 1920, educators adopted a variety of mechanisms, including tenure, certification, and higher salaries to

deal with the economic and social problems. Pensions eventually would become the most supported tool for reshaping educational institutions. ⁴

Kentucky educators are enrolled in a defined-benefit (DB) pension plan. Public educators are nearly unanimously enrolled in defined-benefit pension plans, rather than defined-contribution (DC) pension plans. Under DB plans, individuals are required to contribute a predetermined amount for their time employed. Once retired, their benefits are determined by set formulae, often using number of years worked and salary amounts. Once retired, individuals are then entitled to receive that benefit amount for the rest of their lives, regardless of how long that is. ⁵

Backloading is present in teacher retirement systems due to the harsh penalties associated with early retirement. Under many systems, teachers accrue very little in their early years of teaching due to the formulae used in DB pension plans. Systems will often have a minimum number of years to receive full retirement benefits. If an individual retires even one year earlier, they will receive only a fraction of the full benefits. The penalties become greater as you get farther from retirement age. Delaying benefits until retirement creates an immediate, and sometimes high, opportunity cost to remaining in teaching before retiring. Depending on the specific plan, individual teachers could be eligible for a rather high percentage of their current salary by retiring immediately. ⁵

Teachers have one of the most attractive defined benefit systems. However, turnover remains high, mostly due to young teachers deciding to change jobs. Young teachers often realize that they prefer other work. Such heavily backloaded benefits are unlikely to retain them, the system harshly penalizes “stop outs,” those young women who usually take leaves, most often for family reasons, and then return. ⁶

“There is also evidence that math and science teachers, those most sought after, are retiring earlier than their peers in other educational subjects.”⁷

“In 1999-2000, out of a teaching workforce of about 3.45 million, there were about 535,000 new hires. Analysis shows that the primary reason behind the high hiring rate of teachers is not enrollment increases or retirement but pre-retirement losses of current teachers.”⁸

For an overview of the KTRS specifics for this paper: a teacher is eligible to retire once reaching 27 years of service with full benefits, without penalty. Up until this point, teachers retiring early are penalized by receiving less monthly retirement pensions. To qualify for monthly retirement benefits, becoming vested, teachers need to meet one of two requirements: attaining age 55 and completing 5 years of Kentucky service, or completing 27 years of Kentucky service regardless of age. Teachers not meeting one of these two requirements are ineligible to receive benefits under the KTRS.

Teacher pensions in Kentucky are determined based on set percentages by the state legislature. The cases differ on the amount of salary able to be used in the formula. Teachers reaching with an age of 55 and 27 years of service are allowed to use the average of their three highest year salaries, most often the last few years of employment, while those failing to make either qualification must use the average of their 5 highest salary years. Under the pension funding model, teachers' pensions are calculated as follows: average of the highest three or five years' salary, multiplied by a determined percentage, multiplied then by the number of years of service. In Kentucky, the percentage is 2.5 percent for years less than 31 years worked and 3 percent for additional years after 30. This is expressed as Equation 1:

*(1) Monthly Pension Payments= number of years of experience x 2.5% x
Average salary of highest years*

With 27 years of service and a multiplier of 2.5 percent, teachers are able to receive almost 67.5 percent of their final salary by not working at all. School districts may also have financial incentives to retire the more experienced, and costly, teachers. Districts, which are responsible for teachers' salaries, can cut their costs by incentivizing the teachers to retire earlier. While total costs are now higher, with the pension of the retired teacher and the salary of the new hire, the district ends up paying less by shifting the retirement pensions to the state system.

Data Description

This paper will use six years of panel data on 110 counties, drawn from three sources. The first is from the Kentucky State Teacher Retirement System's (KTRS) annual report. The second being the Kentucky Department of Education's (KDE) annual report cards for the districts. The third being locale descriptions of the districts from National Center on Education Statistics (NCES).

The KTRS's annual reports were used to obtain the number of benefit recipients in each county as well as the total number of payouts for the counties. Under KTRS, the public school districts, as well as several colleges and universities and various associations, are enrolled in the KTRS. The paper is focused on K-12 systems, and thus there are several counties where these other various groups are located which have been removed from the data; e.g. Madison County is removed due to Eastern Kentucky University being in Richmond, and Fayette County includes various agencies (the University of Kentucky and the University of Louisville are not in KTRS).

The data is presented in the amount of recipients currently living in that county. For example, if one teacher worked for Fayette County School but now resides in adjacent Scott County, their payment will be considered under Scott County's totals.

