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Abstract

During the late 1990s public pension funds across the United States accrued large actuarial surpluses. The seemingly flush conditions of the pension funds led legislators in most states to substantially improve retirement benefits for public workers, including teachers. In this study we examine the benefit enhancements to the teacher pension system in Missouri. The enhancements resulted in large windfall gains for teachers who were close to retirement when the legislation was enacted. By contrast, novice teachers, and teachers who had not yet entered the labor force, were made *worse off*. The reason is that front-end contribution rates have been raised for current teachers to offset past liabilities accrued from the enhancements. Total teacher retirement compensation, net of contribution costs, is lower for young teachers today as a result of the enhancement legislation. Given sharp increases in pension costs in other states, this finding may generalize to young teachers in many other plans.

1. Introduction

Between 1995 and 1999, the average annual nominal return to the Dow Jones Industrial Average was 25 percent, yielding 200 percent cumulative growth over a five-year period. Partly as a result of these abnormally high returns, state and local pension funds experienced dramatic increases in their funding ratios. By the late 1990s many funds were reporting actuarial surpluses – that is, they were reporting that they had more assets than required to fund promised pensions.

The actuarial surpluses were used to justify legislation in most states that enhanced pension-benefit formulas for public workers.[1] Educator pensions were among the most-actively enhanced – between 1999 and 2001 alone, for example, the National Conference of State Legislators (NCSL) reports that educator pensions were enhanced in more than half the states.[2] In most states teachers' benefits were automatically and retroactively adjusted to reflect the enhancements at the time of their enactment without additional required contributions.[3] Therefore, teachers whose retirement plans happened to coincide with the timing of the benefit enhancements were able to collect the more-generous pensions even though their lifetime contributions were structured to fund a much less remunerative flow of benefits.

We use administrative personnel data to examine the implications of the pension-enhancement legislation in Missouri. We estimate that the net, immediate increase in pension wealth for Missouri educators due to the enhancements was on the order of $1.6 billion (in 2009 dollars), or roughly

[1] For example, according to the Delaware Office of Pensions "The (enhancement) legislation (in Delaware in 2001) was developed to reduce the overfunded position in the State Employees' Pension Plan by granting benefit improvements to active and retired members…" (NCSL, 2001).

[2] The NCSL reports improvements to educator pension benefits in the following states between 1999 and 2001: AR, AZ, CA, CO, DE, GA, HI, ID, KY, MA, MO, MS, MT, ND, NE, NJ, NV, NY, OH, PA, SC, SD, TX, UT, VA and WY (see NCSL, 1999, 2000, 2001). The NCSL also documents numerous changes to non-educator pensions. In addition, note that other states made changes that were not in the NCSL reports; e.g., WI (Act 11, 1999).

[3] While many states operated similarly to Missouri, some states, like Illinois, required teachers to pay a fee to receive the improved benefits for prior years of service. In the absence of paying the fee, the improved benefit formula would only apply to future service years. The fee to have the improved benefit formula applied retroactively was low enough that for most teachers, the price of the upgrade was far lower than the cost of providing the improved benefits (Fitzpatrick, 2011).

$25,000 for each teacher in the labor force. These benefits accrued to teachers instantly upon enactment of the enhancement legislation because the enhancements were implemented retroactively. The enhancements also increased the returns to continued teaching by accelerating the rate of pension-wealth accrual for each additional year of work. If we include the potential increase in pension benefits available to teachers in our calculations – that is, the promised but yet unrealized benefit gains from the enhancements – our estimate of the value of the enhancement package increases to over $3 billion.[4]

The gains in pension wealth associated with the enhancements were distributed across the teaching workforce highly unevenly, with older and more-experienced teachers benefiting the most. For the typical career teacher just approaching retirement eligibility in the year-2000, we estimate that the present value of her pension-wealth increase was nearly $100,000 (in 2009 dollars). In contrast, novice teachers were generally made worse off by the pension enhancements. A new teacher at the time when the benefit enhancements were enacted, or a teacher with just a few years of experience, could expect to gain just $10,000 to $20,000 in pension wealth. Furthermore, although contribution rates did not rise immediately when the enhancements were enacted, they began to rise shortly thereafter. In 2005, several years after the last significant enhancement in Missouri (and well before the 2008 financial crisis), contributions to fund the pension system were raised by one percent of earnings (the annual maximum set by state statute). The 2005 rate increase would be the start of an eight-year timespan over which contributions were increased by the full one percent *every single year*.[5] In 1995, the baseline "pre-enhancement" year in our study, the combined employee-employer contribution rate in Missouri

[4] The entire education share (at all levels) of the fiscal-year-2000 budget in Missouri was approximately $4.8 billion (in 2009 dollars).

[5] Again, this experience was not unique to Missouri. Many states began to increase contribution rates starting around 2005 (e.g., see NCSL, 2005)

was 21 percent of teacher earnings (split evenly between teachers and school districts). The current contribution rate is 29 percent.[6]

The legacy costs of the enhancements continue to strain budgets for K-12 schools in Missouri and other states.[7] They have also helped to shape the structure of educator compensation in important ways, most notably by imposing a large distortionary tax on the next generation of teachers to fund liabilities that were accrued, in part, by providing benefit levels to the previous generation beyond what they contributed to the system. The lack of attention devoted to the pension enhancements by researchers and policymakers is surprising given (1) their sheer fiscal magnitude and prevalence in pension funds across the United States, and (2) their labor market implications for this key sector of the economy.

The conventional narrative is that defined-benefit pension plans offer risk-free retirement benefits for pensioners. This is because workers are entitled to a guaranteed annuity from their employer at retirement, and it is up to the employer to accumulate assets and bear the investment risk to ensure that the annuity is fully funded. But the story is not this simple. Our analysis reveals a commonly-overlooked intergenerational risk in defined-benefit pension systems stemming from the flexibility by which worker contributions can be adjusted. That is, while back-end retirement benefits are well-established and given great legal protection, states can adjust contribution rates regularly to ensure system viability.[8] Contribution rates can be raised with no more than a year's notice, and used to offset poor fund management. One form of poor management involves making poor investment decisions. The

[6] Note that Missouri teachers are not enrolled in Social Security. Contribution rates and pension benefits are typically lower in systems where pensioners are also enrolled in Social Security.

[7] Novy-Marx and Rauh (2009) estimate the unfunded liabilities for state and local public pension plans across the United States to be on the order of $2.5 to $3 trillion. They do not provide separate estimates for K-12 educators, but K-12 employees account for one-third to one-half of the public employees covered under state and local plans. This is largely a public-sector issue – there has been a shift away from these types of plans in the private sector (Brown, 2008).

[8] Most public sector plans are contributory, meaning both employees and employers contribute. Some state courts have limited the ability of districts to change employee contributions for currently active employees. However, money is fungible. If employers must bear the entire burden of rising costs, these are funds that might have otherwise been used for pay increases.

focus of this paper is on a second form of mismanagement: the failure of public pension funds to resist rent-capture when market returns are abnormally high. A prudently-operated pension fund would use excess returns generated during periods of above-average market performance to offset periods of below-average market performance. But because the system is easy to manipulate inter-temporally, it facilitates rent-capture when asset returns in the short run exceed long-run expectations. Inter-temporal rent-taking can take several forms. For example, a government agency can skip necessary funding contributions on the behalf of employees when investment returns are high enough to mask the behavior.[9] Or senior workers, who have more political power than their junior counterparts, can lobby for and receive windfall benefits. The latter scenario is precisely the one that played out for teachers in Missouri and many other states following the abnormally high stock market returns in the late 1990s.

