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Does the Missouri Teacher Career Ladder Program Raise Student Achievement?

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Prepared for *Performance Incentives: Their Growing Impact on American K-12 Education* in Nashville,Tennessee on February 28, 2008

Working Paper 2008-15
February 2008

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This working paper was supported by the National Center on Performance Incentives, which is funded by the United States Department of Education's Institute of Education Sciences (R30SA06034). This is a draft version of a paper that will be presented at a national conference, Performance Incentives; Their Growing Impact on American K-12 Education, in Nashville, Tennessee on February 28-29, 2008. The authors wish to thank the staff of the Missouri Department of Elementary and Secondary Education and the Office of Social and Economic Analysis for their assistance in obtaining the data used in this study. This work is supported by the Ewing Marion Kauffman Foundation. The views expressed in this paper do not necessarily reflect those of sponsoring agencies or individuals acknowledged. Any errors remain the sole responsibility of the author.

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Grant No.: 2007-0284
MPR Reference No.: 6333-400

MATHEMATICA
Policy Research, Inc.

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Draft Report

March 4, 2008

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# ACKNOWLEDGEMENTS

This research was supported by a grant from the Ewing Marion Kauffman Foundation of Kansas City, Missouri. The authors would like to thank the Foundation for its support and acknowledge several people who contributed to this report. Margo Quiriconi and Havaca Johnson of the Kauffman Foundation were helpful at various stages of the process. We appreciate the generous cooperation of Leigh Ann Grant-Engle and Rosalyn Wieberg of the Missouri Department of Elementary and Secondary Education. Nii Addy, formerly of Mathematica, Stephanie Schmidt and Elizabeth Warner, of the U.S. Department of Education, and Mike Podgursky, of the University of Missouri-Columbia all provided useful input at early stages of the project. We also thank Howard Nelson, Kate Walsh, and Lori Taylor for helpful conversations and suggestions.

At Mathematica, Tim Silman read drafts and provided input at every stage. John Deke carefully read drafts and provided critical input on methodology. The report was edited by Marc DeFrancis and prepared for publication by Donna Dorsey.

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CONTENTS

TABLES

Table		Page

ABSTRACT

Although Missouri has had a Career Ladder program for teachers since 1987, very little research has been carried out to measure the program's effects and what has been studied has not been comprehensive. This paper examines the program's effect on student achievement across the state, using longitudinal data on district math and reading scores for 524 Missouri school districts over a nine-year period. Our primary specification compares achievement levels in participating districts with a matched group of non-participating districts. We also applied alternative specifications to identify the impact of the program, for example controlling for prior district scores and measuring variations in district participation over time to identify effects of the program within a given district. Across the range of specifications, the estimated effects of the Career Ladder program range from small positive effects to no effect in both math and reading. We conclude that if the Career Ladder has a positive impact on test scores, it is probably very small.

I. BACKGROUND

A. POLICY PROBLEM AND RESEARCH QUESTION

Public school teachers are usually paid according to two objective criteria alone: their years of experience and their educational attainment (certificates, degrees, or coursework). This system, known as the uniform salary schedule, has received criticism for being unfair, because it does not reward effort or skill, and for being inefficient, because it does not encourage hard work or attract talent (Hanushek 1981).

Education policymakers seeking to reform the way teachers are paid have tried many times, often without success, to tie teacher compensation more closely to the quantity and quality of teachers' work. An influential 1983 report by the National Commission on Excellence in Education, entitled *A Nation at Risk*, shined a spotlight on the problem and spurred a wave of reforms during the mid- to late 1980s. Many of the reforms included career ladders for teachers, which allowed teachers to advance in salary based on factors other than seniority such as demonstrated skills or performance. However, most of the reforms enacted in the late 1980s did not last very long (Glazerman 2004). This study focuses on an important exception, a teacher career ladder program that the State of Missouri started in 1986 and that continues to operate more or less unchanged.

One goal of Missouri's Career Ladder program is to improve student achievement by offering teachers opportunities to earn extra pay for extra work and professional development, where eligibility for these opportunities is based on a combination of seniority and subjective performance evaluation. The policymakers who established the program hoped that the incentives created by the availability of such opportunities as well as the activities themselves improve academic services, programs, and learning outcomes for students, in part by attracting and retaining effective teachers.

This paper is part of a larger study that focuses on Missouri's Career Ladder Program as a whole to and find out how it really works and whether it is achieving the goals mentioned above. The study posed the following broad research questions:

1. How does the program operate in theory and in practice?

2. What effect does the Career Ladder have on student achievement?

3. What effect does the Career Ladder have on teachers' career decisions, specifically their decisions to stay in their school district or to remain in the teaching field?

This paper addresses the second research question above, while two companion reports (see Silman et al. forthcoming and Booker and Glazerman forthcoming) address the other two questions.

To date, policymakers have very little evidence on which to base answers to these three questions. The only published evidence on the effectiveness or even the operation of the Missouri Career Ladder program that we could find was limited to two reports on early program implementation (Schofer et al. 1987; Taylor and Madsen 1989), two single-district studies also from the early years of the program (Ebmeier and Hart 1992; Henson and Hall 1993) and a brief set of tabulations by the Missouri Department of Elementary and Secondary Education (DESE) using 1999 test score results for a subset of the state's districts. Our analysis of statewide test scores covers 10 years of data, substantially updates the DESE analysis, and explicitly accounts for observable differences between Career Ladder and non-Career Ladder districts.

Across the country, policymakers have little rigorous evidence on the effectiveness of teacher incentive programs in general. Reviews by Glazerman (2004), Goldhaber and Anthony (2007), and Podgursky and Springer (2007) indicate that attempts to study teacher incentive programs rigorously are frequently thwarted by the early termination of the very programs being studied. Arizona appears to be the only state besides Missouri to have a career ladder program that has lasted since the 1980s. Dowling et al. (2007) have studied the effects of Arizona's Career Ladder Program on student achievement. Their study design compared student performance in participating districts with performance in a matched set of comparison districts over a two-year period. They found positive impacts on test scores in math, reading, and writing even over the short period they examined. It is worth noting, however, that the Arizona and Missouri programs differ in at least one major respect: In Arizona the career ladder plans allow student achievement to be considered in determining teacher pay, whereas in Missouri the plans do not.

