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A Method for Identifying Salary Spiking: An Assessment of Pensionable Compensation and Reform in Illinois

Dan Goldhaber
Cyrus Grout
Kristian Holden

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Dan Goldhaber
American Institutes for Research/CALDER
University of Washington

Cyrus Grout
University of Washington

Kristian Holden
American Institutes for Research/CALDER

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CALDER • American Institutes for Research
1000 Thomas Jefferson Street NW, Washington, DC 20007
202-403-5796 • www.caldercenter.org

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Abstract

Defined benefit (DB) pension systems determine the size of pension payments using an employee's "final average salary". Thus, employees enrolled in DB pension systems face an incentive to "salary spike" – strategically increase late career pensionable compensation – to increase their retirement income. This is an important issue given that public pension systems face increasing scrutiny due to ongoing concerns about their fiscal sustainability. This paper develops an empirical method to quantify the prevalence of salary spiking by identifying cases where end-of-career compensation deviates from expected levels of compensation. We apply this method to the teacher pension systems in Illinois and examine how salary spiking changed in response to policy reform. The results suggest that salary spiking is very common, with about half of late career employees observed as having pensionable compensation that exceeds expectations. Policies designed to dissuade salary spiking by internalizing its costs across districts appear to reduce the prevalence of salary spiking, but there may be unintended consequences for individuals who are *not actually spiking*, as such discouraging the assignment of supplementary responsibilities to late career employees.

1. Introduction

Many state pension systems are drastically underfunded, with estimates of total U.S. shortfalls exceeding several trillion dollars. The increasing contributions required to pay down these unfunded pension obligations can put significant pressure on states and local governments which must raise taxes or reduce spending elsewhere. The roles that overly optimistic actuarial assumptions, over-promising of benefits, and persistent underfunding have played in producing these shortfalls have been addressed in the public pension literature.[1] Another potential source of underfunding that has received relatively little empirical attention is "salary spiking".

Salary spiking is the act of *strategically* using increases in pensionable compensation to boost the value of an employee's defined benefit (DB) pension. Most states operate traditional DB pension plans which provide employees a guaranteed monthly payment for the duration of their retirement and the size of the payment is typically a function of the employee's years of service and final average salary (FAS) level. An incentive to "spike" salary arises from the fact that spikes in compensation in years that factor into retirement benefit formulas result in higher level of pension income for the duration of one's retirement. We broadly define earnings as compensation instead of "salary", as many types of earnings can be included in pension benefit calculations, including one-time payments that employees may concentrate into their FAS period.

Salary spiking is problematic for two reasons. First, salary spiking can result in unfunded liabilities, the costs of which are ultimately borne by taxpayers. Public pension systems in the United States are designed to be funded by employee and employer contributions, paid as a percentage of compensation over the course of an employee's career. Pension systems set contribution rates according to their expectations about the growth rate of compensation; states tend to assume constant growth through the FAS period.[2] When an employee's FAS is influenced by an end-of-career spike in compensation, the value of his pension is likely to outstrip the value of his contributions to the system. Below, we present evidence that this constant compensation growth assumption tends to be close for late career employees, but understates growth just prior to exit for about 60% of employees.[3] Second, salary spiking (particularly the most egregious cases) is likely to be viewed by the public as an abuse of the system and inherently unfair. As noted by the Washington Select Committee on Pension Policy, "Stories of pension spiking will occasionally make headlines and may weaken public trust in state retirement systems".

Salary spiking is clearly a policy concern in some states. Illinois, for instance, adopted policies in 1979 and 2005 to explicitly to discourage salary spiking, with the most recent designed to "align the responsibility with awarding the raises with the responsibility for paying them". There is little evidence, however, on the prevalence of salary-spiking behavior in public pension systems and no formalized method for identifying it. To date, the only prior analysis of salary spiking in the literature is Fitzpatrick's (2017) analysis of whether the 2005 salary spiking policy (mentioned above) affected the use of

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[1] See Novy-Marx & Rauh (2011) and Biggs (2015) on unfunded liabilities. Costrell and Maloney (2013) and Malanga and McGee (2018) consider the financial implications of these large burdens on taxes and spending, and Novy-Marx and Rauh (2009) and Brown, Clark, and Rauh (2011) explore likely causes.

[2] For instance, Illinois—the setting for this study—states that they use a flat 5% growth assumption for all employees age 50+. This assumption is based on expected inflation, real productivity growth, merit or seniority; https://www.trsil.org/sites/default/files/documents/2012addendum.pdf, (accessed December 3, 2019).

[3] Moreover, if salary spiking is more common among people with higher expected pension wealth (e.g. life expectancy) this will increase the financial implications relative to actuarial assumptions.

retirement bonuses to boost final average salaries in the Teacher Retirement System of Illinois (TRSIL).[4] Mannino and Cooperman (2013) provide supplementary evidence on salary spiking by reviewing reports of salary spiking, surveying managers of state and local public pension plans, and examining near-retirement compensation growth in two retiree data sets.

In this paper, we analyze salary spiking in Illinois in a manner that is broadly applicable to any pension system where detailed compensation records are available. Specifically, we advance an empirical method for identifying salary spiking at the employee-level, measuring the magnitude of spikes in compensation, and assessing its financial implications.[5] We apply this approach to the Teacher Retirement System of Illinois (TRSIL) and the Chicago Teachers' Pension Fund (CTPF), which operates independently from the statewide system.[6] We also assess the prevalence of salary-spiking behavior before and after the 2005 adoption of an "excess compensation" policy intended to curb the practice of salary spiking by billing districts for increases in pensionable compensation in FAS averaging period that exceed 6%.

We find that around 40% to 50% of employees have unexpectedly large increases in compensation during their FAS periods. This compares similarly to concurrent work by Shuls & Lux (2019), which applies the empirical method described in our working paper (Goldhaber, Grout, & Holden, 2018) to Missouri. Shuls & Lux also raise questions about the influence of "macroeconomic fluctuations" on the prevalence of salary spiking, which we describe and explore in Section 3, Salary Spiking Mechanisms. Given the high proportion of employees in Illinois that have spikes, and the average increase in FAS of about $9,000, back-of-the-envelope calculations suggest costs of $332 million per cohort of exiting employees prior to the introduction of the 2005 policy to discourage salary spiking. Descriptively, there is a modest reduction in costs in the post-policy period to $261 million per exiting cohort.

The paper proceeds as follows. Section 2 describes the key features of TRSIL and CTPF. Section 3 discusses how and why salary spiking occurs Section 4 describes the data. Section 5 presents our empirical approach to identifying salary-spiking behavior, Section 6 presents our findings and Section 7 concludes.

2. Background

In this section, we describe the key features of two pension systems: the Teacher Retirement System of Illinois (TRSIL) and the Chicago Teachers' Pension Fund (CTPF).

[4] Fitzpatrick (2017) shows that many school districts awarded retirement bonuses as large as 20% of compensation, resulting in additional liabilities estimated at $116 million per year. When in 2005 the state began billing school districts for any pension liabilities associated with compensation growth in excess of 6%, effectively internalizing the cost of salary-spiking behavior to the employer for salary growth above this level. Fitzpatrick finds that school districts changed their behavior to avoid these billings while still paying retirement bonuses, suggesting that they had been awarding compensation inefficiently.
[5] In contrast, Fitzpatrick (2017) focuses on estimating the causal impact of a salary spiking *policy* and indirectly examines the change in spiking behavior as shown by changes in salary.
[6] As described below, the CTPF pension plan is very similar to the TRSIL Tier 1 plan. However, Chicago Public School District faces different incentives around salary spiking than other Illinois school districts because any unfunded liabilities resulting from salary-spiking behavior accrue to its own pension fund rather than being pooled into the state-wide system.