Our study illustrates the policy significance of the intergenerational risk to pensioners in an education context, building on prior work in this area by Gold (2002) and Novy-Marx and Rauh (2008). We describe in detail a series of generous enhancements to the educator pension system in Missouri between 1995 and 2002. We show that new teachers today would be better off without their enhanced pension benefits and the associated contribution-rate increases. Thus, the benefit enhancements have made the pension-benefit package in education less, rather than more, appealing to young college graduates.

2. Background

Educators in public schools in the United States are nearly universally enrolled in defined-benefit pension plans. Most plans are administered at the state level and share a common structure (Costrell and Podgursky, 2009). The following formula is used to determine the annual benefit at retirement:

[9] In Missouri the fund does not require government contributions beyond those by school districts. However many state legislatures routinely took "pension holidays" and did not make the appropriate actuarial contributions for many years (Civic Federation, 2006; Pew Center on the States, 2010).

$$B = F * YOS * FAS \quad (1)$$

In (1), *B* represents the annual benefit, *F* is the formula factor, which is usually close to two percent, *YOS* indicates years of service in the system, and *FAS* is the teacher's final average salary, commonly calculated as the average of the final few years of earnings. Future benefits may or may not be adjusted for inflation.

It typically takes 3-5 years for teachers to become vested in the system; once vested, a teacher can collect her pension upon becoming collection eligible. The "normal retirement age" is one way that collection eligibility is determined. It varies across plans between the ages of 60 and 65, and can be service-based as well (e.g., 30 years of service). There are also early-retirement provisions in most systems that allow individuals to retire and begin collecting benefits prior to normal retirement. These provisions typically depend on either (1) work experience alone, or (2) a combination of age and work experience. An example of the former is the "25-and-out" provision in Missouri, which allows teachers to retire with 25 years of system service regardless of age (with a collection penalty). An example of the latter is Missouri's Rule-of-80. The Rule-of-80 allows for full benefit collection once a teacher's combination of age and experience sums to 80.

The benefit enhancements to the pension system in Missouri occurred primarily between 1995 and 2002. As noted above, the Missouri system is not unique – most states enhanced educator pension benefits in the late 1990s and early 2000s, and many of the enhancements were substantial as was the case in Missouri. More information about enhancements in other states can be found in reports from the National Conference of State Legislators (1999, 2000 and 2001) and, over a wider timespan, Clark and Craig (2009).

Table 1 describes the series of enhancements that occurred to the Public Service Retirement System (PSRS) in Missouri. In 1995 the formula factor was 0.023, final average salary was calculated based on the highest five years of earnings, and early retirement was possible through the 55-25 rule.

The 55-25 rule allowed for a teacher to retire and collect benefits without penalty if two conditions were met: (1) the teacher had to be at least 55 years old, and (2) he/she had to have accrued at least 25 years of system service. By 2002 the formula factor had been raised from 0.023 to 0.025, the final-average-salary calculation changed from the highest five to highest three years of earnings, and the 25-and-out and Rule-of-80 provisions had been incorporated into the system (Rule-of-80 is a more-flexible version of the 55-25 rule). In addition, the cap on post-retirement cost-of-living adjustments (COLAs) was raised from 65 to 80 percent of the baseline annual pension payment, and a retroactive bonus was added for teachers who reached their 31st year of system service.[10] How were the gains distributed across the teaching workforce? We examine this question next.

3. Enhancement Effects on Pension Benefits

3.1 Individual Teachers

We begin by considering the changes in pension wealth for individual teachers owing to the pension enhancements, ignoring the issue of funding contributions. An individual's pension wealth at any point in time can be calculated as the present value of the stream of pension payments. Pension wealth at time *s*, with collection starting at time *j* where $j \geq s$, can be written as:

$$\sum_{t=j}^{T} Y_t * P_{t|s} * d^{t-s} \qquad (2)$$

In (2), Y_t is the annual pension payment in period *t*, $P_{t/s}$ is the probability that the individual is alive in period *t* conditional on being alive in period *s*, *d* is a discount factor, and T is set to 101.[11] Details about

[10] In 2001 the formula factor was increased to 0.0255 if service years exceed thirty.
[11] At the point of initial collection Y_t is equal to the baseline benefit "*B*" from equation (1). Y_t is cost-of-living adjusted during retirement.

our pension-wealth calculations are provided in Appendix A.[12]

We illustrate the benefit-enhancement effects for a representative mid-career teacher in Missouri who is currently 37 years old and began teaching at age 25. Figure 1 shows her pension-wealth accrual over the career cycle under the different sets of rules that were in place between 1995 and 2002 (throughout our study we refer to school years by the spring year; i.e., "1995" refers to the 1994-1995 school year). At each point in each figure we calculate the present value of her pension wealth if she were to quit teaching immediately.[13] The vertical axis reports pension wealth in 2009 dollars.

Beginning in 1995 the pension-wealth profile is single peaked; the peak coincides with collection eligibility by the 55-25 rule. Wealth accrual increases dramatically at age-49 because the teacher earns her 25th year of service in that year, which makes her eligible to collect at age-55 (under the 55-25 rule) rather than age-60. Pension wealth grows at a high rate until she is eligible to begin drawing her pension (at age-55) and subsequently declines. Pension wealth declines after the peak because each year of work past age-55 represents a year of forgone pension payments (this is a typical feature of DB pension plans). Put differently, the opportunity cost of continued work increases substantially upon becoming collection eligible.[14]

The next graph in the figure overlays the teacher's pension-wealth profile using the pension rules from 1996. The change in 1996 was the enactment of the 25-and-out provision. Now the spike at age-49 is much larger because the teacher can begin collecting benefits immediately, albeit with a

[12] The most important parameter that we specify in our calculations, at least in terms of affecting the pension-wealth values that we report throughout, is the discount rate. We use a real rate of four percent, which is in between the rate used in other recent studies (Coile and Gruber, 2007; Costrell and Podgursky, 2009). Appendix A examines the sensitivity of our findings to changes to the discount rate.

[13] At each quit point we identify the optimal collection date in terms of maximizing the present discounted value of future pension payments, and use that age for the calculations.

[14] An alternative way to think about teachers' decisions to work past the peak is in terms of the retirement replacement rate. Once teachers become benefit eligible they are working for only a fraction of their actual earnings, plus they are no longer required to contribute to the pension system. Teachers clearly respond to their pension incentives - Podgursky and Ehlert (2007), Costrell and Podgursky (2009) and Koedel and Podgursky (2012) provide more information about teacher responses to retirement incentives.

penalty, upon attaining her 25th year of service. The 25-and-out clause does not change the peak, it simply lowers the cost of missing it.

Next we overlay the pension profile from 1999, which includes the formula factor increase. The entire profile shifts upward, although the gain is hard to detect prior to reaching the first pension wealth spike because the gain is small and pension payments for early exiters are discounted into the future. If the representative teacher stays until she reaches the full-retirement peak (at the 55-25 rule in the figure) the gain in the presented discounted value of her pension payments is large (just over 10 percent).

In the year-2000 the *FAS* calculation was changed to be based on the highest three years of earnings and the Rule-of-80 was enacted. These changes are reflected in the next panel of the figure. The flexibility of the Rule-of-80 allows the representative teacher to attain full collection eligibility several years earlier; the extra years of collection, along with the change to how *FAS* is calculated, increase her pension wealth again. Relative to 1995, her peak-value pension wealth in the year-2000 is over 14 percent higher.[15]

Finally, the last graph in Figure 1 shows a small spike that occurs post-peak owing to the provision that raises the formula factor at the 31st year of system service (from 0.025 to 0.0255 for all service years). Peak value is unchanged – this last enhancement's primary function is to reduce the cost of working past the peak.[16]

Focusing on the last graph in Figure 1, one way to describe the total effect of the enhancements is that the system moved from one characterized by a pension-wealth "peak" to a pension-wealth

[15] Figure 1 illustrates wealth accrual for uninterrupted teaching spells in the same plan. However, note that Rule of 80 is advantageous for individuals who enter the profession at a young age, take several years off mid-career, and return to the same plan later (e.g., women who leave teaching for several years for family reasons and then return (Flyer and Rosen, 1997; Grissom and Reininger, forthcoming)). Compared to a plan in which 30 years of service is required for retirement, the Rule of 80 (and other similar "age + experience" rules in other plans) allows teachers to progress toward retirement even while out of the workforce.