B. OVERVIEW OF THE MISSOURI CAREER LADDER PROGRAM

As background, we describe the program as it operates, based on available program documents and published literature, and to a lesser extent how it operates in practice. Silman et al. (forthcoming) present more in-depth findings on program operations based on first-hand data collected for this study.

1. Program Structure and Operation

Through the Career Ladder program, teachers who meet statewide and district-level performance criteria are eligible to receive supplementary pay for meeting Career Ladder responsibilities, which can be extra teaching work or participation in professional development. The program does not replace the regular salary schedule. Career Ladder responsibilities must be academic in nature and directly related to the improvement of programs and services for students.

A teacher moves up the Career Ladder in three stages. To move up the ladder, teachers are assessed at each stage through periodic observations and evaluations of documentation. Each successive stage offers the opportunity to receive more supplementary pay for Career Ladder responsibilities: up to $1,500 for Stage I, $3,000 for Stage II, and $5,000 for Stage III. Out of more than 65,000 teachers in 524 districts statewide, more than 17,000 teachers (26 percent) from 333 districts (64 percent) participated in the Career Ladder program during the 2005-06 school year.

The Missouri Career Ladder has the distinction of being the most mature teacher compensation reform program in the country. It came into being in 1985 and has outlasted dozens of programs that were introduced around the country at the same time. Missouri's program is unusual in the way it mixes teacher performance, tenure, and extra responsibilities to define salary supplements. To advance up the Career Ladder teachers must meet certain tenure requirements and show progress in their performance as rated by classroom observers, yet the bonuses are actually given for the extra responsibilities they carry out. The Career Ladder advancement accounts for only the amount of extra responsibility and the rate at which the extra work is compensated.

2. District Participation

Missouri's program is available statewide but districts must choose whether they will participate and, if so, they must provide matching funds. Districts that choose to participate must submit a District Career Ladder Plan (DCLP) to the Missouri Department of Elementary and Secondary Education (DESE). DESE approves plans that meet state guidelines for improving academic services and programs for students. DCLPs must be aligned with a statewide Missouri School Improvement Program. They also must include curriculum development plans, professional development plans for teachers, guidelines for teachers' Career Development Plans, and an instrument for Performance-Based Teacher Evaluation.

While all participating districts must contribute matching funds for the program, poorer districts receive a higher percentage of matching funds from the state. Every year the state ranks districts according to their per-capita income, and based upon this ranking the state covers 40 percent of Career Ladder program costs for districts in the top quartile, 50 percent of costs for districts in the next quartile, and 60 percent of costs for districts in the bottom half. Some districts may decide not to participate in because they are unable to afford their share of the program costs despite this graduated matching rate.

3. Teacher Eligibility and Qualifications for a Bonus

To enroll in the Career Ladder and qualify for bonuses, each teacher must develop her or his own Career Development Plan (associating each Career Ladder responsibility with either a designated plan or some other instructional improvement). The district Career Ladder Review Committee, which is made up of educators (selected by teachers) and administrators, must then approve the teacher's development plan. Through scheduled and unscheduled observations, as well as reviews of their Career Development Plan and other documentation such as lesson plans, the teacher must show evidence of performance at or above the expected level on 20 criteria listed in the district's Performance-Based Teacher Evaluation (PBTE) instrument. The criteria span these six areas: (1) engaging students in class, (2) correctly assessing students, (3) exhibiting content knowledge, (4) showing professionalism in the school, (5) participating in professional development, and (6) adhering to the district's education mission. There are also specific qualification criteria for each stage of the Career Ladder, as follows:

- ***Stage I***. To qualify for Stage I, a teacher must have five years of teaching experience in the state and have performed at the "expected" level or above on all criteria on the most recent final evaluation instrument of the PBTE.

- ***Stage II***. To qualify for Stage II, a teacher must have completed two years of service at Stage I of the Career Ladder. The district may waive one year of service at the previous stage if the teacher has spent seven years teaching in Missouri. The teacher also must have performed at the "expected" level or above on all criteria, and above the expected level on at least 10 percent of the criteria on the most recent final evaluation instrument of the PBTE.

- ***Stage III***. To qualify for Stage III, a teacher must have completed three years of service at Stage II of the Career Ladder. The district may waive two years of service at the previous stage if the teacher has spent a total of 10 years teaching in Missouri's public schools. The teacher also must have performed at the "expected" level or above on all criteria, and above the expected level on at least 15 percent of the criteria on the most recent final evaluation instrument of the PBTE.

To receive a salary supplement, teachers must spend a specified amount of time on a certain number of responsibilities outside of their contracted time. Examples of the extra responsibilities that Career Ladder teachers undertake include doing extra work, such as providing students with opportunities for enhanced learning experiences, remedial assistance, and various extended day/year activities, and participating in professional development, such as taking college classes, attending workshops, and participating in professional organizations.[1]

The district's Career Ladder Review Committee evaluates the teachers to determine if they have carried out their responsibilities and should receive supplementary pay. Almost all Career Ladder teachers do receive this supplementary pay. The minimum time teachers must spend on these responsibilities in a given year is determined by their stage on the Career Ladder, as follows:

- Stage I teachers must spend a total of at least 60 hours on at least two responsibilities
- Stage II teachers must spend a total of at least 90 hours on at least three responsibilities
- Stage III teachers must spend a total of at least 120 hours on at least four responsibilities.

