Cross-Subsidization in Teacher Pension Benefits: Examining Rates of Return Among School Districts

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When pension benefits are not directly tied to contributions, some individuals may earn disproportionate returns on their retirement contributions. For instance, individuals who receive relatively larger late-career raises will receive disproportionately greater returns. For teachers, whose salaries are determined by salary schedules set by districts, these differences may be nonrandom, with larger raises accruing to teachers in more advantaged school districts. Using salary schedules from 490 school districts, the authors estimate the rate of return on contributions for each district. They then analyze the relationship between district characteristics and the rate of return. They find that the rate of return varies markedly among school districts, with larger and generally more affluent school districts benefiting. These findings demonstrate how salary structures and current pension design lead to cross-subsidization of pension benefits among school districts.

Keywords: descriptive analysis; educational policy; equity; finance; policy analysis

In pensions, cross-subsidization occurs when some individuals receive benefits that exceed their contribution levels, while others receive benefits that are less (Costrell & McGee, 2019). In this analysis, we examine whether the defined-benefit (DB) pension structure in Missouri and the structure of school district salary schedules create a form of cross-subsidization among school districts. We examine this issue by calculating a rate of return using salary schedules from 490 Missouri school districts. Teachers are typically paid using a step-and-lane salary schedule. These schedules map out what a teacher can expect to earn every year of his or her career, with raises for additional degrees. By estimating the rate of return on the basis of each district's salary schedule, we are essentially estimating the rate of return of a career teacher in each of these districts.

Missouri's largest teacher pension system, the Public School Retirement System (PSRS), is a final average salary (FAS) DB pension plan. In a FAS DB plan, a worker's retirement benefit is not entirely connected to his or her contributions into the system. Rather, the benefit is based on a formula that typically takes into account years of service and a FAS calculation. Most FAS DB systems use a short period of time when determining the FAS. Of the 607 DB public pension plans in the Urban Institute's (2019) State and Local Employee Pension Plan Database, only 1 calculated the FAS using the employee's aggregate salary over his or her entire career. On average, the plans use 3.7 years' salary to calculate FAS, with the 3 highest years being the modal number (333 plans). Although there may be advantages to determining benefits in this fashion, there are also potential drawbacks. When benefits are not tied to contributions, it is possible for some individuals to get disproportionately larger or smaller benefits relative to their contributions.

One way to think about this is in terms of the internal rate of return (IRR) an individual may expect to receive on his or her retirement contributions.[1] In a DB plan, the IRR is essentially the interest rate on retirement contributions that would provide the promised level of benefit to retirees for a specified period of time. Assume a worker starts his job at $30,000 and retires 30 years later with a guaranteed benefit of $70,000. The IRR is the interest rate necessary, on the basis of his annual contributions, to provide that $70,000 benefit for a specified period of time.

Several factors influence an individual's rate of return, such as how long he or she draws the pension. The longer an individual receives the benefit, the higher the rate of return will be. Two factors at the front end also influence the rate of return: the slope and the curvature of the earnings profile (Shuls, 2017b). An individual with a steeper earnings profile, such that the slope from starting salary to ending salary is higher, will generally receive a higher rate of return on his or her contributions. For

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Table 1
Summary of Missouri's Public School Retirement System

Plan Rules
Contribution rates
Individual: 14.5%
Employer: 14.5%
Total: 29.0%
Vesting
5 years of service
Retirement eligibility
Full benefit (multiplier = 2.5%)
Age 60
Years of service = 30
"Rule of 80," age + years of service = 80
(If years of service > 30, multiplier = 2.55%)
Final average salary
Highest 3 consecutive years
Benefit formula
Benefit = Years of service × Final average salary × Multiplier
COLAs
Determined annually
Cannot exceed 5% per year
Cumulative COLA cannot exceed 80% of original benefit
Average COLA 1982–2018 = 2.725%
2017 COLA = 0.0%

Source. Authors' calculations from *PSRS/PEERS Comprehensive Annual Financial Report* (Public School Retirement System of Missouri, 2016) and Public School Retirement System of Missouri (2018).
Note. COLA = cost-of-living adjustment.

example, if two individuals start at the same salary, but one receives a $500 annual raise and the other a $750 annual raise, the individual receiving the higher raise will also have a higher rate of return because the slope of his or her salary is higher. Similarly, if two workers start at different levels but end their careers at the same salary, the individual who started at the lower salary will have a higher rate of return, as his or her salary profile will be steeper.