[16] The median retirement age for teachers in Missouri declined over the enhancement period (see Figure 2). The 31st-year enhancement may have been enacted in response to the shift in retirement timing.

"plateau." When pension-wealth accrual has a peak as in Figure 1, we would expect to see a similar peak in retirements because it is financially very costly to miss the peak. The move to the flatter plateau structure should correspond to a flattening of the retirement profile given that the penalty associated with missing the peak is greatly reduced. This is consistent with what we observe in Figure 2, which plots the unconditional attrition rate, by experience, in the workforce before and after the enhancements.[17] The figure clearly shows a fanning out of retirement attrition in the post-enhancement period. Furthermore, consistent with the pension enhancements having essentially no effect on pension wealth for early-exiters, attrition rates for inexperienced teachers are virtually unchanged.[18]

3.2 Aggregate Effects

We now turn to the aggregate effects of the benefit enhancements across the Missouri teaching workforce. We use personnel data from the 1995 through 2009 school years for this portion of our analysis. The data are from the Department of Elementary and Secondary Education in Missouri, and include all of the information that we require to calculate teachers' pension-wealth profiles over the career cycle (namely earnings, age, gender and system experience; see Appendix A for details).

We estimate the gains from the pension enhancements across the teaching workforce in three ways. First we estimate the immediate gain in *current pension wealth* (CPW). Our CPW calculations measure the "overnight" changes in teachers' already-accrued pension wealth, ignoring any gains that come through the option value of continued work under the new, enhanced system. The CPW measure surely understates the total value of the enhancements because teachers' benefits from continued work are also affected. This suggests a second measure: *peak-value pension wealth* (PVPW). The peak-value

[17] The pre-enhancement data are from 1993 and 1994, and the post-enhancement data are from 2006 and 2007. A teacher is identified as exiting if she is not observed teaching in Missouri for two consecutive years.

[18] Of course, other factors beyond the pension changes may have contributed to the changes in attrition rates between 1993-1994 and 2006-2007 shown in Figure 2. We merely note that the change in the pattern of attrition in Figure 2 is consistent with what one would expect given the change in pension incentives. Although not the focal point of our analysis, this finding is in line with a large literature on teachers and other workers showing that the timing of retirement decisions is affected by pension wealth accrual and peak-values – for example, see Coile and Gruber, 2007; Costrell and McGee, 2010; Friedberg and Turner, 2011; Friedberg and Webb, 2005.

measure captures the gains in *potential* pension wealth if all teachers retire at the peak (Coile and Gruber, 2007).[19] Of course, not all teachers maximize pension wealth, and for this reason the PVPW measure overstates the total value of the enhancements. Our third measure, *expected pension wealth* (EPW), is our preferred measure because it accounts for teachers' actual separation behaviors. So, for example, the expected gain in pension wealth for a teacher with 5 years of experience is bounded by the CPW or PVPW measures – her gain will fall somewhere in the middle and depends on how long she is expected to stay in the labor force.

To calculate EPW, we use the personnel files over a two-year span in the pre- and post-enhancement periods to create two matrices of exit rates for nearly every age-experience cell in the data (1993 and 1994; 2006 and 2007).[20] We then map out exit probabilities for teachers with every age-experience combination over the course of the career cycle in the pre and post periods. So, for example, an age-27 teacher with two years of experience would have an immediate exit probability corresponding to that of all age-27 teachers with two years of experience, a one-year exit probability corresponding to that of all age-28 teachers with three years of experience, etc. The exit probabilities account for the fact that, say, a teacher with 5 years of experience has positive survival probabilities into years 6, 7, 8, etc.; but may not work long enough to reach peak value. We construct pre- and post-period matrices to allow for teachers to respond to the pension incentives as well as other factors affecting teacher retention.[21]

The EPW calculations provide the most accurate estimates of teachers' expected pension benefits, as well as system-wide costs. They map very closely to the actuarial calculations associated

[19] "Peak value" is one way to capture the option value of continued work that is built into typical DB pension plans. Also see Stock and Wise (1990a, 1990b).

[20] We trim the matrix at the edges where there are very few teachers; for example, we do not calculate EPW for teachers who entered the workforce at age-21 because there are so few teachers who fit this profile that we cannot assess exit behaviors with any degree of confidence.

[21] Economic theory predicts some response in the separation probabilities to the enhancement legislation. While the differences in pre- and post-enhancement separation rates in Figure 2 are consistent with theoretical predictions, changes in the separation probabilities over time may also be influenced by other factors. As a practical matter, our findings are qualitatively similar if we use the pre-period separation matrix throughout our study.

with the benefit enhancements.[22] A limitation of the EPW calculations is that they cannot be computed annually because we use observed teacher attrition rates before and after the entire package of enhancements was enacted to construct the separation matrices. For this reason we report EPW calculations only at the edges of our data panel: 1995 and 2009.

Table 2 shows the total fiscal impacts of the benefit enhancements in Missouri using each pension-wealth measure from 1995 through 2009. The top panel of Table 2 describes the labor force in Missouri in each year. The following three panels show our calculations for the average teacher-level change in CPW, PVPW and EPW, along with a comparison to the 1995 counterfactual. The counterfactual calculations hold pension benefits constant using the 1995 rules. For the EPW counterfactual in 2009, we also use the pre-enhancement separation probabilities. If the characteristics of the labor force were held fixed and real wages held constant over time, the counterfactual calculations would not change. In the bottom three panels of the table we aggregate our teacher level calculations to measure the total fiscal effects of the enhancements. The final enhancement is reflected in our data for the 2002 teaching cohort. Therefore, for brevity we report estimates only for selected subsequent years.

We highlight several aspects of the table. First, it is straightforward to identify the value of the individual enhancements from the annual CPW and PVPW calculations. Unsurprisingly, the biggest changes in pension wealth were the result of the rule changes in 1999 and 2000, which included three main adjustments: (1) the formula factor increase, (2) the introduction of the Rule-of-80, and (3) the change to the FAS calculation (see Table 1). Second, note that the total contribution rate, split evenly between teachers and school districts in Missouri, did not change during the enhancement period. It

[22] The 2003 PSRS Consolidated Annual Financial Report (p. 33) shows the expected costs of specific benefit enhancements. These numbers match closely to our estimates, although not exactly. One reason is that we use actual *ex post* observed behavior to determine separation probabilities for our calculations, while the pension fund had to predict behavior *ex ante*. Our assumptions also do not exactly match theirs – a notable difference is in terms of discounting (our nominal rate is 7 percent; they use 8 percent).

first changed in 2005, and has increased by one percent per year through 2012. Third, the aggregated EPW calculations in the bottom-right cell of the table show our estimate of the total value of the benefit-enhancement package for the cohort of teachers in Missouri in 2009: approximately $2.4 billion. This estimate is for the stock of teachers in 2009 specifically; a more-complete depiction of the value of the enhancements would also include the enhancement gains for future cohorts of teachers in Missouri.