In the 2005-06 school year, an average of 79 hours were spent by Stage I participants, 111 hours were spent by Stage II teachers, and 144 hours were spent by Stage III teacher. These hours approximately translate to supplementary pay at $19, $27, and $35 per hour, respectively, for Stages I, II, and III, somewhat lower than the nominal hourly rates that would be earned by doing the minimum requirement: $25, $33, and $42 per hour. The bonus amounts have never been increased or adjusted for inflation since the program was established in 1985.

District participation in the Career Ladder program has grown steadily since it started in 1986-87, although it grew the most rapidly in the program's early years. Table 1 shows the history of the Career Ladder program. The table's first column shows that the number of districts participating rose dramatically in the program's first six years, from 63 districts in the first year to 204 districts by 1992-93. After 1995-96 growth slowed, with the total of 333 districts participating in 2005-06 reflecting an increase of 47 districts over a ten-year period. Similar patterns hold for growth over time in the number of teachers participating and in the total state payments made for the program.

In this study we sought to identify the Career Ladder program's impacts by examining changes between districts before and after they begin implementing the program. One of the challenges we faced is that while the program has been in operation since the 1986-87 school year, Missouri did not start state-wide standardized testing in math and reading until 1997-98. By that time, 288 districts were already participating in the program, and only 18 districts stopped participating after 1997-98, so there is little opportunity to compare student achievement in those districts before and after participation. During the recent nine-year

[1] DESE recommends that teachers should not spend more than one-third of Career Ladder hours on college classes and workshops.

period for which standardized test score data is available, only 66 districts switched participation status. Thus, the majority of variation in participation status occurs cross-sectionally between districts.

Table 1. History of Career Ladder Program

Year	Number of Districts Participating	Number of Teachers Participating	Total State Payment
1986-87	63	2,400	$2,624,025
1987-88	121	5,074	$7,182,975
1988-89	147	5,811	$10,484,500
1989-90	177	6,803	$13,839,075
1990-91	192	7,580	$16,688,675
1991-92	199	8,322	$18,902,575
1992-93	204	8,536	$20,362,750
1993-94	229	10,696	$24,426,950
1994-95	269	13,021	$29,300,325
1995-96	286	14,107	$33,358,250
1996-97	278	13,741	$34,312,899
1997-98	288	14,098	$35,799,849
1998-99	299	14,707	$37,333,522
1999-00	309	15,827	$37,687,074
2000-01	322	16,688	$37,993,100
2001-02	330	17,101	$38,253,625
2002-03	338	17,412	$38,599,500
2003-04	332	16,982	$37,103,360
2004-05	328	16,919	$36,465,400
2005-06	333	17,378	$36,986,803

Soure: Table contains data from the Missouri Career Ladder program 2005-06 annual report, produced by the Missouri Department of Elementary and Secondary Education.

II. Data

DESE provided us with district-level data on average math and reading scores, Career Ladder participation, and a broad range of demographic and other variables. The test score data cover nine years and nearly all of the 524 districts in the state. The Missouri Office of Social and Economic Analysis provided us with additional district-level census data.

Comparing mean district characteristics, we find that districts participating in the Career Ladder program are on average smaller, more white, more economically disadvantaged, and more rural than districts that do not participate. Table 2 compares the mean characteristics of participating and non-participating districts, at the beginning and the end of the analysis period.[2] Districts that were participating had much lower average enrollments than districts that were not: In 1997-98, average enrollments were 1,108 students (participating districts) and 2,411 students (non-participating), and in 2004-05 enrollments were 1,164 (participating) and 2,513 (non-participating). The median participating district (585 students) was also smaller than the median non-participating district (762 students) in 2004-05. Participating districts were also more likely to be rural (75 percent) than non-participating districts (62 percent) in 1997-98.

Districts that participate in the Career Ladder program are more predominantly white than non-participating districts, with an average of 97 percent white in participating districts in 1997-98, compared to 91 percent white in non-participating districts. The size of the gap is relatively constant over the analysis period, as the African-American and Hispanic percentages rise for both groups by 2004-05. The percent of students who are economically disadvantaged, as measured by free or reduced-price lunch eligibility, is greater for participating districts, with a difference of 44 percent (participating) to 38 percent (nonparticipating) in 1997-98 and 50 percent to 45 percent, respectively, in 2004-05. This mirrors the characteristics of the districts' overall populations. Districts that participate have

[2] Nine districts participated in the Career Ladder program for at least one year during the analysis period on a limited basis, in order to reward National Board Certified teachers. In our analysis we do not include those districts in the sample of participating districts.

a higher percentage than other districts of households that are considered poor, a higher percentage with no college education, and a lower median income.

Table 2. Characteristics of Participating and Non-participating Districts

	1997-98		2004-05	
Average Characteristics	Participating Districts	Non-participating Districts	Participating Districts	Non-participating Districts
Enrollment	1,108	2,411	1,164	2,513
Percent white	96.7%	91.1%	94.9%	88.4%
Percent African-American	2.0%	7.6%	2.6%	9.1%
Percent Hispanic	0.7%	0.7%	1.6%	1.6%
Percent economically disadvantaged	43.5%	38.4%	49.5%	44.6%
Teacher annual salary	$27,939	$28,511	$33,569	$34,889
Teacher experience level	12.1	12.4	12.2	12.5
Student-teacher ratio	13.1	13.2	12.2	12.5
Percent in a large or mid-size city	8.0%	19.9%	7.5%	22.8%
Percent in a large or small town	17.5%	18.2%	16.3%	20.3%
Percent in a rural area	74.5%	61.9%	76.2%	56.9%
Percent urban	15.5%	31.8%	14.8%	35.6%
Percent with no college	65.4%	61.5%	65.3%	61.0%
Percent poor	14.4%	12.4%	14.3%	12.2%
Median household income	$31,945	$36,039	$32,040	$36,579
Propensity score	0.665	0.363	0.641	0.351
Number of districts	286	236	320	202

Districts that were participating in the Career Ladder program during the analysis period were also more likely to have started participating prior to the analysis period. Table 2 includes an average propensity score for participating and non-participating districts, which is the predicted probability of the district participating in 1994-95, based on the district's 1994-95 characteristics.[3] The primary determinants of the propensity score are the state

[3] The propensity score is generated from a district-level logit regression with 1994-95 district data. The dependent variable is an indicator for district Career Ladder participation in 1994-95, and the explanatory variables are percent African-American, percent Hispanic, percent economically disadvantaged, log of enrollment, percent urban, percent with no college, percent poor, log of median household income, and the district's state Career Ladder match rate.

matching rate,[4] with districts that have higher matching rates being more likely to participate, and the percent urban and percent with no college education, with urban and highly-educated districts being less likely to participate. In both 1997-98 and 2004-05, districts that were participating in the program were approximately 30 percent more likely to have been doing so in 1994-95 than non-participating districts, based on their 1994-95 characteristics.