2.1 Teacher Retirement System of Illinois

Established in 1939, TRSIL operates pension plans that cover school public school employees throughout the state of Illinois (with the exception of Chicago Public School employees). Most TRSIL members are teachers (about 80%), but because the system also includes school administrators and staff; we refer to members as "employees". We focus on employees enrolled in TRSIL's Tier 1 plan, which includes all employees enrolled prior to 2011.[7] Employees currently contribute 9.0% of their compensation to the pension fund and employers contribute 0.58%.[8] As of 2018 TRSIL was 40% funded, facing an unfunded liability of $77.9 billion – roughly $486,000 per active member.[9]

A typical DB pension plan pays an annuity in retirement that is a function of a benefit factor, a member's years of service (YOS) and final average salary (FAS):

(1) $$Annuity = B * YOS * FAS$$

TRSIL has a more complicated relationship between B, YOS, and FAS. Prior to 1998, the benefit factor depended on an employee's YOS so that the FAS replacement rate, $B * YOS$, is equal to:[10]

- 1.67% for each of the first 10 years
- 1.9% for each of the second 10 years
- 2.1% for each of the third 10 years
- 2.3% for each year over 30 years

For example, an employee with 30 years of service by 1990 would have an annuity of $0.567 * FAS$ (where $0.567 = 0.0167 * 10 + 0.019 * 10 + 0.021 * 10$). Note that, because the benefit factor increases with years of service, TRSIL plans have even more "backloading" of retirement compensation towards employees who serve long careers relative to plans in other states with constant benefit factors (Costrell & Podgursky, 2009). If salary spiking is more common near the end of an employee's career, this backloading may further incentivize due to compensation growth over an employee's career, this backloading further incentivizes after 1998, TRSIL adopted a fixed benefit factor of 0.022 for all newly accrued YOS, and members were given the opportunity to upgrade the benefit factor applied to previously accrued YOS to 0.022 (see Fitzpatrick (2015) for a detailed discussion. Annuity values are capped at 75% of FAS, at which point, increasing pension annuities is only possible by increasing FAS.

FAS is equal to an employee's pensionable earnings during his or her four highest consecutive years of compensation.[11] Employees can retire with full benefits at age 62 with 5 or more YOS, age 60 with 10 or more YOS, or age 55 with 35 or more YOS. Tier 1 members can also retire early at age 55 with 20 or

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[7] TRSIL subsequently introduced Tier 2 which enrolled members hired after 2011. We exclude Tier 2 members from our analysis because our data only cover the period 1992-2012.

[8] Interestingly, in Illinois, the state pays the vast majority of the employer contribution. For more on state subsidies of school district pension costs, See Costrell et al. (forthcoming). Additionally, TRSIL members are not covered by Social Security.

[9] For more details, the 2018 GASB report is available at https://www.trsil.org/sites/default/files/documents/GASB2018.pdf (accessed December 3, 2019).

[10] Employees earn one year of service credit for any school year in which they are employed and receive compensation for 170 days. If compensation is earned for fewer than 170 the employee is granted service credit at the ratio of actual number of days paid to 170 days. For further information, see https://www.trsil.org/members/retired/guide/chapter-five-service-credits (accessed November 27, 2019).

[11] If these contain a partial year of work, TRSIL adjusts FAS upward as if the employee worked a full year. This may cause reported compensation to understate pensionable earnings, but that said, the average FTE in the analytic sample is quite high at 0.98 so this likely has little practical impact.

more YOS with a reduced benefit. Under DB pension systems rules, it is generally the case that not all types of compensation are "pensionable" – *i.e.*, eligible for inclusion in the calculation of FAS. A pension plan's definition of pensionable compensation naturally has implications for how employees and employers might engage in salary-spiking behavior. Under TRSIL, the definition of pensionable compensation is relatively expansive, including for instance, salary earned for performing extra duties, bonuses, retirement incentives, severance payments, and payments for unused vacation or sick leave paid or due and payable along with or prior to your final paycheck for regular earnings. Compensation such as workers compensation, payments made after retirement or for work done during retirement, are not pensionable.[12]

One way the state has attempted to limit salary-spiking behavior is by placing limits on pensionable compensation for year-over-year increases in compensation that are greater than 20%, which we call the "20% growth cap".[13] For example, an employee who earns $50,000 and $100,000 in their last two years will only have $60,000 pensionable compensation in their last year, instead of $100,000. While the 20% growth cap rule creates an upper bound on the liabilities associated with salary spikes, it leaves employees and employers plenty of room to spike salaries. TRSIL's own actuarial assumptions about annual compensation for employees age 50 and older is 5%– well below the 20% threshold.[14]

Another way that the state has tried to limit salary-spiking behavior is through "excess compensation" billings. Since 2005, school districts have been charged an excess compensation fee whenever an employee's year-over-year increase in pensionable compensation earned during his FAS averaging period exceeds 6%. The size of the fee is calculated as the actuarial value of the increase in expected retirement wealth caused by the increase in compensation above 6%, with payment due upon the employee's retirement. The excess compensation rule created a clear incentive for school districts to avoid compensation structures that would result in employees experiencing salary growth in excess of 6% at the ends of their careers, whether through the payment of bonuses or compensation for unused leave. As documented by Fitzpatrick (2017), the 2005 rule changed prompted many school districts to spread smaller retirement bonuses across multiple years of service in order to avoid triggering excess compensation billings.

2.2 Chicago Teachers' Pension Fund

Chicago Public Schools (CPS) operates a pension system called the Chicago Teachers' Pension Fund (CTPF) that is separate, though similar, to TRSIL. The Tier 1 plan considered in this study has the same annuity formula (including the benefit formula and upgrade option described above), FAS period, and benefit cap at 75% of FAS. The retirement eligibility rules are slightly different, with CTPF requiring 20 YOS at age 60 instead of 10 YOS for full retirement eligibility. As of June 2018, the CTPF was 50.1%

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[12] A complete list of pensionable and non-pensionable compensation is available pages 5-6 of the Tier 1 Member Guide available at https://www.trsil.org/sites/default/files/documents/Tier1MemberGuide-August2019-web_2.pdf (accessed December 3, 2019).

[13] The 20% Growth Cap affects pensionable compensation, and likely should be assessed when reporting financial liabilities. In practice, this appears to make little difference overall as relatively few people have gains much above 20%. We have considered spiking magnitudes that adjust for 20% gains by replacing any value with 1.2 times compensation in the prior year and find that the average magnitude changes by about $700 on a base of around $10,000.

[14] This growth rate reflects both inflation and increases due to merit or seniority. For further details, see https://www.trsil.org/sites/default/files/documents/2012addendum.pdf (accessed December 3, 2019).

funded with $10.9 billion in unfunded liabilities – roughly $377,000 per active member. Employee contributions to the system are equal to 9% of compensation.

One important difference between TRSIL and CTPF is that CTPF covers only one employer, CPS. Any additional pension income earned from salary spiking in CPS contributes directly to the liabilities of CTPF. Thus, CPS as an *employer* is fully incentivized to prevent salary spiking, while CPS *employees* face similar incentives to salary spike. This contrasts with *other employers* in Illinois, who can pass the burden of additional unexpected benefits to the state. It is not surprising then, that CTPF does not have a similar excess compensation rule as TRSIL to internalize the costs of salary spiking across employers. In the section below, we discuss these unique incentives by defining different types of salary spiking and how this might occur in Illinois.

Another important difference between TRSIL and CTPF is the definition of pensionable compensation. As described above, TRSIL has a relatively expansive definition with retirement/severance bonuses explicitly pensionable while in contrast, CTPF has a more restrictive definition. For CTPF, compensation such as merit, longevity, and retention bonuses are pensionable compensation, but explicit retirement, severance, and lump-sum payouts are not pensionable.[15] The more restrictive definition of pay for CTPF may reflect the alignment of incentives for managing pension liability between Chicago Public Schools and CTPF. In particular, a review of CBAs for non-CPS school districts indicates that excess compensation policies likely motivated districts to redefine compensation as not pensionable. Thus, one may view this tightening of definitions as part of the alignment of incentives between employers and pension agencies.

3. Salary Spiking Mechanisms

Before considering what patterns of compensation constitute salary spiking, it is worth thinking carefully about both *why* and *how* salary spiking might occur. We discuss these two points in turn.

As described above, salary spiking is the act of increasing an employee's pensionable compensation with the intent of boosting pension income, and the incentive to spike arises from the fact that a one-time increase in compensation can be leveraged into a higher level of pension income for the duration of one's retirement. For example, an employee in a plan with a four-year FAS averaging period and a 60% replacement ratio (e.g., $annuity = 0.02 * 30\ YOS * FAS$) who receives a one-time spike in pensionable compensation of $20,000 will increase his FAS by $5,000 and receive an additional $3,000 in each year of retirement. Assuming a 4% discount rate, this would translate into additional pension income worth about $40,000 in present value terms.[16]

This incentive to spike is likely to influence the behavior of both employees and their employers by encouraging them to concentrate compensation into the employee's FAS period. From the perspective of the employee, the incentive to spike compensation is fairly obvious. Continuing with the example above, the value of receiving an additional $20,000 of compensation outside of the FAS period is simply

[15] The definition of pensionable compensation in CTPF is compensation payed for service completed during normal school hours. See https://www.ctpf.org/sites/main/files/file-attachments/admin_rules_-_salary.pdf, retrieved 1/7/2020 for more details.

[16] To streamline discussion, we do not address other costs associated with awarding an employee additional compensation (e.g., pension contribution, taxes, or overhead) since they must be paid whether or not the additional compensation is paid during an employee's FAS averaging period.