Additionally, workers with earnings profiles that are more convex, or less concave, will receive higher rates of return. A convex earnings profile occurs when an individual receives larger raises toward the end of his or her career, whereas, a concave curve is when raises diminish as a worker approaches retirement. If two individuals end their careers with the same final salary, but one individual earned more early in his career and had raises that tapered off at the end of his career (concave), while the other received larger end-of-career raises (convex), the former would have a lower rate of return because he contributed more to the system but receives the same benefit. This is one of the reasons school administrators tend to see greater pension benefits compared with their counterparts who remain teachers (Koedel, Ni, & Podgursky, 2013). They start at a teacher's salary but end with a much higher administrator's salary.

Our goal in this analysis is to explore the relationship between salary schedules and rate of return in order to examine whether certain types of school districts tend to benefit from the current DB benefit structure.

Thus, the two main research questions are as follows:

1. What is the IRR for a career teacher in each Missouri school district?
2. What school district characteristics are related to a district's IRR?

All of the school districts used in this analysis participate in the PSRS of Missouri. Although this analysis relies on data from public school districts, conclusions can be drawn for all DB pension systems that are designed in a similar manner (see Table 1 for a summary of the plan's features). That is, our findings about variation in rate of return should generalize to other DB systems with a short FAS calculation in which workers have varying earnings profiles. Thus, our findings have implications for many public employee retirement plans throughout the country.

In the following sections, we examine the literature related to FAS DB pension plans, especially those for teachers. We then discuss our methodology. Next, we show the results of our analyses. We follow this with a discussion of our findings and possible implications for public policy.

Our findings confirm that salary structures may affect the rate of return among employees. Teachers who realize lower rates of return on their retirement contributions are cross-subsidizing the benefits of those receiving higher rates of return. We find, on average, that larger school districts with higher salaries tend to have higher rates of return.

Literature Review

In this review, we focus on the literature as it relates to the impact of plan design or variations in pay on pension benefits from DB plans. Specifically, we are considering the impact when plans use short time spans to calculate workers' FASs. When a plan uses a short period of time to calculate a worker's FAS, it separates benefits from contributions. Because benefits are not tied to contributions, it is possible for some individuals to receive substantially larger benefits from the pension relative to the amount of contributions. When this is done by individuals intentionally increasing their salary during the FAS window, it is often referred to as pension or salary spiking (Fitzpatrick, 2015; Goldhaber, Holden, & Grout, 2019; Mannino & Cooperman, 2015; Shuls & Lux, 2019).

Our concern here, however, is not with the individual who may attempt to increase his or her own benefit but with the way in which the system may affect whole groups of individuals. For instance, the structure of FAS DB plans means that schools pay significantly higher premiums for experienced teachers (McGee & Winters, 2017). As teachers approach retirement and hit retirement eligibility rules, they are eligible for considerably larger retirement benefits. Of course, they did not contribute proportional amounts to the retirement system.

The backloading of benefits also has implications for when an individual's pension benefits would be worth more than the value of his or her contributions and interest (Aldeman & Johnson, 2015; Aldeman & Robson, 2017; Lueken, 2017).

Using data on all 50 states from the Urban Institute's State and Local Employee Pension Plan database, Aldeman and Johnson (2015) calculated the value of pension benefits at each year of a teacher's career and compared it with the value of his or her contribution, and the contribution of his or her employer, if the teacher received a rate of return equivalent with the rates assumed in the pension plans. These assumed rates of return are often near 8%. They found that the median teacher must work 25 years for the value of his benefits to exceed the value of his and his employer's contributions plus interest. Using a similar methodology, Aldeman and Robson (2017) suggested that 38% of Missouri teachers would receive pension benefits greater than the value of their contributions receiving the guaranteed rate of return. Similarly, Lueken (2017) determined the crossover point, the point at which benefits surpass the value of the individual's contributions, for the largest school district in each state.

In their analysis, Aldeman and Johnson (2015) and Aldeman and Robson (2017) used a hypothetical salary for each state. Lueken (2017) used the salary schedule for the largest district in each state. As Shuls (2017a) noted, school districts within a state have markedly different salary schedules. The shape of a salary schedule may lead to significant variation in returns within the same state. Using salary schedules from 464 Missouri school districts, Shuls estimated how changing the number of years in the FAS would affect retirement benefits for career teachers in each district. He concluded the current DB system, with a 3-year FAS, favors school districts with steeper salary schedules.