3.3 The Distribution of Enhancement-Driven Gains

The enhancement benefits were distributed disproportionately to older and more-experienced teachers. An important reason is that they were implemented retroactively. Older teachers also disproportionately benefited because work-separation probabilities plummet for teachers who reach experience levels in the high single digits (this is true in both the pre- and post-enhancement regimes). For example, the probability that a typical entering teacher in Missouri is still teaching after eight years is approximately 55 percent. But among teachers who survive to that point, over 80 percent will complete at least 25 years of system service. The implication is that older teachers face a much lower risk of missing out on a large pension, which is a key condition for gaining substantially from the enhancements. Alternatively, for young teachers, it is very likely that their gains from the enhancements will be close to zero. Another reason that the enhancements were disproportionately distributed to older teachers, of course, is that even for young teachers who work until retirement, their benefits are deferred (and discounted) for many years.

Tables 3 and 4 illustrate the unevenness in gains from the pension enhancements across the teaching workforce. First, Table 3 shows the average EPW gain, age and experience for teachers by gains-decile for the 2009 teaching workforce. The EPW gains for each teacher in 2009 are calculated by subtracting counterfactual EPW from actual EPW. The table shows that while the average EPW gain for bottom-decile teachers was just under $4,000; teachers in the top decile gained, on average, over $100,000 in expected pension wealth from the enhancements. Consistent with the above discussion,

younger and inexperienced teachers are concentrated in the bottom deciles while older and more experienced teachers are in the top deciles.[23] Also note that we have yet to incorporate the higher contribution rates that younger teachers who persist in the profession can expect to pay over the course of their careers.

Table 4 provides a simulation analog to Table 3. The table evaluates a representative career teacher at different points in the career cycle at the time when the enhancements were enacted. We consider the teacher's benefits upon entry into the workforce, at age-40, age-48, and age-53. We report EPW and PVPW in each scenario. As in Table 3, Table 4 shows that the gains from the enhancements are much larger when the teacher is older. A subtle point is that EPW gains exceed PVPW gains for the age-48 teacher. This is because the probability that the age-48 teacher misses the peak in either regime is high relative to the other scenarios, and the enhancement benefits in cases where the peak is missed are large (see Figure 1).

4. Incorporating Funding Contributions

Up to this point we have ignored employer and employee contributions to fund the pension system. Given that 29 percent of earnings are currently contributed by teachers, or on their behalf, this is a non-trivial matter. In this section we incorporate funding contributions into our calculations and examine changes to the "total pension package" for new teachers.

Contribution rates in Missouri increased by eight percentage points between 2004 and 2012. The run-up in contribution rates is surely driven in part by the pension-benefit enhancements, but other factors may also be important. A key factor, for example, is surely the financial crisis that began in 2008. *Ex ante*, one might also expect the smaller market correction in the early 2000s to have affected the run-

[23] The average ages in the bottom deciles may initially seem too high; note that in addition to including young teachers, the bottom deciles also include late entrants into the profession. This can be seen by the low experience values in the last column of Table 3.

up in contribution rates, although below we show that this earlier market correction is unlikely to have played an important role.

We initially put aside the issue of what caused the rate increases and simply compare the current compensation structure in Missouri, which features the enhanced pension benefits and the 29-percent contribution rate, to the old structure with pension benefits based on the 1995 rules and a 21-percent contribution rate. Regardless of what historical events have led to the current status of the pension fund, the recent experience illustrates the risk inherent to the current system from the employee's perspective.[24]

Table 5 provides an across-regime comparison from the vantage point of a new entrant into teaching.[25] The first two columns in the table show benefits and contributions under the pre- and post-enhancement regimes. The third column compares the teacher's outcomes across regimes. The table reports expected net pension wealth for the novice teacher, as well net pension wealth at peak value; the latter calculations are relevant if the novice goes on to complete a full career in teaching.

We begin by considering the case where the incoming teacher cares only about her own contributions and ignores the contributions made on her behalf by the school district. Although standard economic reasoning suggests that how teachers and districts split the pension contributions is unimportant, applying recent evidence from Card and Ransom (2011) to our context suggests that teachers may place more weight on their "share" of pension contributions, which appear as salary deductions.[26] Evaluating each regime independently, Table 5 shows that the teacher has positive net

[24] For example, suppose that the entire contribution-rate run up in Missouri was driven by the effect of the 2008 financial crisis, ignoring the time inconsistency. Young teachers would still bear most of the unanticipated cost of paying down losses from the market crash.

[25] The table focuses on a new entrant into teaching at age-24. This is the most common entry age into teaching in Missouri.

[26] Card and Ransom (2011) study defined contribution (DC) plans with employer and mandatory employee contributions. They show that employees are more responsive in terms of their supplemental savings behaviors to their own contributions, which is at odds with standard models. Numerous other studies show that factors outside of standard model influence savings behavior (e.g., see Choi et al., 2004; Madrian and Shea, 2001; Reis, 2006; Shefrin and

returns from the system in terms of expected and peak-value pension wealth, as would be predicted given that she does not internalize the district contributions on her behalf. However, the third column in the table shows that she is marginally *worse off* under the current regime using both measures of net pension-wealth accrual. That is, despite the benefit enhancements, which were very generous, and despite the large increase in district-provided contributions on the teachers' behalf, the new teacher would still be better off if she could go back to 1995 and receive pre-enhancement benefits while making smaller contributions from her own earnings over the course of her career. This is true even when we compare the regimes at peak value, which sets the probability of separation prior to reaching collection-eligibility to zero. Put differently, even when we place a probability of one on the novice teacher completing a full career in teaching (as is the case in the peak-value calculations), she is still worse off under the new pension regime in Missouri.

Next we move on to the more-relevant scenario where the teacher internalizes the district contributions. Notice that in both regimes her expected pension wealth is negative. This is a result of the backloaded structure of benefits and is not a unique feature of the Missouri system. It reflects the fact that the fund transfers resources from early-exiters to retirees, and a typical starting teacher has a high probability of exiting early.[27] The teacher is much worse off under the new regime, in expectation and even if she reaches peak value, because the contribution rate is so much higher. Overall, when we consider the combined contributions of teachers and districts, it is evident that the compensation structure in Missouri today is much less favorable for a prospective new teacher than it was in 1995.

Thaler, 1992). Still, the case illustrated in Table 5 where teachers place zero weight on the district contribution is an extreme case.

[27] Readers familiar with actuarial calculations would recognize that if contributions reflected normal costs in 1995, the expected pension-wealth values in Table 5 for the old regime would be closer to zero; however, normal costs in 1995 were over two percentage points below the combined district-teacher contribution rate. Also note that the entry-age normal contribution rate is an average rate covering entrants at various ages. Many teachers enter the plan at later ages and earn higher expected returns than the young new entrants we consider here.

The analysis in Table 5 reflects the implications of the total system risk for new teachers in Missouri, but how much of that risk can be attributed to the enhancements in isolation? Although this is a simple question conceptually, precise calculations are difficult. In fact, even the fiscal notes attached to the enhancement legislation are vague. For example, the following excerpt was taken from the fiscal note attached to the legislation that added the Rule-of-80 and changed the *FAS* calculation in Missouri:

> "Oversight notes that while there is a significant fiscal impact to the retirement systems, there is no immediate cost to local school districts since their contribution rates would not increase….There will be a long-term fiscal impact as a result of this legislation, since elimination of the system's surplus and creation of an unfunded actuarial liability will contribute to any need for increased contributions in the future."