$20,000. Within the FAS period, however, its value is equal to $20,000 in current compensation plus additional retirement income worth $40,000.

To think about an employee's incentive to salary spike more abstractly, consider **Figure 1**. It represents a hypothetical budget constraint for an individual choosing between labor and leisure in her final year of work under a traditional DB pension plan (Panel A), and a plan without a FAS period (Panel B). The budget constraint in Panel A is kinked at the point where an employees' potential current compensation is higher than at least one of the years that would otherwise be included in her FAS calculation. To the left of this point, the employee's rate of compensation is higher because increased effort affects both current compensation and retirement compensation. Under a higher rate of compensation, employees with stronger preferences for consumption over leisure and effort will tend to increase their supply of labor inside the FAS period, resulting in a spike in compensation.[17] This contrasts with plans that do not calculate FAS, as shown in Panel B. Under a DC plan, if labor/leisure preferences are smooth over time, one would not expect to observe a discontinuous shift in effort at the end of an employee's career because the marginal rate of substitution between leisure and effort is equal to the (constant) rate of compensation. In contrast, one can show that under a DB pension system, employees cannot maximize utility at the same level of leisure and effort and will maximize utility by either *decreasing or increasing compensation*.[18]

From the perspective of the employer, the incentive to salary spike is less obvious since the employer does not directly benefit from the influence of a salary spike on an employee's pension income. However, returning to the example above, consider that an employer can effectively award $60,000 in additional compensation while only expending only $20,000 if that $20,000 awarded inside an employee's FAS period. If the employer is one of many employers in the pension system, the cost of funding the $40,000 in additional pension liabilities will spread out across enough actors that the employer will bear very little of it.

Given that both employees and employers have an incentive to engage in salary-spiking behavior, one might expect the *how* of salary spiking to involve both parties. As such, we characterize salary spiking related to retirement bonuses as being both *institutional spiking* – characterized by actions taken at an institutional level (e.g., a school district or state agency) – and *employee spiking* – characterized by actions taken at the level of individual employees.[19]

For *institutional spiking,* a natural institution to consider is within the school district as compensation for employees is generally determined by negotiation with school districts (Strunk, Goldhaber, Knight, & Brown, 2018). In this case, employees could push for compensation via additional duties and responsibilities, by bargaining for changes to the salary schedule that would affect all employees, or for compensation like retirement or longevity bonuses. The use of retirement bonuses in TRSIL are an excellent illustration of this. As documented by Fitzpatrick (2017), rules guiding the provision of retirement bonuses are stipulated in collective bargaining agreements (CBAs) negotiated between school districts and teachers' unions. Other institutions may exist, as employees may influence state-level policy,

[17] Note that an optimal allocation of labor and leisure in **Figure 1** requires the marginal rate of substitution between compensation and leisure to be equal to the slope of the budget constraint, but at the kink point, the budget constraint has two slopes, so no single marginal rate of substitution will satisfy both.
[18] It is fairly easy to see that any proposed solution at the kink point would require that the marginal rate of substitution is equal to two different rates of compensation, which produces a contradiction.
[19] Alternatively, employers may not be as distinct from employees in public education. For instance, research by Moe (2006) suggests that district employees have strong incentives to get involved in school-board politics to elect candidates aligned with their own interests.

such as how Illinois state policy recently dropped a proposed policy to charge excess compensation for compensation growth over 3% after concerns were expressed from teacher organizations.[20]

Given the constraints set at the *institutional level*, employees decide whether to seek out additional compensation that will increase pensionable compensation. *Employee spiking,* for instance, can occur when employees choose whether to pursue additional duties and responsibilities to increase their pensionable compensation. In the example of retirement bonuses in TRSIL, not every employee within a district that provides retirement bonuses will ultimately receive one.

Finally, some salary spiking may occur as *incidental spiking*. For instance, suppose that a state increases compensation for all employees in a given year. Those who coincidentally retire in the same year will all benefit from a spike in salary, but they did not *intend* for this effect; we define this unintended outcome as *incidental salary spiking*. This contrasts with the individual and institutional level mechanisms discussed above which speak to the intent. To be clear, the data-driven methods for identifying salary-spiking behavior that we advance below do not distinguish between different types of salary spiking. Rather, our approach looks for deviations in an employee's historical pattern of compensation and is agnostic to the motivations and mechanisms underlying any such deviation. While this is a limitation from a *behavioral* perspective, it is an advantage from an actuarial standpoint because spiking can have important impacts on unfunded liabilities regardless of their intent.

4. Data

Employment records were obtained from the Illinois Teacher Service Record (TSR) via a Freedom of Information Act (FOIA) request from the Illinois State Board of Education (ISBE). These records provide annual employment data for teachers, administrators, and other school employees from 1991-1992 to 2011-2012 including information on annual compensation and experience. According to ISBE, compensation and experience values are representative of pensionable compensation and service credit (e.g. experience that affects pension benefits as reported in Equation 1). [21]

As described below, our empirical approach requires observing patterns of compensation over a sufficiently long period of employment to be able to establish a pattern of compensation and identify any deviation from that pattern of compensation. Therefore, we focus on individuals with at least 10 observations in our data.[22] We also limit the sample to those who are observed exiting employment. Overall, these restrictions define a sample of 59,724 TRSIL and CTPF employees, with about 5,400 employees exiting each year between 2000-2001 and 2010-2011. Of the 271,560 unused employees, about half are not observed exiting the sample by 2012 (132,559) and should clearly be excluded as they are continuing work, while the rest are not observed in for at least 10 years of data. This latter group includes employees who appear to exit the sample with less than 10 YOS (about 57%) and censored records of employees with higher levels of experience who exit within 10 years of the start of our data in 1992.

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[20] See https://www.forbes.com/sites/ebauer/2019/06/04/hidden-in-the-legislate-a-thon-illinois-restores-pension-spiking/#5447acd92193, retrieved 1/14/2020.

[21] Fitzpatrick (2017) states that TSR changed salary reporting practices for in 2003 by requiring districts to report salary earned over the summer. To the best of our knowledge, we are not able to verify this, as our communications with ISBE indicate that summer earnings are included in all TSR years, and they are not aware of any change in 2003.

[22] As described below, 10 observations in our most restrictive model allows for only 3 degrees of freedom and individuals with fewer observations would likely have very poorly fit data.

A limitation of the data is that it does not contain a variable that uniquely identifies unique employees. Therefore, we link individual records across years using first, middle, and last name, and the institution where they received their baccalaureate degree. We adopted a conservative approach, keeping only exact matches, with one caveat.[23] The year-over-year match rate ranged between 90% and 95% which is consistent with the 8% rate of teachers leaving the profession as reported by NCES for 2012-2013.[24]

Descriptive statistics for employees included in the analytical sample are presented in **Table 1**. The first column shows means for all employees, and the second and third columns report statistics for employees in CTPF and TRSIL, respectively, with the last column reporting the difference between TRSIL and CTPF. All statistics represent employees' characteristics as of their final year of employment. Consistent with the presence of salary-spiking behavior, we see that average compensation growth is higher during employees' final two years of service (T and T-1). The increase in growth rates is greater in non-CPS districts.

Apart from having very different racial demographics, employees in CPS and CTPF have similar characteristics. The majority are female, tend to hold an advanced degree (Masters or Doctorate), earn about $78,000 in nominal dollars, and exit with about 28 years of service.[25] The sample is composed primarily of teachers. Relatively few are administrators (e.g. principals, assistant principals, and support staff) or employees serving in other roles (e.g., counselors, janitorial).

5. Empirical Approach

On a case-by-case basis, distinguishing between a compensation increase that constitutes salary spiking and one that does not, may not be terribly difficult. However, it would be extremely resource intensive to gauge the system-wide prevalence and magnitude of salary-spiking behavior in this manner. As noted above, the empirical approach we advance below to identify salary-spiking behavior is agnostic as to *why* or *how* an employee experienced any particular change in compensation. In this sense, we do not precisely identify who is, or is not, spiking. The advantage of our approach is that it establishes a definition of salary spiking that can be consistently applied to any pension system using readily available administrative data.

We propose the following empirical definition of salary spiking: an employee is salary spiking if his end-of-career compensation significantly and positively deviates from his prior pattern of compensation. To put this definition into operation, we define a range of end-of-career compensation that falls "within expectations" given an employee's preceding levels of compensation and comparing that employee's *actual* end-of-career compensation to the range of *expected* compensation.[26] To define a range of end-of-

[23] Between 1998-99 and 1999-2000, the structure of name fields changed from having one field containing first, middle and last name to three separate fields. Because name order is not preserved consistently across employers, the exact match rate is less than 40%. For this period, we use a fuzzy match algorithm (85% of records can be matched with a score greater than 0.98) and to link records for any individual with records before and after 1999. Records are matched using the user-written Stata command reclink; "Or-blocking" is used so that only records with matching names or universities are considered.