Table 1 Kentucky Teacher Retirement System Data Descriptions (June 31, 2013)

Contributing Members	74,831
Amount of Payments	\$1,733,296,377
Number of Payments	48,714
State Average Payment Amount	\$35,581
Local School Percentage of State Recipients	88.7%
Largest Employee	Jefferson County Schools- 10,215

The data obtained from the Kentucky Department of Education's annual report cards uses seven variables to express various measures of district characteristics. These, being on the district level, were used for the counties in the state. Several counties are home to multiple school districts. However, those counties' characteristics are represented by the county school system; e.g. Daviess County School District is used, without consideration of the Owensboro School District. The data obtained from the NCES is to describe the locale of the various districts. The NCES has multiple defined locale options. These have been reduced to four larger categories: city, suburb, town, and rural. The data available stretches 2008-2013 for 110 counties in total.

Table 2 below shows a description of the data used in the analysis of the sample. Sample size is based on panel data, six observations for each of the 110 counties; several variables were

unavailable for the most recent year from a few counties. This is unimportant in the estimation as a balanced panel is not required. The observation numbers available are noted below.

Table 2 Data Descriptions

Variables	Observations	Mean	Standard Deviation	Type
ACT Composite	658	18.12	1.02	Dependent
Spending per student	658	10059.57	1817.72	Explanatory
Total Compensation	660	31448.18	4024.23	Explanatory
Enrollment	660	4431.30	9098.81	Explanatory
Student Teacher Ratio	660	15.29	1.39	Explanatory
Number of National Board Certified Teachers	658	11.99	21.22	Explanatory
Average Teacher Experience	660	11.88	1.45	Explanatory
Number of Free Lunch Eligible Students	656	2173.74	4781.62	Explanatory
City	660	.02	.13	Control
Suburb	660	.05	.21	Control
Town	660	.19	.39	Control
Rural	660	.75	.44	Control
Appalachian	660	.45	.50	Control
Non-Appalachian	660	.55	.50	Control

Model

The model to be used in the analysis will examine how total teacher compensation, salary and pension, affects student outcomes, controlling for other explanatory variables. This will allow an inspection of whether higher pay increases student outcomes. The model is estimated in Equation 3, as:

$$(3) \quad T_{it} = \beta_{0it} + \beta_1 S_{it} + \beta_2 L_{it} + \beta_3 Y_{it} + \beta_4 A_{it} + \gamma_t + \varepsilon_{it}$$

where the dependent variable, T, is the average ACT composite test score of the county i in year t. The β 's are estimated coefficients. S_{it} is a vector of coefficients that describe school

characteristics; L_{it} is a coefficient for the locale of the school district. Y_{it} is a measurement of teacher salary. A_{it} is a variable for the categorization of the district. The variable, γ , is a variable indicating the school year and ε_{it} represents the model error term, which is correlated across all years t for each county. In the estimation, that correlation is represented by variances clustered on county.

The variable S is a vector representing several measurable school district characteristics; these include: Spending per student, enrollment, student teacher ratio, average years of teacher experience, and number of students eligible for free lunch. The variable L consists of four locale types: City, Suburb, Town, and Rural. Y is the amount of average total teacher compensation within a county: the current average salary and the current average pension payout. The salary and pension payments are both current amounts. While this is not ideal, pensions actually reflect previous salaries, we have included it as an inexact measure of total compensation. A is a representation for whether the county is Appalachian or non-Appalachian.

Research Question Hypothesis:

The null hypothesis (H_0) is that higher compensation for teachers will lead to increased student outcomes. The alternative hypothesis (H_1) is that higher compensations will not lead to increased student outcomes, as measured by average ACT scores. I predict that higher compensation will lead to increased student outcomes due to higher quality teachers and extra motivation. Increasing compensation is understandably a tool for attracting higher skilled individuals. Teaching, with higher compensation, would be able to compete closer to current relatively higher paying jobs. Outcomes could also increase if the instructors are motivated to work harder due to their now increased compensation. The model will be unable

to differentiate between which of these two effects is the motive, but detection of the combination can be shown.

Analysis and Findings

The results are presented in Table 3 below. The included results are from the models specified above. Several expected outcomes are found: number of national board certified teachers increase average ACT test scores, number of free lunch eligible students decrease average ACT scores, Appalachian districts also perform lower on student outcomes, measured by average ACT composite scores. Their coefficients and t-statistics are included in Table 3.