Specifics about what future contributions might look like were not provided.[28]

One reason that it is difficult to identify the portion the contribution-rate increases attributable to the enhancements is that the actuarial assumptions used by the fund change over time.[29] The actuarial assumptions can greatly affect the stated soundness of the fund, which is what determines the required contribution rate. As just one example, the 2011 Actuarial Valuation Report from PSRS indicates an increase in the overall valuation of assets due to "assumption changes" of nearly $4.6 billion. One of the assumptions contributing to the increased asset valuation is lower expected inflation moving forward. However, a steadfast feature of the fund is an assumed nominal rate of return of 8 percent on assets. One would expect a change in inflation expectations to affect the expected nominal rate of return, but the fund did not change the expected 8 percent return on assets. Therefore, the fund effectively increased its assumed *real* rate of return.

Because the reported financial status of the fund, upon which contribution rates are based, is constantly changing and can be manipulated by adjusting the actuarial assumptions, we do not feel

[28] This text is taken from the fiscal note attached to Missouri Senate Bill 0331, 1999.
[29] The PSRS annual reports and actuarial valuations do not provide sufficient information to permit outside reviewers to "back out" the cost of any particular enhancement. Nor do they provide sensitivity analyses regarding the effect of alternative assumptions on estimates of liabilities.

confident in our ability to precisely identify the share of the contribution-rate increases attributable to the enhancements. However, what we can do with some confidence is rule out stock-market volatility as a source of the rate increases, at least prior to 2009. Table 6 uses data taken directly from the fund on annual asset returns to the fund's portfolio between 1996 and 2009.[30] We take a hypothetical $100 in 1996 and place it in the fund, and compare growth in asset value to the case where our $100 would earn a fixed annual return of 8 percent, per the fund's assumption. The idea is that as long as the fund outperforms its own assumption of an 8-percent return, required contributions would not need to change as a result of stock-market volatility. Recall that teachers' contribution rates were raised in Missouri for the first time in over a decade in 2005.

One factor that is clearly ruled out by Table 6 as a cause for the rate increases prior to 2009 is the stock-market correction in the early 2000s. Despite the decline in the fund's performance corresponding to the market correction, which can be seen in the early-2000s in the table, the fund's assets easily outperformed the fixed 8-percent return scenario up until the 2008 financial crisis. Assuming that the 2008 crisis was not anticipated by the fund, then, we can rule out stock-market volatility as a reason to increase pensioners' contribution rates prior to 2009. That is, the annual rate increases between 2005 and 2008 could not have been driven by the stock market. The benefit enhancements are the most likely alternative explanation.[31]

In Table 7, as an approximation, we attribute the four rate increases preceding the 2008 financial crisis to the benefit enhancements, and assume that the four post-crisis rate increases were unrelated to the enhancements (which is far from certain). This scenario is reflected in the table by the total contribution rate used for the calculations, which we lower to 25 percent of earnings while

[30] Complete data on fund returns prior to 1996 were not provided. However, the stock market in the early 1990s performed at a fairly high level as well, and we know based on the actuarial reports that the pension system was overfunded into the late 1990s.

[31] We could find no other explanations in PSRS annual reports for the pre-2009 rate increases.

continuing to compute benefits using the post-enhancement rules.[32] Table 7 shows that a newly entering teacher in Missouri is still worse off under the new regime. Furthermore, even in the case where the new teacher completes a full career in the profession and survives to peak-value, she is no better off because her higher lifetime contributions owing to the enhancement legislation fully offset her gains in pension wealth.[33,34]

5. Other Considerations

Even if the benefit enhancements produced windfall gains for a group of senior teachers and made new teachers worse off, it is possible the increased backloading of compensation could produce longer-term workforce benefits. Lazear (1979) has argued that defined benefit pensions (and compensation backloading generally) can be an efficient compensation strategy in the presence of moral hazard (e.g., shirking) by senior workers. Senior employees are induced to provide greater effort by the threat of losing backloaded benefits. However, this rationale seems irrelevant for teaching because senior teachers are tenured.[35] Nor can a case be made on productivity grounds. Value-added studies of teacher effectiveness routinely find that the returns to teacher experience level out after a few years on the job (e.g., Clotfelter et al., 2006; Rivkin et al., 2005; Rockoff, 2004). Koedel and

[32] In principle, the contribution rate adjustment by itself could result in behavioral changes, which we ignore in Table 7 by using the post-enhancement exit probabilities for the EPW calculations.

[33] An alternative assessment of the effect of benefit enhancements might be based on "normal costs." Normal costs are an actuarial estimate of the value of benefits accrued by an employee in any year, usually expressed as a percent of salary. If we compare actuarial normal cost estimates in 1995 with post-enhancement rates during the period from 2005 to the present we find a difference of between 2-3 percent (it is not stable). If these are treated as the true, long run cost of the benefit enhancements, we calculate that new teachers experience a small EPW benefit. That said, the fund-provided normal cost calculations may not be reliable. Furthermore, by construction normal costs exclude legacy costs, which in Missouri and other states represent a key feature of the pension enhancements.

[34] If we lower the real discount rate in our calculations from four to two percent (which is a large reduction and assumes that teachers considerably more patient), these findings in Table 7 are reversed. We show the alternative calculations in Appendix A. However, such a low discount rate seems at odds with teachers' valuations of their pension benefits per the analysis of Fitzpatrick (2011). In fact, Fitzpatrick's findings suggest that "discount rates of teachers (are) at the high end of those for employees in other settings" (p. 30). One explanation she offers is that teachers are "oversaturated with deferred compensation." (p. 31)

[35] Few tenured teachers are ever fired. See The New Teacher Project (2009) for more information.

Podgursky (2012) directly estimate the effect on productivity and retention induced by the "pull" and "push" incentives of teacher pension plans. They find no evidence that teacher quality is improved by the backloaded benefit structure. Fitzpatrick (2011) shows that teacher valuations of backloaded benefits are below the cost of providing them; rather than increasing backloading in educator compensation, her analysis suggests that we could make everyone better off by doing the opposite.

Finally, purely from the standpoint of improving workforce quality, the rollout of the pension enhancements was highly inefficient. Large changes in compensation occurred for late-career teachers whose response elasticities are necessarily small, at the expense of early-career teachers and teachers who have not yet entered the profession, whose response elasticities have the potential to be much larger. A more strategic use of the resources that were devoted to fund the pension enhancements would have been to use them to raise teachers' front-end salaries, which prior research suggests can improve workforce quality.[36]

6. Conclusion

In a 2011 speech to the National Board for Professional Teaching Standards, United States Secretary of Education Arne Duncan spoke at great length about the need to improve educator compensation in order to improve the appeal of the profession for young, skilled workers.[37] Pension reform seems like an obvious area where changes should be considered. Our findings add to the growing body of evidence questioning the efficacy of DB pension plans for teachers and their effect on public-school payroll costs (e.g., Costrell and Podgursky, 2009, 2010; Fitzpatrick, 2011; Koedel, et al.,

[36] Manski (1987) suggests combining salary increases with higher credentialing standards to improve teacher quality; also see Startz (2010). Note, however, that the connection between teachers' front-end and back-end earnings makes it difficult (i.e., expensive) to raise salaries within the confines of a final-average-salary DB plan. For example, if salaries were increased across the board, it would result in large windfall gains for late-career teachers because pension payments depend only on the final few years of earnings (per equation 1 above).

[37] The transcript from this speech is widely available. A summary press release was issued by the United States Department of Education on July 29, 2011.