Missouri implemented statewide standardized testing in 1996-97 with the introduction of the MAP math test in grades 4, 8, and 10. In 1997-98 Missouri added a MAP reading test in grades 3, 7, and 11, and continued to test math and reading in these grades through the 2004-05 school year. We use the district average scale scores for math and reading through this time period, with the analysis covering 1996-97 through 2004-05 for math and 1997-98 through 2004-05 for reading. The MAP scale scores vary from 450 to 910 across grade levels and subjects.

In both 1997-98 and 2004-05, the average math and reading test scores for districts that were participating in the Career Ladder program were quite similar to those for districts that were not. Table 3 compares average test scores across participating and non-participating districts in 1997-98 and 2004-05, separately by grade and subject. Non-participating districts had higher average test scores in most grades and subjects in both years, although the differences are quite small relative to the standard deviations and the gap in average test scores is never statistically significant at the 10 percent level.

[4] Prior to 1996 the state matching rate on Career Ladder expenditures was determined by district property value per pupil, and ranged from 90 percent for the lowest property value districts to 35 percent for the highest property value districts.

Table 3. District Average Achievement Levels

		1997-98		2004-05	
Subject	Grade	Participating Districts	Non-participating Districts	Participating Districts	Non-participating Districts
Math	4	636.6 (12.0)	637.2 (12.4)	644.3 (11.6)	644.9 (13.3)
Math	8	695.5 (15.1)	696.2 (14.7)	704.9 (11.7)	706.2 (15.3)
Math	10	718.2 (14.0)	720.2 (15.5)	737.3 (13.4)	736.9 (15.3)
Reading	3	635.1 (10.4)	633.9 (10.9)	641.9 (9.7)	641.2 (11.3)
Reading	7	668.2 (11.3)	670.1 (12.9)	676.9 (9.4)	677.4 (10.9)
Reading	11	704.2 (13.1)	707.1 (10.9)	712.1 (8.1)	713.4 (8.1)
Number of Districts		286	236	320	202

Standard deviations in parentheses

III. METHODS

We can think about modeling achievement impacts with a student-level cumulative achievement function, in which current student achievement depends on school and family inputs.[5] Ideally such a model would use student-level longitudinal data spanning the entire analysis period, in order to compare the achievement trajectories of individual students as they enter or exit treatment status. In our analysis, treatment status varies at the school district level because treatment is exposure to a regime in which teachers are offered the possibility of a bonus if they qualify and then perform certain activities.

Therefore, we model district average student achievement in each time period as a function of the district's Career Ladder participation status, as well as other observable characteristics of the district. The estimation equation is:

$$(1) \quad A_{igt} = CL_{it-1} + X_{it} + PS_i + \theta_{gt} + \delta_i + \varepsilon_{it}$$

where A_{igt} is the average achievement level in district i for grade g in year t, CL_{it-1} is Career Ladder participation status for district i in year t-1, X_{it} is a set of district demographic control variables, PS_i is the district's 1994-95 propensity score (explained below), θ_{gt} is a set of grade by year indicators, δ_i are district random effects, and ε_{it} is the random error term. Because there are unobserved factors that vary between participating and non-participating districts but not necessarily over time, we include district random effects in the error structure to improve the precision of the coefficient estimates by accounting for the district-specific component of variance.

We did not include lagged test scores as a control variable on the right hand side of the estimating equation. A reason for this is that prior to 2004, Missouri did not require districts to test their students in consecutive grades. This intermittent testing design makes it difficult to explicitly model achievement growth in the way that most student-level achievement models require. Over the analysis period students would have at most two test scores in a

[5] See Todd and Wolpin (2005) for more details on cumulative achievement functions.

subject, spaced two to four years apart, making a comparison of achievement trajectories before and after treatment mostly uninformative.

Districts can choose each year whether or not to participate in the Career Ladder program, so naïve comparisons of participating with non-participating districts will confound selection effects with program impacts. That is, districts' career ladder participation status, CL_{it} may be correlated with unobserved determinants of student achievement, represented in our model by δ_i and ε_{it} and therefore endogenous. If participation is endogenous, the estimated achievement effect would be biased. The estimates could be downward biased, for example, if districts only participated out of fear of falling test scores, or could be upward biased if districts participated because they were reform-minded in general. Our qualitative research (see Silman et al. forthcoming) suggests that teachers themselves were the main force behind district participation decisions and that the program was simply viewed as a way to augment salaries.

One way to address the problem of endogenous participation is to use propensity score methods that attempt to balance the distribution of observable characteristics among Career Ladder and non-Career Ladder districts. The propensity score is the probability that a district would have started participating before 1995-96, which we estimate using a logistic regression. We include this propensity score as a control variable in the model and also use it to form subgroups of observably similar comparison and treatment schools.

After adjusting for the propensity score, the mean characteristics of participating and non-participating districts in 1997-98 are no longer significantly different. The first two columns of Table 4 show the unadjusted mean characteristics of participating and non-participating districts in 1997-98, and the last two columns show the mean characteristics after regressing each characteristic variable on the district propensity score. Participating districts are on average significantly different from non-participating districts in most respects, but when the district characteristics are adjusted for the propensity score, none of the differences is statistically significant, and most of the difference between the mean characteristics is eliminated. For instance, participating districts have a mean percent African American of 2.0 percent and non-participating districts a mean of 7.6 percent, a difference of 5.6 percent, but after adjusting for the propensity score this difference shrinks to 0.6 percent.