[24] https://nces.ed.gov/programs/coe/pdf/coe_slc.pdf

[25] As expected, there is a significantly higher amount of experience in this sample because we focus on exiting employees as opposed to the average employee in TRSIL and CTPF.

[26] We focus on end-of-career salaries, and the final four years of employment in particular, because roughly 90% of TRSIL employees earn their highest four years of compensation during their final four years of employment. Hence, for the great majority of employees, the FAS period is the final four years.

career compensation that is within expectations, we use simple forecasting methods. Specifically, we regress compensation on years to exit:

(2) $$C_{it} = \alpha_i + \beta_i' f(Year_{it}) + \varepsilon_{it}, \quad t < T,$$

where C_{it} is employee i's compensation in year t, $Year_{it}$ is the school year, $f(\cdot)$ is a polynomial function of $Year_{it}$, and β_i' is a vector of coefficients estimated separately for employee i. Note that the forecast model estimates separate intercept and slope coefficients for each employee. In other words, the model is fully interacted such that it is equivalent to estimating a separate regression model for each employee.[27]

The estimated parameters from this model are used to forecast the final years of compensation for employee i. In our preferred specification, we forecast the final four years of compensation (equal to the length of the FAS period):

(3) $$\hat{C}_{it} = \hat{\alpha}_i + \hat{\beta}_i' f(Year_{it}),$$

and the 95% confidence interval for the forecast of $\hat{C}_{iT}$:

(4) $$CI_{it} = \left[\hat{C}_{it} \ , \ \hat{C}_{it} + T_{0.05} * S_{ie} * \sqrt{1 + h_{it}}\ \right] \ ,$$

where $T_{0.05}$ is the t-statistic for a one-tailed test, S_{ie} is the standard error of the regression for employee i, h_{iT} is the Tth diagonal element of the projection matrix given by $x_t'(X'X)^{-1}x_t$, X is the matrix of independent variables in **equation (8)**, and x_t is the tth row of X.[28] For our primary specification, we adopt a quadratic functional form and use a 95% confidence level in defining the T-statistic.[29]

Given the range of expected compensation defined by CI_{it}, we define the indicator variable $Spike_i$ as follows:

(5) $$Spike_{it} = 1 \ \textbf{IF} \ C_{it} > CI_{it} \ ; \ \textbf{ELSE} \ Spike_{it} = 0$$

In other words, an end-of-career increase in compensation is characterized as salary spiking when the difference between actual and forecast compensation is positive and statistically significant. Note that we choose a 95% level of confidence out of convention, which places a high degree of certainty on whether an employee's compensation deviates from prior patterns of compensation. For example, a 95% confidence level implies that the average increase in compensation in a final year of employment needs to be larger than $8,227 to be considered salary spiking, while a less conservative 80% confidence level implies an average of $6,117. We report qualitatively similar results using this lower confidence level in Appendix A.

To illustrate our approach, we apply our method to two hypothetical employees in **Figure 2**: an employee who is (by our definition) salary spiking and an employee who is not. For each individual, we forecast a range of expected salaries in their final year of service (2009-2010) defined by **equation (10).** The

[27] It may be tempting to estimate a pooled regression with additional controls for employee and employer characteristics in the interest of improving precision but as discussed below, doing so would advance a conceptual definition of salary spiking that differs from the definition proposed above.

[28] See Greene (2003) for a detailed discussion of this statistic on page 111.

[29] Regarding the functional form of the regression models, our primary specification is a simple quadratic polynomial in school year. This specification has been widely used to fit age-earnings profiles of workers (e.g., Mincer, 1974), though we are sensitive to concerns that such models may not provide an appropriate fit (Murphy & Welch, 1990), and so, we present a figure in Appendix A indicating that functional form is likely not an issue relative to the magnitudes of salary spiking we find.

magnitude of the salary spike is defined as the vertical distance between actual compensation and forecast compensation. In Panel B, the hypothetical employee's final compensation in 2009-2010 falls within the expected range of compensation, and he is not identified as salary spiking. While the predicted compensation is higher than actual compensation, we define the magnitude of the salary spike as zero because they are within the CI.

In specifying **equation (8)** above, we must make a number of practical considerations related to the treatment of part-time employment, the number of years to include when estimating **equation (8)**, and the range of years over which to forecast compensation. First, regarding panel length, our primary model specification uses all available years of employment data for each employee—either to form predicted compensation or as a comparison to a prediction. This approach has the appeal of using the full set of information available. That said, researchers have argued that there is a bias-variance tradeoff in forecasting if more recent years of data contain better information for predicting final compensation.[30] As such, we also estimate models restricted to each employee's 10 most recent years of service.

Regarding the number of years to forecast, the FAS averaging period is four years for both TRSIL and CTPF and there is an incentive to spike salary during each of these years. Therefore, we forecast expected compensation for an employee's final four years of service because including FAS years in the regression model may bias $\hat{\alpha}_i$ and $\hat{\beta}_i$ if an employee is spiking in years T-1, T-2 or T-3.[31] While an employee's FAS period may plausibly occur outside of her final four years of service (if end-of-career compensation was declining, for instance), this is rarely the case among members of TRSIL – 98% of members experience their highest earning period during their final four years.

As noted above, our regression approach is equivalent to estimating independent regression model for each employee. In the pursuit of greater precision, it is tempting to pool observations in order to leverage the large size of the analytic sample. However, a pooled model would be conceptually incongruous with how salary spiking occurs. Specifically, it would characterize salary spiking as having a higher than expected end-of-career compensation given one's observable characteristics, whether or not that corresponded with an increase in pay. Furthermore, because we are interested in testing whether an employee's end-of-career compensation significantly deviations from prior patterns of compensation, applying estimates of variance derived from the overall sample will tend to be biased.

6. Results

6.1 Prevalence and Magnitude of Salary Spiking

Here we present evidence on the prevalence and magnitude of salary-spiking behavior. **Table 2** considers three samples of employees: exiting members of TRSIL (column (1)), exiting members of CTPF (column (2)), and a falsification group – non-exiting members of TRSIL (column (3))—this group has little incentive to salary spike because they are unlikely to be in their FAS period. For each sample group, we find that average model fit is quite good, with adjusted R-squared statistics averaging over 0.90. For the TRSIL sample, 95% of the individual regressions have an adjusted R-squared statistic above 0.85. (column (3)).

[30] For example, see discussion by Clark and McCracken (2009), or Greene (2003, page 112), for a practical example of this tradeoff.
[31] In an Appendix, we present results where these years *are* included in the regression models and fewer years are forecast.

Among TRSIL employees exiting employment 46% are identified as salary spiking in year T, 40% in year T-1, 26% in year T-2, and only 15% in year T-3 using a 95% confidence interval. In Appendix A, we report qualitatively similar results using an 80% confidence interval, with the proportion of employees identified as salary spiking 12-16 percentage points higher than that reported in **Table 2**. As described above, we define the magnitude of a spike in compensation as the difference between actual and forecast compensation in year t if an employee is identified as salary spiking in that year, and zero otherwise. Among the TRSIL members identified as salary spiking, the average magnitude of the spikes in compensation (across the four years) is $43,500, corresponding to an increase in FAS of $10,875.[32] These results are consistent with both quantitative evidence of salary spiking (e.g. Fitzpatrick, 2017) and qualitative evidence mentioned above.[33]

Next, we consider CTPF members. Between 17% and 26% are identified as salary spiking during the final four years of service. That the prevalence of spiking among CTPF members is substantially lower than among TRSIL members is consistent with the fact that CTPF members are served by a single employer. In this setting, the employer (CPS) bears the full burden of the costs associated with salary spiking – it is not shared among a large number of employers as is the case in TRSIL.

Lastly, as a falsification test, we consider TRSIL employees who are *not* identified as exiting employment (i.e., are still employed as of 2011-2012) and who have no pension-driven incentive to spike salary.[34] With a 95% confidence internal, we might expect about 5% of individuals in this falsification group to be identified as salary spiking. We find that between 13% and 21% of employees are identified as salary spiking in a particular year – similar to the proportion of exiting CTPF members identified as salary spiking. These results suggest that a significant proportion of the salary spiking identified among exiting members of TRSIL and CTPF may be incidental – i.e., driven by fluctuations in compensation that are independent from an influence of the pension system.