2011; Koedel and Podgursky, 2012; Richwine and Biggs, 2011). We show that pension enhancements enacted during the late 1990s and early 2000s have led to much higher pension-fund contribution rates today. The net result of the enhancements was a significant intergenerational transfer of wealth to senior teachers from novice teachers and teachers who had not yet entered the workforce. New teachers in Missouri today would be better off without their enhanced pension benefits and the associated contribution-rate increases.[38]

This empirical research was based on the circumstances in Missouri. However, the following lessons generalize. First, senior teachers are the major beneficiaries of retroactive pension enhancements. This is because (1) they realize the benefits quickly (i.e., with limited discounting), and (2) their pensions are enhanced despite their lifetime contributions being designed to support a less-remunerative flow of benefits. Senior teachers are better off whether or not the enhancements are accompanied by immediate increases in contribution rates because most of their careers are already behind them. Second, for newly entering teachers, even immobile career teachers who will stay in the profession *and* in the same pension system for their entire careers, pension enhancements offer little attraction. This is because the heavily-backloaded payout from the enhancements is highly discounted for entering teachers, but must be paid for over an entire teaching career. Finally, for an average entering teacher the expected net benefit from pension "enhancements" is clearly negative. This new teacher will contribute every year of her career, but is statistically unlikely to stay in the plan until she becomes benefit eligible. Thus, the case for using pension enhancements as a recruitment tool is a weak one, particularly when it is recognized that early career salary increases or other current benefits are being traded off for long-term deferred retirement compensation.

[38] While Missouri has sharply raised contribution rates for new teachers it has not, as yet, cut benefits for new hires. New teachers in a number of states face higher contribution rates and/or benefit cuts. For example, since 2008, ten states have increased the number of years until a new teacher is vested. For a comprehensive review of recent contribution increases and benefit cuts in teacher pension plans see Doherty, et al. (2012).

A final point concerns risk. Many states are considering shifting from DB plans to defined contribution (DC) or hybrid plans. The conventional narrative is that such a change shifts investment risks from employers to employees. In DB plans, teachers are provided an annuity at retirement and it is up to the employer to ensure that assets are accumulated during the employee's work life to pay for the annuity. In DC plans that risk is borne by employees. There is a large literature documenting problems that arise when employees underinvest, make bad investment decisions, or simply happen to reach retirement age in a bear market (e.g., see Madrian and Shea, 2001; Munnell and Sunden, 2004). However, as we have shown, public sector DB plans are not riskless for teachers, although the risk is more nuanced. Hansen (2010) has already noted the risk that pension systems impose on mobile teachers, who face the risk of significant pension wealth loss due to unanticipated geographic moves or labor force withdrawal. Our study illustrates another important risk: being in the wrong generational cohort.

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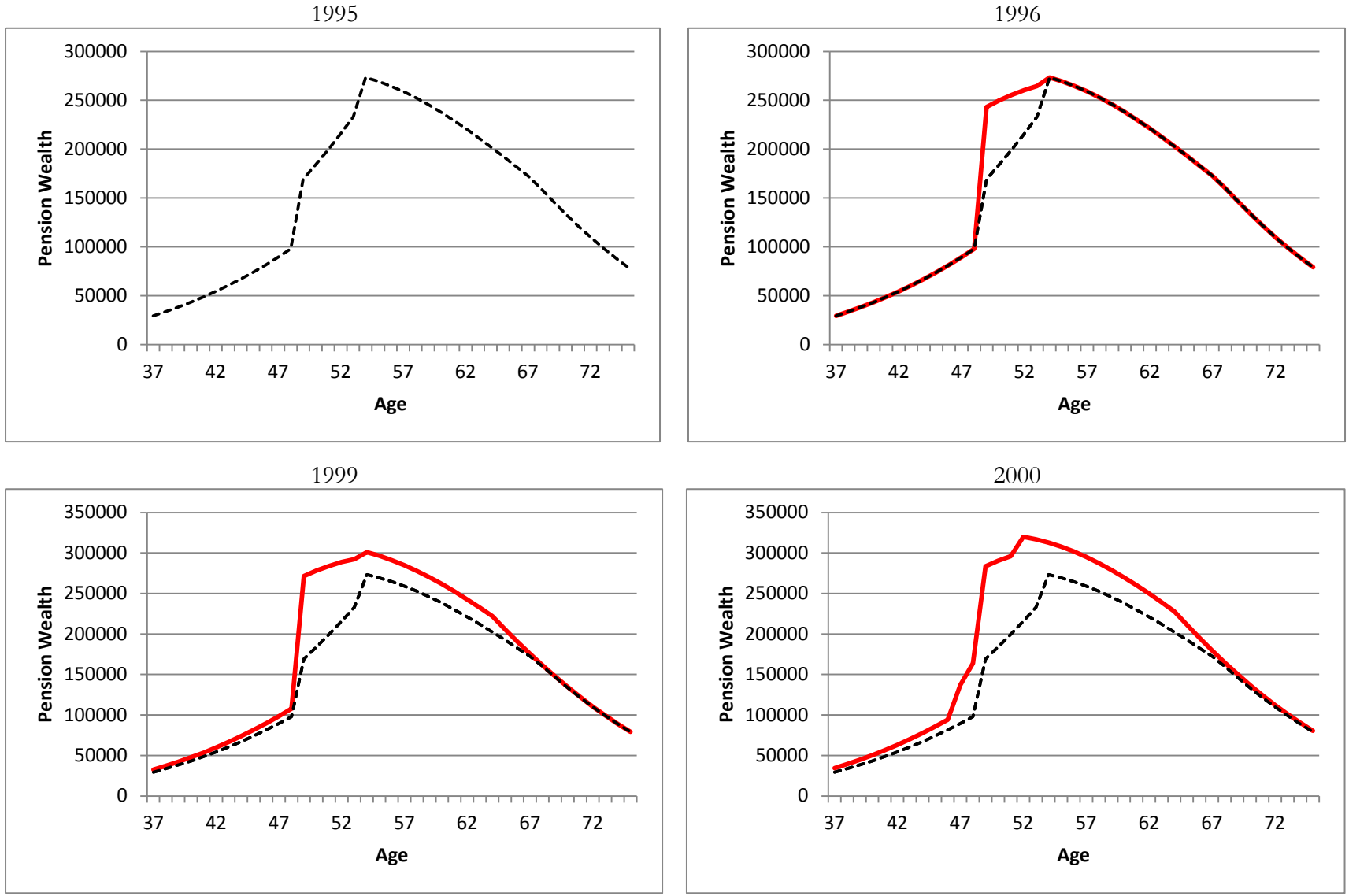
Figure 1. Pension Wealth Accrual over the Career Cycle for a Representative Teacher in Missouri Who Began her Career at Age of 25 and is 37 Years Old. Accrual is for a Fixed Salary Profile over the Career Cycle Based on Rules in 1995, 1996, 1999, 2000 and 2002. 1995 is the Base Year (Dashed).