Because there are many ways to specify such a model, we identified a benchmark model that we believe is most plausible, and later use sensitivity tests to examine the robustness of the benchmark results according to different modeling or specification assumptions. The benchmark estimation specification models the average district math and reading test scores as a function of district demographics, community characteristics, and the propensity score variable. The model includes district random effects to account for the district-specific component of variance, as well as grade-by-year fixed effects. The treatment variable is an indicator for the district participating in the Career Ladder program in the prior year. We use lagged Career Ladder participation because the effect of a district's participation in the program is likely to be strongest on student achievement in the following year. We omitted 67 comparison districts with very low propensity scores from the model, since their characteristics are quite different from those of any of the participating districts.

Table 4. Propensity Score Adjusted Characteristics of Participating and Non-participating Districts, 1997-98

	Unadjusted Means		Propensity Score Adjusted Means	
Average Characteristics	Participating Districts	Non-participating Districts	Participating Districts	Non-participating Districts
Enrollment	1,108*	2,411*	1,494	1,943
Percent white	96.7%*	91.1%*	94.4%	93.8%
Percent African-American	2.0%*	7.6%*	4.2%	4.8%
Percent Hispanic	0.7%	0.7%	0.7%	0.7%
Percent economically disadvantaged	43.5%*	38.4%*	40.9%	41.1%
Percent in a large or mid-size city	8.0%*	19.9%*	13.4%	13.5%
Percent in a large or small town	17.5%	18.2%	19.4%	15.8%
Percent in a rural area	74.5%*	61.9%*	67.2%	70.7%
Percent urban	15.5%*	31.8%*	21.7%	24.4%
Percent with no college	65.4%*	61.5%*	63.9%	63.4%
Percent poor	14.4%*	12.4%*	13.5%	13.5%
Median household income	$31,945*	$36,039*	$33,578	$34,061
Number of districts	286	236	286	236

* indicates difference is significant at 5% level

IV. RESULTS

A. MAIN FINDINGS

Our best estimates of the average effect the Career Ladder Program has had on achievement across the three tested grade levels are significantly positive but small for math scores and not significantly different from zero for reading scores. The estimates, presented in Table 5, are reported in "effect size" units, which represent the fraction of a standard deviation at the district level in the distribution of student scores.[6] An effect size of 0.066 for math and 0.043 for reading suggest that a district's participation in Career Ladder is associated with an increase in scores of 6.6 percent and 4.3 percent of standard deviation in the distribution, respectively, in the distribution of mean test scores across districts. For comparison, the coefficient on the district's percentage of students who are economically disadvantaged is –0.828, so a ten point decrease in percent disadvantaged would be associated with an increase in average test scores of 0.083 of a standard deviation. Or, correspondingly, the effect of Career Ladder participation on math scores is comparable to a 7 percentage point reduction in the district's percentage of economically disadvantaged students, holding all else equal. In terms of student-level effect sizes, the effect size of 0.066 is equivalent to approximately 0.02 standard deviations in the student level distribution of scores. (Test scores vary considerably more across students than do average scores across districts).

Although the estimated Career Ladder effect on math scores is statistically significant, caution is needed in making causal inferences. Because districts choose whether to participate in the program, there may be other confounding differences between Career Ladder and non-Career Ladder districts that are impossible to fully control for, which could bias the estimated achievement effects. Additionally, a difference of less than one tenth of a standard deviation in test scores, even when it is statistically significant, is quite a small effect.

[6] To derive effect size estimates, we standardized all scores so that the distribution of average test scores has a mean of zero and a standard deviation of one within each grade level, subject, and year.

Table 5. Benchmark Specification

	Math	Reading
Overall CL Effect	.066**	.043
CL Effect (enrollment < 1600)	.060*	.042
CL Effect (enrollment 1600-5000)	.075	.023
CL Effect (enrollment > 5000)	.203	.137
Number of districts	454	454
Number of district-grade-year observations	10,425	10,013

* indicates significance at 10%, ** at 5%, *** at 1%

When we looked for a differential Career Ladder effect by district size, we found that the achievement effect is largest for the large districts, but these size effects are not statistically significant. Table 5 presents the results from interacting the district Career Ladder participation indicator with an indicator for district size, where districts are divided into three size categories based on their K-12 student enrollment (<1600, 1600-5000, or 5000+). If there is a fixed cost to a district for participating in the Career Ladder program, there could be more benefit for a large district to participate, since they have more teachers to benefit from the program, although we learned from qualitative research (see Silman et al. forthcoming) that the program has very little fixed cost. The funding rules starting in 1996-97 required a lower state matching rate for large districts, so their participation required a greater district contribution per teacher than did the participation of smaller districts. Nevertheless, the vast majority of both participating and non-participating districts fall in the small-district category, and the small-district math effect is positive and statistically significant at the ten percent level.

The results differ when we disaggregate by grade level (Table 6). For both math and reading the point estimates of the Career Ladder participation effect is largest for the elementary grade (grade 4 in math, grade 3 in reading), with an effect of 0.124 in math and a 0.100 effect in reading, each approximately twice as large as the effect for all grades combined, and statistically significant at the five percent level. For math, the 8th grade effect is also significant, with an effect of 0.082. For both subjects the elementary grade effect is statistically significantly different from the high school grade effect. The results of interacting the Career Ladder indicator with district size show a similar pattern, namely the largest effects occur for the elementary grades and for districts with high enrollments.

We can only speculate on the reasons for a differential effect by grade level. The pattern of larger effects for elementary grades could be due to a greater return in test scores from extra instruction given in those grades. Or perhaps it is easier to affect student test scores at a younger age, generally and apart from extra instruction, so that any effect is more pronounced in elementary school.