Another potential reason for the higher-than-expected level of spiking among the falsification group is that the estimated models have either persistent bias or incorrectly estimated precision.[35] While we find little evidence of misspecification, it is widely acknowledged in the forecasting literature that forecast intervals tend to have poor coverage rates; for example, Makridakis, et al. (1987) consider simulations using M-Competition data and find that 95% confidence intervals only contain about 80% of observations.[36] This is potentially because these intervals do not account for parameter uncertainty, model misspecification, or changes in the data generating process. Compared to prior studies, such as Hyndman et al. (2002) who find coverage rates between 71% and 87%, we find higher rates of 79% to 87%.

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[32] For an employee with 30 years of service, this would increase her annual benefit by roughly $7,000.

[33] Given the relatively large effects, it is potentially interesting to examine district-level patterns in compensation in more detail. This is somewhat challenging, though we have explored the Illinois Salary Survey in 2010-11 in Appendix A. Most types of contract features are unrelated to salary-spiking propensities, such as the structure of the district salary schedule, sick leave policies, and merit or performance pay. Perhaps not surprisingly, union organization is correlated with salary spiking (e.g. IEA-NEA & IFT-AFT relative to independent employers).

[34] We randomly choose a year for each individual to treat as their "false exit" year. To facilitate comparison, the sample consists of TRSIL members and not CTPF.

[35] We also explore the possibility of bias by considering "negative" spiking among nonexiters, and find quite similar proportions to Table 4; the symmetry of this result suggests that estimates of variance overstate precision. A similar proportion of "negative" spiking occurs among exiting employees as well, and are available on request. Alternatively, not accounting for parameter uncertainty would lead to a downward bias in our estimate of sigma, leading to forecast intervals that are too small.

[36] See also Wallis (1974), Newbold and Granger (1974), Gooijer and Hyndman (2006) for a discussion of coverage.

Interestingly, the rates reported in column (3) are fairly close to rates found by Williams and Goodman (1971) who also consider a simple linear regression forecast.

In considering the results for the falsification group and what they suggest about incidental spiking, it is important to note that a large spike in compensation inside an employee's FAS averaging period will generate unfunded liabilities regardless of *why* it has occurred. As such, while incidental spiking may not reflect pension-driven behavior, it is still of interest to those concerned about the funding status of a pension plan. Comparing CTPF and non-exiting TRSIL employees suggests that CTPF has few issues with individual or institutional salary spiking, but a substantial amount of incidental salary spiking.

6.2 Adoption of the 2005 Excess Compensation Rule

As noted above, in 2005 Illinois adopted a policy that requires TRSIL employers to pay "excess compensation" fees when employee salaries increase by more than 6% during years that contribute to the calculation of FAS. These district fees are calculated by TRSIL as the actuarial value of the increase in expected retirement wealth caused by increases in compensation in excess of 6% with payment due when an employee retires from the workforce. In this section, we present descriptive evidence comparing the prevalence and magnitude of salary spiking among TRSIL employees before and after the implementation of the 2005 rule. One challenge is that the rule only became binding once a school district negotiated a new contract with its employees. Because we do not have information on contract timing, we exclude the years 2005, 2006, and 2007 (Fitzpatrick (2017) indicates that the policy was binding for all school districts as of 2008).

Table 3 summarizes the previously presented regression results for employees enrolled in TRSIL in the pre- and post-policy periods, and provide *descriptive evidence* about the impact of the policy on salary spiking.[37] These results indicate that salary spiking is more common in the pre-policy period, with the highest prevalence of spiking in employees' final two years of service. About 53% and 45% of individuals are identified as salary spiking in years T and T-1, respectively. The prevalence of spiking in the post-policy period is significantly lower, down to about 30% in the last two years of employment, with smaller declines in T-2 and T-3.

Next, we describe how the financial implications of salary spiking in TRSIL changed with the introduction of the 2005 excess compensation rule. These calculations focus on TRSIL models as providing an overall estimate of financial costs, including individual, institutional, and incidental sources of salary spiking , as described in Section 6.1. The models estimated and reported in Table 3 for TRSIL identify approximately 2,395 employees as spiking per year, where at least one year from T to T-3 exceeds the 95% CI. The average FAS increase is $9,238 ($36,953 / 4). As noted by Fitzpatrick (2017), the state estimates that each dollar of FAS costs the pension system between $14 to $16, based on TRSIL assumptions about life expectancy and an 8.5% interest rate. Using the average value of $15 gives a total cost of $138,574 per individual with higher than expected compensation. Thus in the pre-policy period, spiking may have cost $332 million per cohort of exiting employees. Starting in 2008, when the policy is fully implemented, only 1,717 are identified as spiking per year with an average FAS increase of $10,127

[37] While CPTF is a natural group to consider as a counterfactual or falsification group, they appear to have substantially different pre-policy trends in both salary and spiking prevalence and confounding a potential causal interpretation of the effect of the policy.

for a cost of $261 million. Thus, the policy may have reduced the impacts of salary spiking by approximately $71 million.[38]

Importantly, the figures discussed above do not include the revenue collected from excess compensation billings. This is somewhat complicated because only compensation increases above 6% are billed, and we do not have precise data on how much the state has collected from these billings. That said, there are reports that the state collected a cumulative $38 million by 2013-2014. Thus, computing a per-cohort cost might be about $3.8 million, a relatively modest amount compared to the suggested change in salary-spiking behavior. It should also be noted that this additional revenue represents a redistribution of resources to cover financial liabilities rather than a reduction in salary-spiking costs.

We emphasize that this is only a rough calculation of financial costs. Assessing the precise financial implications in terms of pension wealth is challenging because we do not observe age or exact benefit factor for individuals, both of which are important factors for pension wealth calculations. For example, if individuals with higher than expected salaries tend to be older (and on average collect fewer benefits in retirement), the figures will overstate the true cost (and vice-versa). That said, one potential application of our approach could be use by state agencies with access to detailed information about age and benefit eligibility, allowing for more precise calculation of financial costs.

Lastly, in adopting the excess compensation rule, the state effectively established a definition of salary spiking: salary growth in the FAS period in excess of 6%. We contrast our method for identifying salary spiking with the state's definition of salary spiking in **Figure 3** by showing the distribution of compensation growth in an individual's final year of employment among employees we did, and did not, identify as spiking. Those who are identified as salary spiking are represented by the solid line and those who are not by dashed line. Panels A and B show results for the pre- and post-policy periods, respectively.

Two points stand out in **Figure 3**. First, this policy is targeted at employees who are salary spiking, and as such, there is a dramatic reduction in the number of employees near 20% growth in the post-policy period. Much of this mass is likely shifted to the new 6% level, both by reducing compensation growth among spikers, but also by transitioning from spiking to non-spiking. Second, the policy appears to have been unintended consequences for employees we do not identify as salary spiking. In the pre-policy period, a sizable portion of non-spiking employees have compensation above 6%, which is about a third of the distribution of non-spiking employees. This mass is greatly concentrated at 6% in the post-policy period. Moreover, there is far less mass for non-salary spikers below 6%. This indicates that the decision to set excess compensation at 6% represents a balance of changing the behavior of employees who may and may not be salary spiking.

7. Conclusions

Salary spiking is a potential source of unfunded pension liabilities, but the prevalence and magnitude of spiking is not well understood. We develop an empirical definition of salary spiking that can be applied wherever reliable compensation data are available, and we use this method to identify the extent to which there appears to be salary spiking in Illinois.

[38] Note that our calculation uses TRSIL estimates of future retirement benefits in a given school year and is not adjusted for inflation.

Our analysis of finds that outside of Chicago Public Schools (which has its own pension system), about half of state pension-eligible employees are identified as salary spiking in their final year of employment. This contrasts with the findings from Chicago Public Schools, where spiking is only about 20% of pension-eligible employees are found to be salary spikers, but it is consistent with what we would expect given the incentives faced by school districts. School districts whose employees are members of the state pension plan (TRSIL) have little incentive to discourage salary spiking among their own employees since any unfunded liabilities generating by spiking are shared by all member districts. In contrast, Chicago Public Schools bares the full cost of any salary spiking that occurs in the district. This suggests that employer incentives play a key role in influencing salary spiking.