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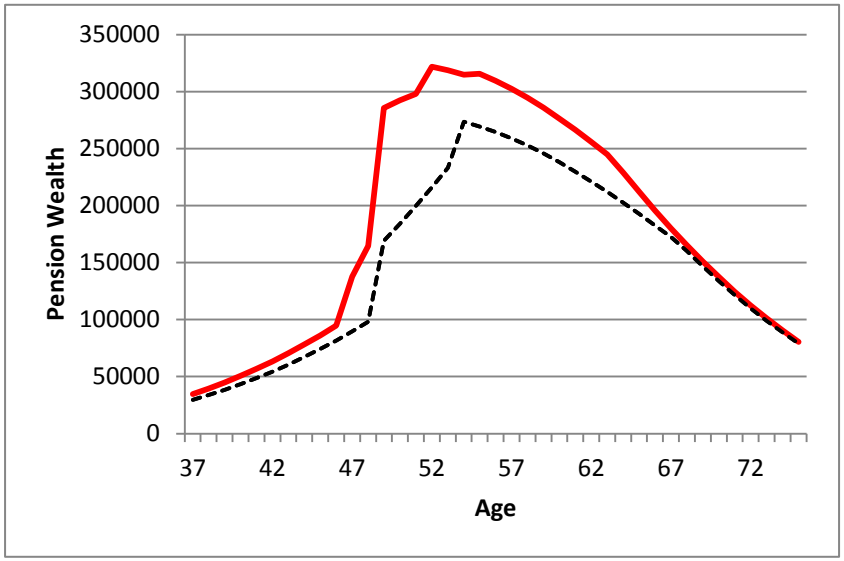
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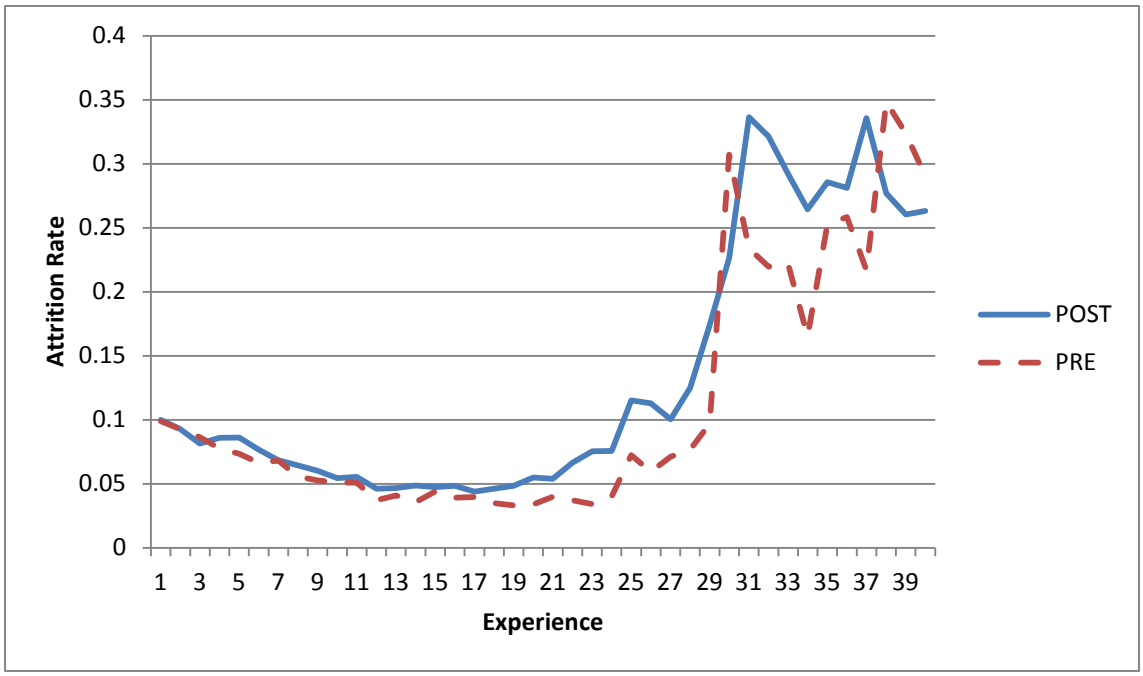
Figure 2. Attrition Rates by Experience Level: Pre- and Post-Enhancement.



Note: The pre-enhancement attrition data are taken from the 1993 and 1994 teacher cohorts. The post-enhancement data are taken from 2006 and 2007. A leaver is identified as an individual who exits the data panel and does not return for two consecutive years.

Table 1. Key Parameters of the Missouri Pension System, 1995 – 2002 (there were no changes after 2002). Initial Parameters as of 1995 are Reported in Row 1.

	PSRS
1995	Formula factor 0.023, early retirement by 55-25 rule, COLA cap 65 percent
1996	Implement unrestricted "25 and out"
1997	COLA cap increased from 65 to 75 percent
1998	
1999	Formula factor raised to 0.025 for full retirement (with corresponding upward adjustments for early retirement)
2000	Implement Rule of 80, FAS changed to highest three years of salary
2001	COLA cap increased to 80 percent
2002	Formula factor increased to 0.0255 if YOS $\geq$ 31 (new factor applies to *all service years* for eligible individuals)

Table 2. Summary of Pension-Enhancement Effects in Missouri. Counterfactual Pension Wealth Computed Using 1995 Pension Parameters. 2009 Dollars.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2006	2009
Total K-12 Enrollment†	781,000	792,000	801,000	809,000	813,000	811,000	814,000	814,000	817,000	827,000	831,000
Teachers	49,491	51,125	52,923	54,504	55,943	57,400	58,256	58,926	59,699	60,904	63,411
Avg. Age	41.3	41.3	41.3	41.2	41.2	41.1	41.0	41.0	41.1	41.1	41.0
Avg. Experience	13.2	13.1	12.9	12.7	12.5	12.3	12.0	11.9	11.9	11.8	11.5
Avg. Current PW ($)	91,387	104,300	107,012	109,080	120,071	127,348	124,628	126,078	127,256	121,643	118,439
Counterfactual (1995)	N/A	94,376	95,566	97,527	98,868	97,786	95,224	96,093	97,740	94,971	93,876
Difference	--	9,924	11,446	11,533	21,203	28,203	29,404	29,985	29,516	26,672	24,563
Avg. Peak-Value PW ($)	280,867	284,146	289,200	291,923	319,167	331,929	332,155	337,180	339,034	329,965	340,489
Counterfactual (1995)	N/A	284,146	285,720	288,407	290,111	286,873	285,583	289,512	291,118	283,370	292,410
Difference	--	0	3,480	3,516	29,056	45,056	46,572	47,668	47,916	46,595	48,079
Avg. Expected PW ($)	207,415										242,965
Counterfactual (1995)	N/A										205,499
Difference	--										37,466
Total Contribution Rate (% of Earnings)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	23.0	26.0
Total Enhancement Value – Current PW ($ Millions)	N/A	507	606	630	1,186	1,697	1,713	1,767	1,762	1,624	1,558
Total Enhancement Value – Peak Value PW ($ Millions)	N/A	0	184	192	1,625	2,586	2,713	2,809	2,861	2,838	3,049
Total Enhancement Value – Expected PW ($ Millions)											2,376

Note: All future benefits are discounted using a real rate of 4 percent. See Appendix A.

† K-12 Enrollment is approximated using school-level enrollment data. Some schools do not report enrollments in some years, so the enrollment figures are underestimates. Comparing our numbers to reports from the department of education in Missouri suggests that the enrollment numbers as reported in the table understate total enrollment by 6-7 percent.

Table 3. Distribution of Enhancement-Driven Gains in Expected Pension Wealth Across the 2009 Teaching Workforce. Gains are Relative to Baseline Expected Pension Wealth Using the System Parameters and Exit Rates from the Pre-Enhancement Period. 2009 Dollars.

	Avg. Pension-Wealth Gains	Avg. Age	Avg. Experience
Gains Decile (lowest to highest)			
One	3,746	39.0	5.8
Two	12,659	31.8	3.6
Three	16,010	31.5	4.3
Four	19,601	36.5	6.5
Five	24,942	40.4	8.8
Six	31,802	42.8	10.9
Seven	40,730	44.3	13.6
Eight	52,314	45.2	16.5
Nine	69,204	47.7	20.9
Ten	103,652	50.6	26.0

Notes: The average ages in the bottom deciles may initially seem too high. However, note that in addition to including young teachers, the bottom deciles also include late entrants into the profession. This can be seen by the low experience values in the last column. All future benefits are discounted using a real rate of 4 percent. See Appendix A.