Table 6. Benchmark Specification, Separately by Grade

	Math			Reading		
	Grade 4	Grade 8	Grade 10	Grade 3	Grade 7	Grade 11
Overall CL Effect	.124***	.082**	.021	.100**	.040	-.008
CL Effect (enrollment < 1600)	.116***	.084**	.001	.103**	.036	-.021
CL Effect (enrollment 1600-5000)	.115	.061	.099	.056	.031	.032
CL Effect (enrollment > 5000)	.359**	.105	.150	.184	.165	.083
Number of districts	454	454	400	454	454	400
Number of district-year observations	3,617	3,615	3,193	3,477	3,475	3,061

* indicates significance at 10%, ** at 5%, *** at 1%

B. Robustness Checks

The findings are robust for the method by which we used propensity scores to construct a matched comparison. The benchmark estimates (Table 5) used the propensity score as a covariate. As an alternative, we used the subgroup classification method whereby we estimate treatment and comparison group means within specified intervals of the propensity score distribution and average the differences across intervals.[7] We repeated this method using four and then ten equal intervals (quartiles and deciles). The results (shown in Table 7) lead to the same conclusion as the covariate adjustment method used to produce the benchmark estimates, with an average effect size of 0.074 in math and 0.064 in reading.

The benchmark specification includes controls for observable district characteristics, but no control for prior test scores because Missouri did not conduct routine annual testing in consecutive grades. However, we were able to construct a synthetic pretest by going back two or more years for a given cohort, to the grade level where the students had been previously tested. This alternative specification uses the prior average test score for each cohort as a control variable. For example, for 10th grade math observations the cohort's prior average test score would be the district average 8th grade math score from two years earlier. As one might expect, effect of the Career Ladder disappears when we use the pretest specification, a result that is almost entirely attributable to the composition effect, i.e. dropping the lowest grade, which we know from Table 6 is largely responsible for the positive Career Ladder effect. Table 8 presents the results including controls for cohort prior average test scores. In order to show how the reduced sample changes the estimated effects, the last two columns report results for the benchmark specification, but restricted to the sample of district-year observations for which there is a cohort prior test score available. Restricting the sample in this way, we find that the effect on reading scores is basically zero, and the effect on math is less positive and no longer statistically significant. It is important to

[7] For a more detailed discussion of this method see Rosenbaum and Rubin (1984).

note, though, that most participating districts were also participating when the pre-test was administered, so the pre-test could also have been affected by district Career Ladder participation. Including the pre-test as a control would bias the results towards zero.

Table 7. Benchmark Specification, Separately by Propensity Score Groups

	Math	Reading
Lowest Quartile	.066	.023
2nd Quartile	.057	.072
3rd Quartile	.105*	-.007
Top Quartile	.070	.166*
Average Effect	.074*	.064
Lowest Decile	.049	.015
2nd Decile	.123	.080
3rd Decile	.024	.003
4th Decile	.027	.099
5th Decile	.015	.050
6th Decile	.006	-.097
7th Decile	.148	.008
8th Decile	.032	.104
9th Decile	.096	.115
10th Decile	.187	.409**
Average Effect	.070*	.079*

* indicates significance at 10%, ** at 5%, *** at 1%

Table 8. Controlling for Prior Cohort Average Test Scores

	Prior average test score as control variable		Test score differences as dependent variable		Benchmark specification, restricted to same sample	
	Math	Read	Math	Read	Math	Read
Overall CL Effect	.044	-.003	-.013	.000	.054	-.006
CL Effect (enrollment < 1600)	.036	-.020	-.021	-.007	.048	-.027
CL Effect (enrollment 1600-5000)	.058	.025	.011	-.012	.061	.033
CL Effect (enrollment > 5000)	.147	.241	.067	.206	.167	.250
Number of districts	454	454	454	454	454	454
Number of district-grade-year observations	4,727	3,127	4,727	3,127	4,727	3,127

* indicates significance at 10%, ** at 5%, *** at 1%

When the cohort prior test score is included as a control variable (the first two columns of Table 8) the coefficients are still statistically insignificant. The coefficients on prior test score variable are 0.284 for math and 0.227 for reading, indicating that cohort prior test scores do explain some of the variation in district average test scores. The relatively low coefficient could be due to the time lag between current and prior test scores (between two and four years, depending on the subject and grade), or to changes in cohort composition due to student mobility and attrition, or to measurement error in the prior test score variable. If the estimated coefficient is low due to measurement error, an alternative would be to use test score differences as the dependent variable, which is equivalent to constraining the coefficient on the prior test score variable to be equal to one. The middle two columns present results for this alternative specification, where the dependent variable is the difference between the district average test score and the cohort prior test score in that subject. The results for this specification are essentially zero for both math and reading.

While the findings based on a pretest are appealing, there are some limitations. One limitation with controlling for prior average test scores is that we must drop one-half to two-thirds of the sample because there is no pretest for the earliest grade level tested or for the first few cohorts of students. For math, fewer than half of the district-year observations have a pretest score (4,727 out of 10,425), and for reading, we retain fewer than a third of the observations (3,127 out of 10,013). Also, variations in student mobility or grade promotion/retention rates could lead to shifts in cohort composition over time.

To this point all of the models have given each district equal weight in the estimation. The majority of Missouri school districts have enrollments of fewer than 1,000 students, so these results are driven primarily by the smaller school districts. While this does reflect the impact of the Career Ladder program in the average school <u>district</u>, it does not reflect the impact on the average <u>student</u> in Missouri, since more students are concentrated in the larger school districts. It is possible that Career Ladder effects on achievement are not uniform by district size. One way to test this is to weight the models by district enrollment, giving more weight to large districts than to small districts.