Table 3: Testing the Research Question

Variables	Average ACT Composite	T-Statistic
Spending per student (\$1000s)	-0.0555**	-2.54
Enrollment (units of 1000)	0.2261***	4.03
Student Teacher Ratio	0.0532674	0.91
Number of National Board Certified Teachers	0.0101766***	2.91
Average Teacher Experience	0.0223212	0.71
Total Teacher Compensation (\$1,000,000s)	7.21	0.41
Number of Free Lunch Eligible Students (1000s)	-0.4404***	-4.88
City	-0.5557194	-1.92
Suburb	-1.0635***	-2.82
Rural	-0.2485723**	-2.00
Appalachian	-0.5724533***	-4.27
2009	-0.013613	-0.20
2010	0.3553181***	4.74
2011	0.6904417***	10.07
2012	0.7688805***	6.42
2013	0.9756143***	9.70

*** p<0.01, ** p<0.05, * p<0.1

Further detailing the results, enrollment has been shown to be positively and significantly associated with average ACT scores. Controlling for the other variables, spending per student was significant and negative with ACT test scores. Student teacher ratio was positively, but

insignificantly, related to ACT scores. The number of National Board Certified teachers is positively and significantly related to ACT scores. The number of free lunch eligible students also reduces test scores, which is agreeable with current research. Locale, for being in a 'suburb' and 'rural', is significantly negatively related to average ACT scores, and Appalachian counties follow in those same footsteps.

In summary, the results are consistent with that part of the education literature finding little effect of money per se in increasing student test scores. However, National Board Certified teachers have students with higher test scores. Such teachers might cost more in pay, but that would be an effect of certification, not money. There is a trend in recent years toward higher ACT scores on average and on higher pay on average, but there is no evidence the pay is leading to the higher ACT scores.

Additionally, controlling for poverty, Appalachian schools still perform worse than their non-Appalachian counterparts within the state. The effects of Appalachia have been well documented, this examination further concludes with the previous research. The model is unable to determine the reason for underachieving in Appalachian schools, but it can be hypothesized in various ways.

Discussion

Limitations

This experiment was limited in a couple of ways which should be covered in further detail. The first noted limitation is that the data is only from the state of Kentucky. While this is applicable to this state, Kentucky has been shown to be unique. Thus, the results should not be generalized to other states. Kentucky's Teacher Retirement system is again unique; the

percentages used and number of years required varies between states. Other states have similar systems but they are unlikely identical to the system used here. Again, pension information is current, and thus a reflection of previous salaries. Data which allowed the examination of current contributions would be beneficial to fix this limitation.

An additional limitation is that all characteristics were gathered at the district level. This makes it impossible to look at individual school level characteristics, and even more refined individual teacher characteristics are impossible. For instance, two districts may have similar average data, while varying greatly on the actual school characteristics within the district.

Another limitation is that the KTRS organizes payment recipients by current payment location. This ignores commuting teachers, as well as those that moved after their teacher career was completed. This is likely to affect the data, and cannot be remedied in this model. Locale

identification was taken from the NCES, which only considers size and relation to other cities.

While Kentucky is a fairly homogenous state, further distinction could be made to include actual demographic information. Additionally, all Appalachian counties are treated the same. Parental data would also be helpful in further highlighting the outcomes. We have only included the number of free eligible lunch students, which creates two income breakdowns, more defined examination would be beneficial, but the data was not available.

Recommendations

The results provided in this paper are an examination of district characteristics when it comes to teacher compensation and student outcomes. While the two were not shown to be related in this examination, it is not enough to disregard the link between the two. While the two are not apparent at the district level, it may still be the case on an individual basis. Recent research has shown that teachers are unlikely to move between districts in Kentucky during their

career. An even stronger finding was that Appalachian districts are unable to pull teachers from the non-Appalachian portion of the state.⁹ Due to this observation, rewarding higher quality teachers is unable to show up in aggregated district averages. Also, increasing Appalachian teacher salaries is unlikely to attract higher quality teachers from other parts of the state. In the future, it could be beneficial to apply this model to individual teachers across the state of Kentucky. Individual teacher data will need to be obtained, but was unable to be for this study.