Although Shuls (2017a) addressed a similar issue, his analysis focused on the impact of changing the number of years included in the FAS. It is really a discussion of a policy issue regarding how many years to use in FAS calculations. The present study adds to the literature by examining how the structure of salary schedules within a single pension system may lead to variations in the return on investment by employees.

Methodology

For this study, teacher salary schedules for the 2014–2015 school year were obtained from 490 of the 515 school districts in Missouri's PSRS. Nearly 400 schedules were obtained from the Missouri School Boards' Association's (2015) Salary Schedule Bank. Additional schedules were obtained using e-mail requests sent directly to school districts. Twenty-four school districts failed to respond to requests. One school district indicated that it did not use a salary schedule. The 25 missing school districts tended to be similar to school districts in our first quintile. In 2014, fewer than 1% of full-time equivalent teachers covered by the PSRS were in the school districts not included in our sample. Not having these school districts in our analysis affects our quintiles when we do not weight for the number of students in each district but does not have much of an impact when we weight for school district size.

We merged salary data with publicly available data from the Missouri Department of Elementary and Secondary Education, which included data on student demographics, teacher employment, and district finances. Using these schedules, we calculate the rate of return for each school district. We then analyze the relationship between rate of return and school district characteristics.

To calculate the rate of return, we calculate contributions over a 30-year teaching career and benefits over a 30-year retirement period. In the PSRS, each teacher contributes 14.5% of his or her salary to the system each year. This contribution is matched by the district. In total, 11.56% of the 29% contributed is used to pay for actuarial accrued unfunded liabilities. The remaining 17.44% is the amount required to cover the normal cost of the teacher's pension benefits (Public School Retirement System of Missouri, 2018). In this analysis, we use the normal cost contribution of 17.44% when calculating the rate of return. We also calculate the rate of return using the full 29%. The different contribution rates predictably lead to different rates of return but do not substantially change the variation among school districts.

Contributions to the pension are also made on district contributions toward individual teacher health insurance, but we do not have that information. For all districts, it was assumed that the teacher works with a bachelor's degree for 5 years before obtaining a master's degree.

To determine the annual benefit, we first calculate the FAS for each district on the basis of the three highest consecutive salaries. We then calculate benefit values using the current PSRS formula:

$$\text{Annual benefit}_i = \text{FAS}_i \times \text{Years of service}_i \times \text{Multiplier} \quad (1)$$

The annual benefit for district i is equal to the district's FAS times years of service (30 years) times a multiplier. In the current formula, the multiplier is 2.5% (Public School Retirement System of Missouri, 2016).

Using the stream of contributions and the stream of benefits, we then calculate the IRR. The IRR for a given district is the value IRR_i that makes the sum of discounted cash flows equal to zero:

$$\sum_{t=0}^{59} \frac{F_{it}}{(1+\text{IRR}_i)^t} = 0,$$

where F_{it} represents teacher i's cash flow (contribution or benefit) in year t. For each rate of return, a 30-year retirement was assumed. This assumption was chosen to equal the length of time we assume the teacher worked. This decision is somewhat arbitrary, but it should not bias our findings. The length of retirement would change the rate of return. The longer a teacher draws his or her pension retirement benefit, the more the benefit is worth and the higher the rate of return. However, it would not bias which school districts have higher or lower rates of return. We conduct sensitivity analyses using retirement lengths of 20 and 40 years and find substantially similar results. The correlation between the 20- and 40-year retirement IRR and the 30-year IRR is >99.9%.

Of course, many teachers will not work full careers in education, let alone in one school district. Although it is important to consider how teacher turnover in school districts may affect

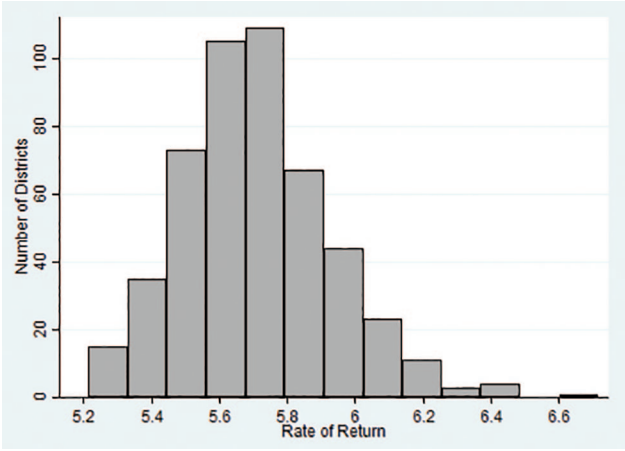

FIGURE 1. *Histogram of internal rates of return.*
Source. Authors' calculations on the basis of Missouri School Boards' Association (2015), Public School Retirement System of Missouri (2016), and district salary schedules.