When we do this, the results are similar (Table 9). The first two columns of Table 9 present the benchmark specification without district random effects, for comparison. [8] District random effects account for the district-specific component of variance, so excluding them could lead to imprecise estimates when districts self-select into treatment.[9] The Career Ladder effect estimates are slightly larger for both reading and math without accounting for district random effects, with effect sizes of 0.096 in math and 0.059 in reading, both statistically significant at the ten percent level. [10] The last two columns show the results

[8] Weighted estimation violates the assumptions of the random effects model. For a discussion see Wooldridge (2002).

[9] See Wooldridge (2002).

[10] The standard errors are adjusted for the clustering of observations by district using the Huber-White method.

when we weight by district enrollment. With enrollment weighting, the math coefficient drops slightly to 0.078 and loses statistical significance, whereas the reading coefficient increases slightly to 0.080, and continues to be significant at the ten percent level. In short, weighting by enrollment (or by the square root of enrollment, in the middle two columns of Table 9) does not appear to change the results very much, indicating that the effects for the average student are similar to those for the average district, positive but small in magnitude, and on the borderline of statistical significance.

Table 9. OLS, With Weights Based on District Enrollment

	Unweighted		Weighted by square root of district enrollment		Weighted by district enrollment	
	Math	Read	Math	Read	Math	Read
Overall CL Effect	.096***	.059*	.071**	.053	.078	.080*
CL Effect (enrollment < 1600)	.085**	.049	.041	.015	.015	-.012
CL Effect (enrollment 1600-5000)	.117**	.077	.080*	.068	.058	.062
CL Effect (enrollment > 5000)	.238**	.194*	.169	.164	.160	.184*
Number of districts	454	454	454	454	454	454
Number of district-grade-year observations	10,425	10,013	10,425	10,013	10,425	10,013

* indicates significance at 10%, ** at 5%, *** at 1%

To better understand the estimates of the Career Ladder effects we decomposed them into separate between- and within-district components. The between-district source of variation in Career Ladder participation is cross-sectional, with some districts that participate throughout the analysis period and others that never participate. The within-district source of variation is based on districts that switch participation status during the analysis period. This primarily consists of districts that enter the program for the first time after 1997-98, but also includes 18 districts that left the program during this period.

The positive effects of Career Ladder participation appear to be primarily due to cross-sectional differences in achievement levels between participating and non-participating districts, rather than variation over time for districts that switch participation status. Table 10 reports results that disaggregate two aspects of the overall Career Ladder effect: The effect due to within-district variation and the effect due to between-district variation. The first two columns report results for the within-district variation, from a specification including district fixed effects to control for all time-invariant district characteristics. The results for this specification are close to zero and insignificant for both math and reading, implying that *we see very little achievement effect for districts that switch participation status during the analysis period*. The middle two columns of Table 10 isolate the effect due to variation between districts, ignoring variation due to districts that switch status. These results show a slightly larger effect than the benchmark specification, with a statistically significant math effect of 0.090, and a statistically insignificant reading effect of 0.053.

To summarize, we found evidence of a small positive effect on math achievement linked with districts' participation in the Career Ladder, but the effect is not particularly robust when examined with alternative specifications. There are important reasons to be cautious about attributing this relationship as one *caused by* districts' participation in Career Ladder. Districts choose whether or not to participate, creating an endogenous selection rule that could bias the estimated participation effects. Moreover, the lack of test score data from the early period, when there was rapid growth in district participation, and the lack of longitudinal student-level test score data, due to districts' not testing in consecutive grades during the analysis period, limit our ability to control for district selection, or to rule out other factors that could be contributing to the estimated positive Career Ladder effect.

Table 10. Diagnostic Specifications

	Within variation only		Between variation only		Benchmark with no control variables	
	Math	Read	Math	Read	Math	Read
Overall CL Effect	.028	.011	.090**	.053	.028	.018
CL Effect (enrollment < 1600)	.026	.021	.081*	.046	.017	.002
CL Effect (enrollment 1600-5000)	-.008	-.163	.108	.062	.064	.079
CL Effect (enrollment > 5000)	.213	.055	.207	.172	.342**	.389***
Number of districts	454	454	454	454	454	454
Number of district-grade-year observations	10,425	10,013	10,425	10,013	10,425	10,013

* indicates significance at 10%, ** at 5%, *** at 1%

V. Conclusions and Implications

Although the Missouri Career Ladder program is one of the nation's oldest and largest teacher career ladder programs, little research has been conducted to examine its effects. Using nine years of math and reading test score data for nearly all of the state's 524 school districts, we find some evidence that participation in Career Ladder has a small positive effect on average math achievement, particularly in elementary grades, but no significant effect on reading scores.

Although our benchmark specification reveals a statistically significant positive effect on math scores, that effect is small, corresponding to less than one point on a student's average scaled test score, or approximately 0.02 student-level standard deviation units (corresponding to 0.07 district-level standard deviation units). Moreover, the positive effect found in the main analysis did not prove to be robust when we made different modeling assumptions. For example, when we examined variation within districts over time, thus canceling out time-invariant factors that might be confounded with Career Ladder status, the Career Ladder effect was statistically indistinguishable from zero. Across the range of specifications, the estimated effects range from small positive effects to no effect in both math and reading. We therefore conclude that if the Career Ladder has a positive impact on test scores, it is probably very small.

An important limitation of the analysis is that it relies on observational data and therefore may be subject to selection bias, despite our efforts to correct the problem. Unlike a randomized experiment, this analysis allowed us no way to control for time-varying unobservable characteristics that might simultaneously determine both program participation and program outcomes. Most districts in Missouri did not change their Career Ladder participation status during the analysis period, so even our ability to control for time-invariant fixed effects is limited. We used propensity scores and district random effects to control for district heterogeneity, but it was impossible to fully control for all possible biases due to the fact that districts' self-select when they begin using the Career Ladder program. When we do limit our review to just those districts that changed participation status during the analysis period, we find no significant effects on either math or reading achievement levels.