When originally testing the link between higher compensation and student outcomes, they were shown to be significant and positively correlated. Once controlling for the year, it is shown that these two are unrelated, but both trending upwards. While, they have both been increasing in the study period, this is spurious. Increasing overall teacher compensation in our lowest achieving districts is unlikely to have any effect on student outcomes. What does seem to strongly improve student outcomes is the number of national board certified teachers within the district. Focusing on the attraction and retention towards these individuals may be the best strategy for increasing student outcomes.

Conclusions

While the alternative hypothesis (H_1) was correct, it is not terribly surprising at the district level. Also, the state of Kentucky has been requiring all high school juniors to take the ACT since 2008. It would be conceivable that a Hawthorne-like effect could be occurring. With the entire state participating, regardless of college interest, it would be logical that the districts, or state as a whole, would prepare students accordingly. The ACT format has been similar for some time, test takers, and test prep has become increasingly effective at taking the test.

Examining how increased compensation would lead to higher student outcomes is important. As described earlier, teacher quality may be the single most important factor in determining student outcomes. If a link could be shown that increased compensation, either through attraction and retention of higher caliber individuals, or through increased effort from now higher paid individuals, policymakers could shift resources accordingly. Unfortunately, this is not observable in this study at the district level. As noted earlier, both ACT scores and teacher compensation have been rising over the observed time period, but this study is unable to attribute any causality. What was identified, was that national board certified teachers are effective at increasing student outcomes; which could mean that the possibility that creating policies to attract and retain national board certified educators may be a tool for increasing the student outcomes within the state of Kentucky. These findings could be built on with more accurate data. The attraction of national board certified teachers seems like a worthwhile investment for districts in the state of Kentucky.

References

- ¹Harris, Douglas N and Tim R Sass. What Makes a Good teacher and Who Can Tell? (2010)
<http://myweb.fsu.edu/tsass/Papers/IES%20Harris%20Sass%20Principal%20Eval%2034.pdf> on March 31, 2014
- ²Corcoran, Sean P., William N Evans and Robert M Schwab. Women, the Labor Market, and the Declining Relative Quality of School Teachers. *Journal of Policy Analysis and Management*. Volume 23 No 3 (2004), pp. 449-470. Accessed at <http://www.jstor.org/stable/3326261> on January 6, 2014
- ³Hanushek, Eric A. The Single Salary Schedule and Other Issues of Teacher Pay. *Peabody Journal of Education*, Vol. 82 No 4, pp. 574-586 (2007) Accessed at [http://hanushek.stanford.edu/sites/default/files/publications/hanushek.2007%20PeabodyJEd%2082\(4\).pdf](http://hanushek.stanford.edu/sites/default/files/publications/hanushek.2007%20PeabodyJEd%2082(4).pdf) on March 31, 2014
- ⁴Graebner, William. Retirement in Education: The Economics and Social Functions of the Teachers' Pension. *History of Education Society*. Vol. 18, No. 4 (Winter, 1978), pp. 397-417. Accessed at <http://www.jstor.org/stable/367711> on February 17, 2014
- ⁵Koedel, Cory, Michael Podgursky, and Shishan Shi. Teacher Pension Systems, the Composition of the Teaching Workforce, and Teacher Quality. *Journal of Policy Analysis and Management*. Volume 32, No. 3, 574-596 (2013). Accessed at <http://onlinelibrary.wiley.com/doi/10.1002/pam.21699/full> on February 16, 2014
- ⁶Podgursky, Michael. Is it Time to Rethinking Teacher Pensions in Maryland?. November 2006. Accessed at http://www.abell.org/pubsitems/ed_pensions_1106.pdf on February 15, 2014
- ⁷Costrell, Robert and Michael Podgursky. Reforming K-12 Education Pensions: A Labor Market Perspective. *TIAA-CREF Policy Brief*. February 2011. Accessed at https://www.tiaa-crefinstitute.org/public/pdf/institute/pdf/pb_reformingpension0211a.pdf on February 12, 2014
- ⁸Kimbrall, Steven M. and Herbert G. Heneman III and Eileen M. Kellor. Can Pensions Help Attract Teachers?. *Journal of Education Finance*. Vol. 30, No. 4 (Spring 2005), pp.399-411. Accessed at <http://www.jstor.org/stable/40704243> on February 14, 2014.
- ⁹Cowen, Joshua M, JS Butler, Jacob Fowles, Megan E Streams, and Eugenia F Toma. Teacher Retention in Appalachian Schools: Evidence from Kentucky. *Economics of Education Review*. Vol. 31 (2012) pp. 431-441. Accessed at on February 14, 2014