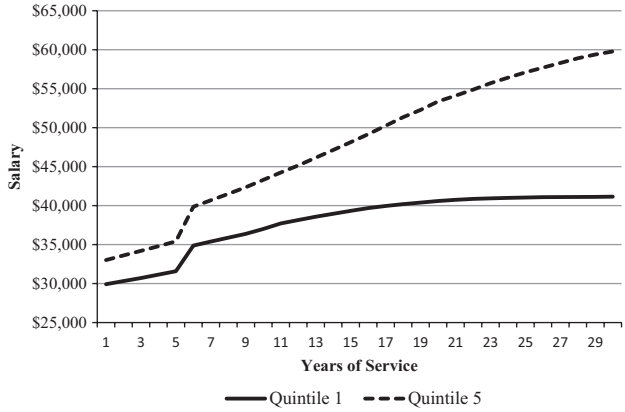

FIGURE 2. *Top and bottom quintile salary schedules.*
Source. Authors' calculations on the basis of Missouri School Boards' Association (2015), Public School Retirement System of Missouri (2016), and district salary schedules.

these estimates, our goal in this analysis is to explore the relationship between salary schedules and rate of return and to examine whether certain types of school districts tend to benefit from the current DB benefit structure.

Because each rate of return is the nominal annual return over a career, it can be used to compare returns among districts. Rates of return by themselves do not include any adjustment for inflation or for the returns possible in other retirement plans.

The rate of return is sensitive to the assumptions in our model. For instance, if we used only the employee's contributions, the rate of return would be higher. Additionally, assumptions about salary schedule increases over time or cost-of-living adjustments (COLAs) may change the rate of return. We conduct sensitivity analyses by calculating various rates of return using inflation-driven salary schedule increases and a COLA. The adjusted rates are almost perfectly correlated with the original rates of return ($r > 0.99$), indicating that our analysis of the variation among districts is robust to uniform inflation adjustments and COLAs. In other words, the model assumptions tend to change the average level of the rates but not the pattern of variation around the mean.[2]

After calculating rates of return, we divide school districts into quintiles by their rates of return. We then conduct two-tailed t tests on the quintiles, comparing each quintile against Quintile 3, to identify which district characteristics displayed statistically significant differences from the median district. For an additional check, we also conducted this analysis when weighting the school districts by the number of full-time equivalent teachers. The results were not substantially different, and we present only the unweighted results.

Results

As expected, rates of return vary among school districts. The overall distribution of rates of return is shown in Figure 1. As the histogram shows, the rates vary between 5.2% and 6.7%. As mentioned earlier, the steepness and the curvature of the earnings profile influences the rate of return. For example, if a school district started a teacher at $30,000, an annual raise of $200 would generate a rate of return of 5.3 percent, and an annual raise of $1,700 would generate a rate of return of 6.8 percent. In these scenarios, the earnings profiles describe a straight line, but they vary in slope.

Many salary schedules do not hold entirely to either of these patterns of consistent percentage raises or consistent dollar-amount raises. Some schedules have large increases in one year, seemingly unrelated to the rest of the schedule. Other schedules give raises at the beginning of the career but flatten out at the end. Still, the rules apply: steeper and more convex curves generate larger returns.

We analyze differences among school districts by separating the districts into quintiles by rate of return. Figure 2 displays the average earnings profile of the highest and lowest quintiles. As expected, districts with higher rates of return have steeper salary schedules that are less concave, whereas districts with lower rates of return tend to flatten out at the end.

We conduct two-tailed t tests on the quintiles, comparing each quintile against Quintile 3 (Table 2). Here, some clear patterns emerge. Districts with higher rates of return tend to be larger, with more students and more teachers. These districts also tend to have higher average salaries. Although they do not spend significantly more per pupil, schools in Quintile 5 do have a higher assessed valuation per pupil, which is marginally significant at the 10% level.