Another limitation of our study is that we focus on the average implementation effect across all participating districts, without access to comprehensive data on how the Career Ladder was implemented or on alternative policies that might substitute for or interact with Career Ladder practices. Participating districts vary in the way they implement the program, in how selective they are in allowing teachers to participate, in the types of activities that are rewarded, and even in the number and size of the bonuses awarded (state levels are maximums). With more detailed data on district-level implementation, we could characterize both the "treatment" and the counterfactual—how districts would spend career ladder funds if they were to decline participation. Possibly, we could examine differential achievement impacts associated with various district implementation strategies.

Readers should also bear in mind that student achievement is only one possible outcome of the Career Ladder program, and average math and reading scores only capture one aspect of student achievement. Another possible outcome is that participating in the Career Ladder helps districts attract and retain high-quality teachers. This could lead indirectly to improved student achievement, and it could also be an outcome that districts are interested in for its own sake; the cost of replacing teachers who leave early or unexpectedly can be high. We examine the program's impact on teacher retention in a separate paper. We also look in more detail at district Career Ladder implementation in a third paper.

1. Implications

This paper has implications for two important groups of policymakers in Missouri and beyond. District-level decision-makers in Missouri must decide whether to adopt or continue participating in Career Ladder. This paper suggests that adopting or continuing the program will not have a large impact on test scores. However, we do not know how districts would have spent their share of the funds that went toward Career Ladder. If they used the funds for other forms of teacher compensation, working conditions, or other school improvements, then this study shows that Career Ladder participation does not make them worse off.

At the state level, the policymakers face decisions each year about whether to modify the program rules, eliminate the program, or continue it unchanged. The effects of possible changes cannot be reliably forecast using existing data, but we have shown the limited extent to which the program can be justified in terms of improving student achievement. Advocates for continuing funding of the program will have to rely on other arguments apart from achievement.

This paper makes considerable progress in evaluating the achievement impacts of the Missouri Career Ladder program, especially given the paucity of existing information, but further research is warranted. In 2004, Missouri began testing students annually in grades 3 to 8, and this holds the potential to provide us with a student-level panel of test score data, allowing for a more precise measure of student achievement in more grade levels and more options for controlling for differing achievement levels across districts. With annual testing in consecutive grades, researchers can better identify impacts on specific years and therefore study more specific policy changes. The best way to exploit this rich emerging archive of student assessment data to inform policymaking would be for state officials to implement future policy changes gradually, agreeing to roll out changes on a pilot basis in limited schools or districts, selected by lottery from a pool of eligible candidates. Combined with careful measurement, such an approach would provide the best possible evidence on the intended and unintended behavioral effects of any future policy change.

REFERENCES

Booker, Kevin, and Steven Glazerman. "The Effects of the Missouri Career Ladder Program on Teacher Mobility and Retention." Washington, DC: Mathematica Policy Research, Inc., Forthcoming.

Dowling, Jane, Sheila Murphy, and Baofeng Wang. "The Effects of the Career Ladder Program on Student Achievement." Evaluation Report. Phoenix, AZ: Sheila Murphy Associates, 2007.

Ebmeier, Howard, and Ann W. Hart. "The Effects of a Career-Ladder Program on School Organizational Process." *Educational Evaluation and Policy Analysis,* vol. 14, no. 3 (1992), pp. 261-281).

Glazerman, Steven. "Teacher Compensation Reform: Promising Strategies and Feasible Methods to Rigorously Study Them." Washington, DC: Mathematica Policy Research, Inc., 2004.

Goldhaber, Dan, and Emily Anthony. "Can Teacher Quality be Effectively Assessed? National Board Certification as a Signal of Effective Teaching." *Review of Economics and Statistics*, Forthcoming.

Hanushek, Eric. "Throwing Money at Schools." *Journal of Policy Analysis and Management*, vol. 1, no. 1 (1981), pp. 19-41.

Henson, Bruce E., and Peter Hall. "Linking Performance Evaluation and Career Ladder Programs: Reactions of Teachers and Principals in One District." *Elementary School Journal,* vol. 93, no. 4 (1993), pp. 323-53.

Murnane, Richard J., and David K. Cohen. "Merit Pay and the Evaluation Problem: Why Most Merit Pay Plans Fail and a Few Survive." *Harvard Education Review*, vol. 56, no. 1 (1986), pp. 1-17.

National Commission on Excellence in Education. *A Nation at Risk*. 1983.

Odden, Allen, and Carolyn Kelley. *Paying Teachers for What They Know and Do: New and Smarter Compensation Strategies to Improve Schools.* Thousand Oaks, CA.: Corwin Press, 1996.

Podgursky, Michael, and Matthew G. Springer. "Teacher Performance Pay: A Review." *Journal of Policy Analysis and Management*, vol. 26, no. 4 (2007), pp. 909–949.

Rivkin, Steven G., Eric A. Hanushek, John F. Kain. "Teachers, Schools, and Academic Achievement." *Econometrica*, vol. 73, no. 2 (2005), pp. 417-458.

Rosenbaum, Paul R., and Donald B. Rubin. "Reducing Bias in Observational Studies Using Subclassification on the Propensity Score." *Journal of the American Statistical Association*, vol. 79, no. 387 (1984), pp. 516-524.

Silman, Timothy, Steven Glazerman, and Kevin Booker. "The Missouri Career Ladder Program, Participant Perspectives." Washington, DC: Mathematica Policy Research, Inc., Forthcoming.

Schofer, Richard C., Jerry W. Valentine, and Jeanette C. Murphy. "The Missouri Career Development and Teacher Excellence Plan: An Initial Study of Missouri's Career Ladder Program." Technical Report. Columbia, MO: University of Missouri, 1987.

Taylor, Barbara, and Jean Madsen. "The Career Ladder Process in Missouri: A Report on How Districts Are Realizing the Goals of the Program." Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA, March 27-31, 1989.

Todd, Petra E., and Kenneth I. Wolpin. "On the Specification and Estimation of the Production Function of Cognitive Achievement." *The Economic Journal*, no. 113 (2003), pp. F3-F33.

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

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