We also consider the implementation of an anti-spiking initiative instituted in Illinois in 2005. This initiative bills employers for liabilities associated with compensation growth in excess of 6%. Consistent with the notion that the excess compensation rule successfully internalized the costs of salary spiking across employers that had previously been shared across all member districts, we find large reductions in the prevalence of salary spiking after the rule went into effect. In particular, we estimate that spiking liabilities were reduced by $71 million per cohort of exiting employees. In fact, the prevalence of salary spiking in the post-policy period is somewhat similar to the levels of spiking identified in CTPF. However, we also find that policies that define spiking in terms of growth thresholds (such as the 2005 anti-spiking initiative) may have unintended consequences: employees with high salary growth who are not in fact salary spiking (e.g. consistently high salary growth each year) may have their compensation reduced due to the policy.[39]

There is an important caveat to the findings presented above. Our approach identifies cases where salary deviates from prior patterns of compensation, but it is agnostic to the motivations behind the increase. As such, it is not possible to determine whether the salary spiking we observe is the result of employees seeking greater benefits from the pension system or simply incidental; for example, an employee may seek additional roles (such as mentorship) regardless of the implications for their pension. In fact, our analysis of non-exiting TRSIL employees indicates that a substantial portion of employees (about 20%) experience unexpectedly large increases in compensation that are likely unrelated to DB pension benefits. This highlights the fact that employees frequently have discontinuous increases in compensation, not just near the end of their employment. Importantly, however, even if these increases are not *intended* to increase DB pension benefits, they still affect pension benefits, and hence pension system liabilities, *regardless* of their intent.

[39] This need not be a cost, as some Illinois districts have been able to avoid excess compensation billings by using district CBAs to classify any increase in compensation above 6% as *non-pensionable*.

References

Biggs, A. G. (2015). *The State of Public Pension Funding: Are Government Employee Plans Back on Track? American Enterprise Institute. AEI Economic Perspectives*. Washington, DC.

Brown, J. R., Clark, R., & Rauh, J. (2011). The Economics of State and Local Pensions. *Journal of Pension Economics and Finance*, *10*(2), 161–172.

Clark, T. E., & McCracken, M. W. (2009). Improving Forecast Accuracy by Combining Recursive and Rolling Forecasts. *International Economic Review*, *50*(2), 363–395.

Costrell, Robert M; Maloney, L. (2013). *The Big Squeeze: Retirement Costs and School District Budgets*. Thomas B Fordham Institute, Washington D.C.

Costrell, R. M., Hitt, C., & Shuls, J. V. (Forthcoming). A $19 Billion Blind Spot: State Pension Spending. *Educational Researcher*.

Costrell, R. M., & Podgursky, M. (2009). Peaks, Cliffs, and Valleys: The Peculiar Incentives in Teacher Retirement Systems and Their Consequences for School Staffing. *Education Finance and Policy*, *4*(2), 175–211.

De Gooijer, J. G., & Hyndman, R. J. (2006). 25 Years of Time Series Forecasting. *International Journal of Forecasting*, *22*(3), 443–473.

Fitzpatrick, M. D. (2015). How Much Are Public School Teachers Willing to Pay for Their Retirement Benefits. *American Economic Journal: Economic Policy*, *7*(4), 165–188.

Fitzpatrick, M. D. (2017). Pension-spiking, free-riding, and the effects of pension reform on teachers' earnings. *Journal of Public Economics*, *148*, 57–74.

Goldhaber, D., Grout, C., & Holden, K. L. (2018). *Public Pensions and Salary Spiking: A Cautionary Tale of Data Inaccuracy Leading to Erroneous Results*.

Greene, W. H. (2003). *Econometric Analysis*. (R. Bannister, P. J. Boardman, G. Soto, & M. McHale, Eds.) (5th ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Hyndman, R. J., Koehler, A. B., Snyder, R. D., & Grose, S. (2002). A State Space Framework for Automatic Forecasting Using Exponential Smoothing Methods. *International Journal of Forecasting*, *18*, 439–454.

Makridakis, S., & Hibon, M. (1987). Confidence intervals: An Empirical Investigation of the Series in the M-Competition. *International Journal of Forecasting*, *3*, 489–508.

Malanga, S., & McGee, J. (2018). *Garden State Crowd-Out: How New Jersey's Pension Crisis Threatens the State Budget*. New York , NY.

Mannino, M. V, & Cooperman, E. S. (2013). *Benefit Enhancement in Public Employee Defined Benefit Pension Plans: Evidence from Three Sources*. University of Colorado Denver.

Mincer, J. (1974). *Schooling, Experience, and Earnings*. New York: Columbia University Press.

Moe, T. M. (2006). The Union Label on the Ballot Box. *Education Next*, *6*(3), 58–67.

Murphy, K. M., & Welch, F. (1990). Empirical Age-Earnings Profiles. *Journal of Labor Economics*, *8*(2), 202–229.

Newbold, P., & Granger, C. W. J. (1974). Experience with Forecasting Univariate Time Series and the

Combination of Forecasts. *Journal of the Royal Statistical Society*, *137*(2), 131–165.

Novy-Marx, R., & Rauh, J. (2011). Public Pension Promises: How Big Are They and What Are They Worth? *Journal of Finance*, *66*(4), 1211–1249.

Novy-Marx, R., & Rauh, J. D. (2009). The Liabilities and Risks of State-Sponsored Pension Plans. *Journal of Economic Perspectives*, *23*(4), 191–210.

Shuls, J. V, & Lux, J. (2019). Examining the Prevalence of Salary Spiking in Missouri's Defined Benefit Public School Retirement System James V. Shuls 1 and Joseph Lux 2 1. *International Review of Accounting, Banking and Finance*, *11*(1), 1–11.

Strunk, K. O., Goldhaber, D., Knight, D. S., & Brown, N. (2018). Are There Hidden Costs Associated With Conducting Layoffs? The Impact of Reduction-in-Force and Layoff Notices on Teacher Effectiveness. *Journal of Policy Analysis and Management*, *37*(4), 755–782.

Wallis, K. F. (1974). Discussion of '"Experience with forecasting univariate time-series and the combination of forecasts"'by P. Newbold and CWJ Granger. JR. *Journal of the American Statistical Association*, *Series A*(137), 155–156.

Williams, W. H., & Goodman, M. L. (1971). of Empirical A Simple Method for the Construction Forecasts for Economic Limits Confldence. *Journal of the American Statistical Association*, *66*(336), 752–754.

Tables and Figures

Table 1. Employee characteristics as of last year of employment

	All	CTPF	TRSIL	TRSIL – CTPF*
Year-over-year salary growth				
T (Final year)	7.2%	2.4%	8.5%	6.1%
T-1	7.8%	5.8%	8.4%	2.6%
T-2	5.6%	5.0%	5.8%	0.8%
T-3	5.5%	6.1%	5.4%	-0.8%
Demographics				
Female	0.71	0.75	0.70	-0.05
White	0.83	0.44	0.95	0.51
Employment characteristics				
Advanced degree	0.72	0.68	0.72	0.05
Salary	78,178	75,704	78,878	3,174
	(32,507)	(25,093)	(34,281)	
Years of service (YOS)	28.07	27.78	28.15	0.37
	(8.25)	(9.34)	(7.91)	
Job position				
Administrator	0.08	0.09	0.08	-0.02
Teacher	0.78	0.77	0.79	0.02
Other position	0.14	0.14	0.13	0.00
Observations	59,724	13,163	46,561	

*Notes: Samples include employees with at least 10 years of consecutive employment at the end of their careers (see sections 4 and 5 for further discussion). CTPF is the Chicago Teachers Pension Fund and includes employees who work for Chicago Public Schools at some point in their observed career. TRSIL is the Teacher Retirement System of Illinois, which covers all other employers in the state, and includes employees who are never observed in CPS. *All differences between CTPF and TRSIL are statistically significant at the 0.01 percent level.*

Table 2. Prevalence and magnitude of salary spiking

	TRSIL	CTPF	Non-exit TRSIL
Model Fit (Avg. R-squared)	0.93	0.91	0.90
Coefficient on quadratic term (Avg.)	-0.19	69.98	32.66
Proportion Spiking in			
T (Final year)	0.46	0.20	0.21
T-1	0.40	0.26	0.20
T-2	0.26	0.20	0.18
T-3	0.15	0.17	0.13
Magnitude among spikers (Avg.)	$43,500	$37,519	$47,816
Observations	46,561	13,163	31,861

Notes: Column 1 reports results for TRSIL employees who exit, and column 2 reports results for exiting CTPF employees. Column 3 presents falsification results using non-exiting TRSIL individuals who are observed in all years of the data, and a randomly selected pseudo-final year. Model fit is summarized by adjusted R-squared terms. Each regression includes school year and school year squared, and average coefficients on the quadratic term are reported in the second row. Prevalence is a sum over an indicator for whether an individual has a salary exceeding the CI given by equation (3). The total magnitude of salary spiking is measured as the sum over difference $S_{iT} - \hat{S}_{iT}$ *for each year an individual is identified as spiking.*