Most notably, the difference among quintiles tends to be a difference of type. Districts with lower rates of return tend to be overwhelmingly rural, whereas Quintile 5 is a mix of rural, town, and city/suburban school districts. In other words, it seems to be the case that smaller, rural districts have salary structures that generate lower rates of return than their larger, more urban counterparts.[3]

Conclusion and Discussion

In this analysis, we examine the rate of return produced by working a 30-year career as a teacher in 490 different school districts in Missouri. We find higher rates of return for districts with salary

Table 2
Mean Characteristics of Districts by Rate of Return Quintile

Characteristic	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Internal rate of return	5.42***	5.59%***	5.69%	5.81%***	6.04%***
Enrollment (2015)	1,049	884	1,073	1,698**	3,630***
Full-time equivalent teachers (2014)	82	69	80	123**	253***
Percentage of students qualifying for free or reduced-price lunch (2015)	57.1%	60.1%	56.1%	57.0%	52.1%
Percentage minority students (2015)	9.6%	8.6%	8.0%	9.4%	17.3%***
Percentage of students proficient or advanced in English language arts (2014)	52.4%	52.8%	54.1%	52.8%	54.6
Percentage of students proficient or advanced in math (2014)	54.0%	52.5%	53.9%	51.8%	53.4%
Average teacher salary (2014)	$36,447	$36,299	$37,292	$38,795*	$44,423***
Average administrator salary (2014)	$69,543	$70,455	$71,894	$76,721**	$85,785***
Per pupil expenditure (2014)	$10,027	$9,509	$9,510	$9,134	$9,453
Assessed valuation per pupil (2014)	$92,310	$86,379	$89,375	$91,741	$106,505*
Average teacher years of experience (2014)	12.1	12.0	12.2	11.8*	12.5
Percentage of teachers with master's degrees (2014)	45.3%	44.3%	45.6%	45.1%	57.3%***
Rural district	80.6%	81.6%	76.5%	67.3%	37.8%***
Town district	13.3%	14.3%	19.4%	19.4%	30.6*
City/suburban district	6.1%	4.1%	4.1%	13.3%**	31.6%***
n	98	98	98	98	98

Source. Authors' calculations on the basis of Missouri School Boards' Association (2015), Public School Retirement System of Missouri (2016), district salary schedules, and Missouri Department of Elementary and Secondary Education (2017).
*$p < .10$. **$p < .05$. ***$p < .01$.

schedules that provides larger raises. These school districts tend to be larger, more affluent urban or suburban school districts. In contrast, smaller, rural school districts tend to give smaller raises, especially later in a teacher's career. As such, these districts generate relatively smaller returns on pension contributions.

Pension rules apply uniformly to everyone. Benefits, however, accrue disconnected from actual contributions. As a result, school districts that provide larger raises help employees receive larger returns on their investment. To be clear, we do not mean that teachers in school districts with higher salaries receive higher rates of return simply because they had higher salaries or because they contributed more into the system. Rather, their rates of return are disproportionately higher because their FASs are high relative to their starting salaries. Because all teachers make the same proportionate contributions to the plan but some get higher rates of return than others, this means that the low rates of return are cross-subsidizing the benefits of those receiving higher rates of return. The low-income, Quintile 1 teachers are subsidizing the pensions of the high-income, Quintile 5 teachers. The differences in rates of return necessarily imply that the cross-subsidies exist.

Although our analysis is conducted using salary schedules from school districts in Missouri, it is important to understand how these findings generalize to other pension systems. Indeed, the principles outlined here are directly applicable for any FAS DB pension plan that fits the following conditions: (1) pay varies among workers within the system and (2) benefits are determined by a calculation that does not take into account contributions. This may apply to teachers in other states, firefighters, police officers, and various other public or private employees who belong to DB pension plans. The magnitude of the variation in rates of return will depend upon the shape of the salary profile for workers in each field and the benefit formula. Nevertheless, this type of system creates variation in returns that may lead to a cross-subsidization of pension benefits among school districts within a state.

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NOTES

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[1]The *Encyclopedia of Education Economics and Finance* explains, "The IRR is the discount rate at which all negative cash flows (cash outflows) and positive cash flows (cash inflows) of a project sum to zero after being discounted back to the present time" (Walkup & Hendricks, 2014).

[2]The analyses presented here assume that a teacher stays in a district for 30 years and that salary is based on a cross-sectional salary schedule. This assumption undoubtedly affects the rate of return. It should not, however, introduce bias into the cross-district comparisons unless changes in salary schedules are heterogeneous over time.

[3]It is possible that these findings may undervalue the difference between groups, as employer-paid health and dental insurance premiums are pensionable. We do not have these data for Missouri school districts.

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