Table 4. Projected Gains in Pension Wealth Due to Enhancements for Hypothetical Teachers at Different Points in the Career Cycle at the time the Enhancements were Enacted (≈2002).

Teacher Profile		Expected Gain	Peak-Value Gain
Age	Experience		
24	0	$12,627	28,362
40	16	50,652	53,732
48	24	86,527	74,627
53	29	83,495	86,865

Note: All future benefits are discounted using a real rate of 4 percent. See Appendix A.

Table 5. Projected Net Pension Wealth for a New Teacher in 2012 under Different Pension Regimes and Contribution Scenarios, in Expectation and Peak-Value (Career Teacher).

			Difference
Age	24	24	
Experience	0	0	
Pension Rules (Benefit Formula)	1995	Post-2002	
Expected Pension Wealth (PDV)	$61,118	$73,745	
Peak-Value Pension Wealth (PDV)	$214,001	$242,363	
Teacher Contribution Rate (direct)	10.5	14.5	
Expected Teacher Contributions (PDV)	$33,331	$49,784	
Net Expected Pension Wealth (PDV)	$27,787	$23,961	-$3,826
Peak-Value Teacher Contributions (PDV)	$87,620	$117,841	
Net Peak-Value Pension Wealth (PDV)	$126,381	$124,522	-$1,859
Total Contribution Rate	21.0	29.0	
Expected Total Contributions (PDV)	$69,278	$102,878	
Net Expected Pension Wealth (PDV)	-$8,160	-$29,133	-$20,973
Peak-Value Total Contributions (PDV)	$175,240	$235,682	
Net Peak-Value Pension Wealth (PDV)	$38,761	$6,681	-$32,080

Note: All future benefits and contributions are discounted using a real rate of 4 percent. See Appendix A.

Table 6. Hypothetical return on $100 invested in PSRS beginning in fiscal-year-1996 versus the assumed fixed rate of an annual 8 percent return.

Year	PSRS Contribution Rate	PSRS Actual Asset Returns	PSRS Assumed Asset Returns
1996	21.0	114	108
1997	21.0	133	117
1998	21.0	158	126
1999	21.0	173	136
2000	21.0	186	147
2001	21.0	190	159
2002	21.0	188	171
2003	21.0	190	185
2004	21.0	211	200
2005	22.0	232	216
2006	23.0	257	233
2007	24.0	302	252
2008	25.0	301	272
2009	26.0	**233**	**294**

Table 7. Projected Net Pension Wealth for a New Teacher in 2012 in Partial-Cost Scenario, in Expectation and Peak-Value (Career Teacher).

			Difference
Age	24	24	
Experience	0	0	
Pension Rules (Benefits)	1995	Post-2002	
Expected Pension Wealth (PDV)	$61,118	$73,745	
Peak-Value Pension Wealth (PDV)	$214,001	$242,363	
Total Contribution Rate	21.0	*25.0*	
Expected Total Contributions (PDV)	$69,278	88,688	
Net Expected Pension Wealth (PDV)	-$8,160	-14,943	-6,783
Peak-Value Total Contributions (PDV)	$175,240	$203,174	
Net Peak-Value Pension Wealth (PDV)	$38,761	$39,189	$428

Note: All future benefits and contributions are discounted using a real rate of 4 percent. See Appendix A.

Appendix A
Pension-Wealth Calculations and Sensitivity

We use the following information for each teacher to calculate pension wealth: (1) age, (2) system experience and (3) earnings, or expected earnings, for the three or five years prior to exit. We determine teacher's survival probabilities over the life cycle using the Cohort Life Tables provided by the Social Security Administration (by gender and birth year). We project out future wages using a growth function that depends on teaching experience. The parameters of the growth function come from a regression based on a 16-year data panel from Missouri where we regress teacher wages on a cubic function of experience. The function captures real wage growth, and wages are also adjusted for inflation. The representative teacher in Figure 1 starts with the base wage typical of a 37-year-old teacher in Missouri, and the growth function adjusts the wage profile moving forward so that *FAS* can be calculated after each possible exit date. For the real-data calculations, teachers' reported wages in each year are used to project wages forward (and backward if necessary).

Our PDV calculations also require that we specify a real discount rate. We use a real discount rate of four percent in our calculations, which allows for a positive real interest rate and some time preference in earnings.[39] For each teacher, after each year of work we identify the optimal collection age assuming that the teacher exits after that year, then calculate the PDV of the expected stream of pension payments over the life cycle as in equation (2) in the text.

We consider the sensitivity of our findings to adjustments to our pension-wealth calculations below. First, we re-calculate net pension wealth from Tables 5 and 7 (using the total-contributions scenarios) using real discount rates of two and six percent. Unsurprisingly, when we increase the discount rate the pension enhancements are even less beneficial for new teachers. If anything, we

[39] Our choice of a four-percent real discount rate falls somewhere in between what others have used in the literature. For example, Coile and Gruber (2007) use 6 percent and Costrell and Podgursky (2009) use 2.5 percent.

view this as the more likely scenario, per Fitzpatrick's (2011) analysis which suggests that teachers highly discount their pension benefits. When we lower the discount rate to two percent, of course, the enhancement package becomes more valuable. We still find that new teachers are worse off in the new regime overall. However, when we isolate the contribution-rate increases attributable to the enhancements (as in Table 7), we find that new teachers are better off with the enhancements in the low-discount rate scenario. If one believes that teachers are very patient, despite recent research suggesting the opposite (Fitzpatrick, 2011), Table A.1 shows that the benefit enhancements have improved the appeal of the "total pension package" for teachers.

Finally, we also briefly note that our pension-wealth calculations are influenced by expected wage growth. For our main calculations in the text, we assume that future wage growth for Missouri teachers will be the same as it has been in the past, per above. However, if anything, it is reasonable to expect slower wage growth in the future because districts' pension-related wage bills have increased as a result of the enhancements. If we were to incorporate lower expected wage growth into our calculations, the pension enhancements would be even less desirable for educators, although we do not present formal calculations because we do not have strong evidence on how much future wage increases will be crowded out by district pension expenditures.

Table A.1. Sensitivity of Findings to Changes to the Real Discount Rate.

	Original Regime	Total Regime Comparison		Isolate Enhancement Driven Rate Increases	
			Difference		Difference
Age	24	24		24	
Experience	0	0		0	
Pension Rules (Benefit Formula)	1995	Post-2002		Post-2002	
Total Contribution Rate	21.0	29.0		25.0	
Real Discount Rate: 2 Percent					
Expected Pension Wealth (PDV)	$122,097	$155,383		$155,383	
Peak-Value Pension Wealth (PDV)	$485,286	$556,112		$556,112	
Expected Total Contributions (PDV)	$87,519	$129,713		$111,821	
Net Expected Pension Wealth (PDV)	$34,578	$25,670	-$8,908	$43,562	$8,984
Peak-Value Total Contributions (PDV)	$243,142	$335,768		$289,455	
Net Peak-Value Pension Wealth (PDV)	$242,144	$220,344	-$21,800	$266,657	$24,513
Real Discount Rate: 6 Percent					
Expected Pension Wealth (PDV)	$23,312	$30,448		$30,448	
Peak-Value Pension Wealth (PDV)	$98,960	$113,391		$113,391	
Expected Total Contributions (PDV)	$56,737	$84,297		$72,670	
Net Expected Pension Wealth (PDV)	-$33,425	-$53,849	-$20,424	-$42,222	-$8,797
Peak-Value Total Contributions (PDV)	$134,726	$182,620		$157,431	
Net Peak-Value Pension Wealth (PDV)	-$35,766	-$69,229	-$33,463	-$44,040	-$8,274

Note: Our primary calculations reported in the text use a real rate of 4 percent.