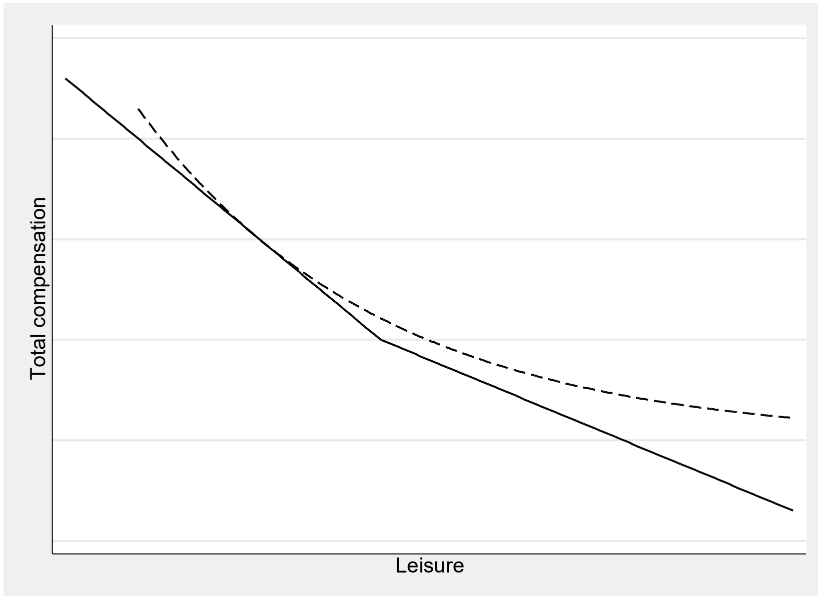
Table 3. Prevalence and magnitude of spiking before and after 2005 anti-spiking policy for TRSIL employees

	Pre-2005	Post-2007	Post minus Pre
Model Fit (Avg. R-squared)	0.94	0.93	
Coefficient on quadratic term (Avg.)	-50.34	28.19	
Proportion Spiking in			
T (Final year)	0.53	0.32	-0.21***
T-1	0.45	0.28	-0.16***
T-2	0.29	0.20	-0.10***
T-3	0.17	0.13	-0.04***
Magnitude among spikers (Avg.)	$43,554	$44,443	
Observations	30,110	16,829	

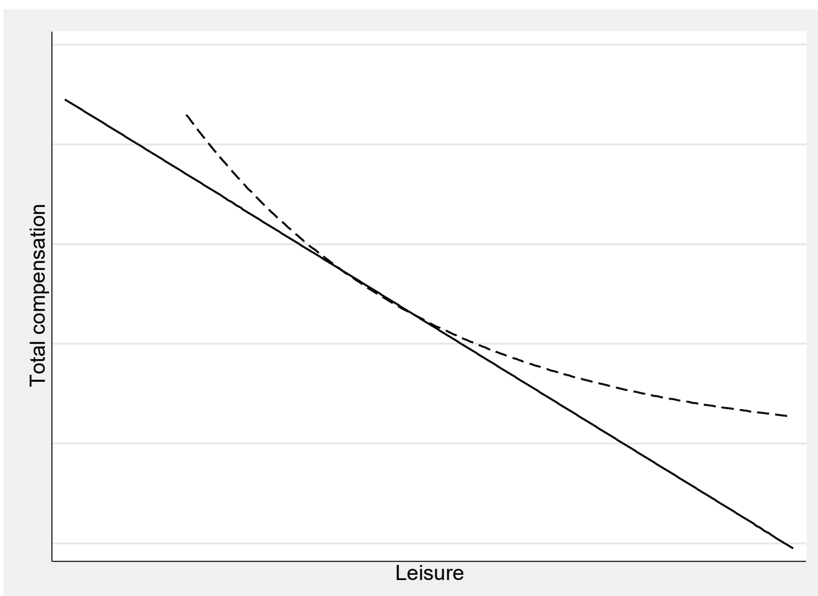
Notes: Each column reports statistics for TRSIL employees who have a FAS year in a given period, Pre-2005 and Post-2007. Notably, 378 individuals have a gap in service that causes them to be observed in both the pre- and post-period during their FAS period. See Table 2 notes for a description of these models.

Figure 1. Illustrations of employee salary spiking incentives

Panel A: Kinked budget constraint under DB pension FAS rules



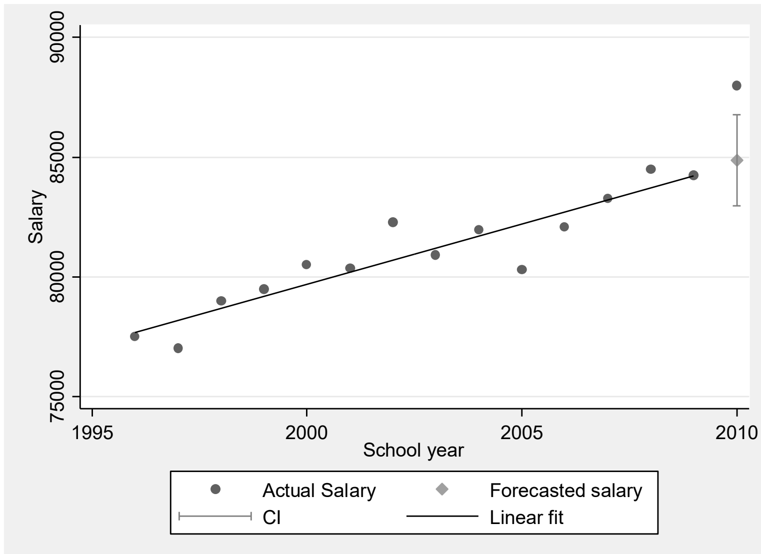
Panel B: Linear budget constraint without pension FAS rules



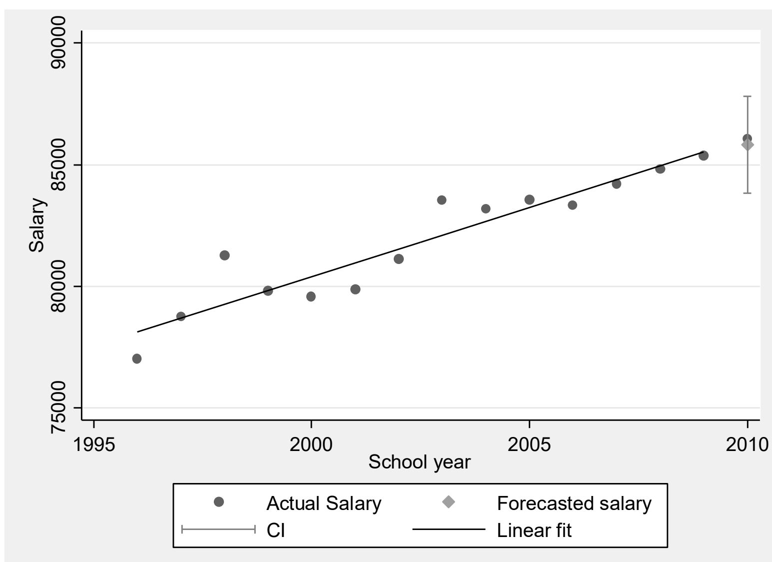
Notes: Panels represent a hypothetical budget constraint for an individual choosing between labor and leisure in their final year of work. In Panel A, the kink is at the point at which FAS begins to increase as salary in the final year exceeds one of the prior FAS years. Panel B represents a system without an FAS period.

Figure 2. Example of actual and forecasted salary for representative employees

Panel A: Example with salary spiking



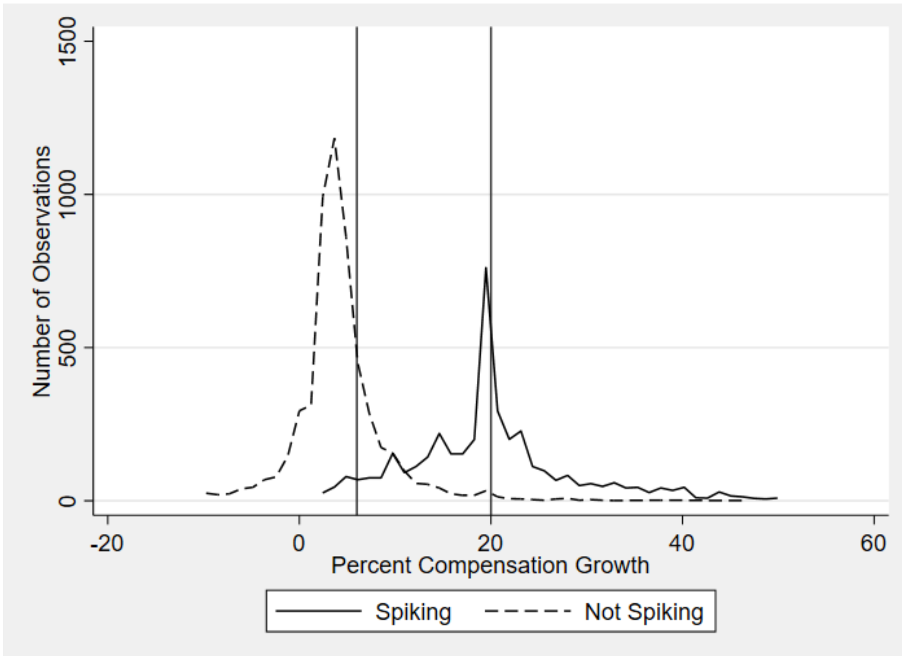
Panel B: Example without salary spiking



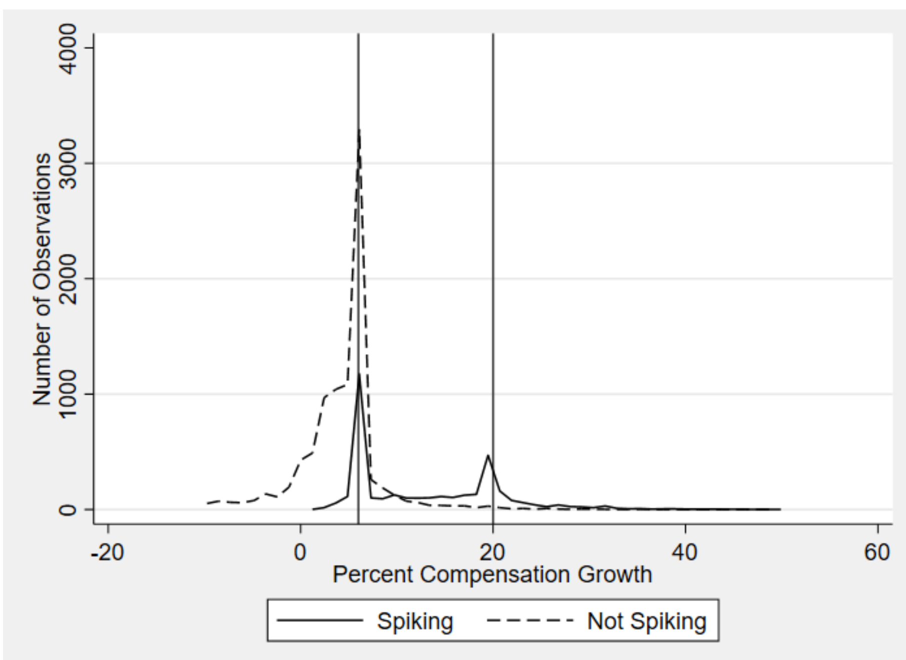
Notes: The figures represent three hypothetical individual's service between 1996 and 2010: Panel A, spiking, Panel B, not spiking, Panel 3, ambiguous spiking. The line indicates fitted values from a regression model excluding 2013, and the diamond point in 2013 indicates the "expected" salary forecast. The confidence interval is constructed from Equation (3) using the standard error of the forecast. The final data point in 2013 lies outside of this range indicating that the individual has a positive salary spike.

Figure 3. Compensation growth before and after excess compensation policy

Panel A: Pre-policy compensation growth



Panel B: Post-policy compensation growth



Notes: Each panel shows the distribution of compensation growth in a TRSIL employee's final year of employment by whether they are identified as spiking. Identification is based on the model from Table 2. The pre-policy period is prior to 2005, and the post-policy period is after 2007. Vertical lines indicate 6% and 20% compensation growth, where spiking policies are binding in post and pre-periods respectively.

Appendix A. Additional tables and figures

Table A1. Prevalence and magnitude of salary spiking with 80% CI for TRSIL

	(1)	(2)	(3)	(4)
Model Fit (Avg. R-squared)	0.92	0.93	0.93	0.93
Coefficient on quadratic term (Avg.)	66.11	31.83	15.38	-0.19
Proportion Spiking in				
T (Final year)	0.50	0.57	0.58	0.58
T-1		0.47	0.52	0.53
T-2			0.36	0.42
T-3				0.33
Magnitude among spiking (Avg.)	$11,351	$21,851	$30,185	$41,594
Observations	46,561	46,561	46,561	46,561

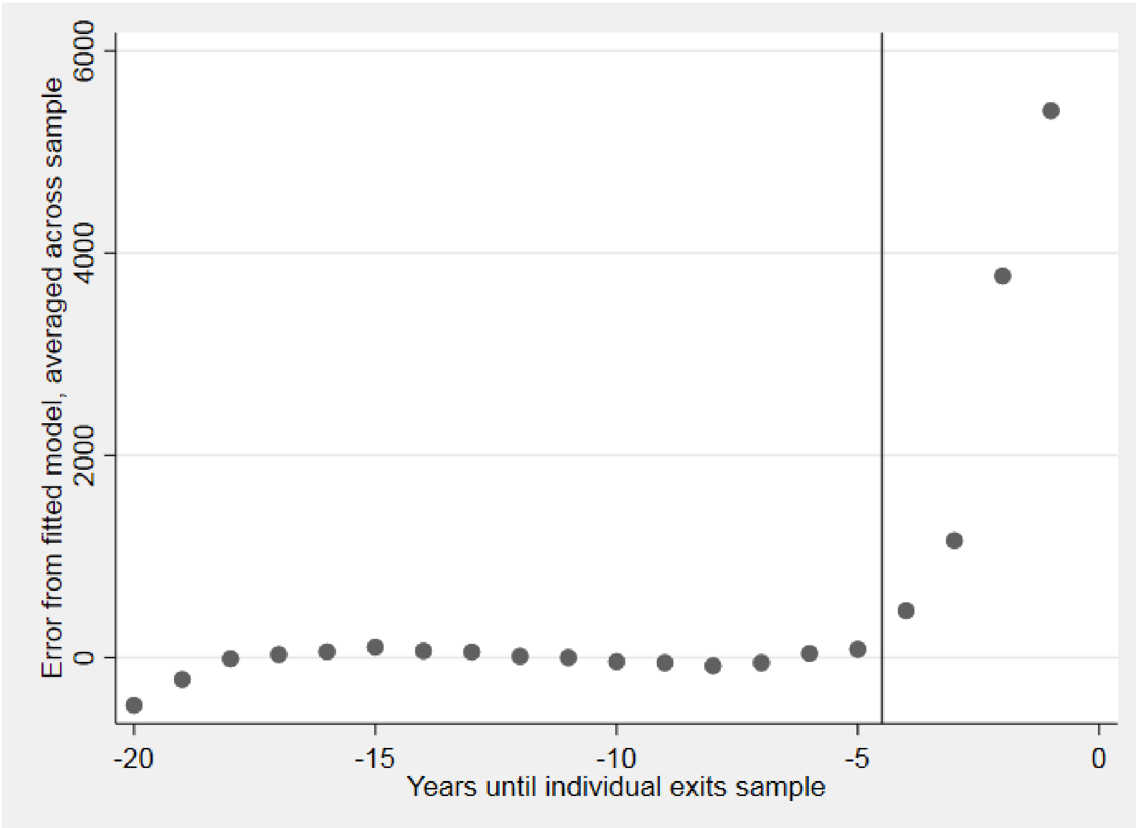
Notes: This table results for TRSIL employees who exit employment using a 80% CI interval instead of 95% as shown in Table 2. Model fit is summarized by adjusted R-squared terms. Each regression includes school year and school year squared, and average coefficients on the quadratic term are reported in the second row. Prevalence is a sum over an indicator for whether an individual has a salary exceeding the CI given by equation (3). The total magnitude of salary spiking is measured as the sum over difference $S_{iT} - \hat{S}_{iT}$ for each year an individual is identified as spiking.

Table A2. Prevalence and magnitude of salary spiking

	(1)	(2)	(3)	(4)
Panel A: TRSIL				
Model Fit (Avg. R-squared)	0.92	0.93	0.93	0.93
Coefficient on quadratic term (Avg.)	66.11	31.83	15.38	-0.19
Proportion Spiking in				
T (Final year)	0.36	0.46	0.48	0.46
T-1		0.33	0.39	0.40
T-2			0.19	0.26
T-3				0.15
Magnitude among spikers (Avg.)	$13,431	$24,221	$32,263	$43,500
Observations	46,561	46,561	46,561	46,561
Panel B: CTPF				
Model Fit (Avg. R-squared)	0.90	0.92	0.92	0.91
Coefficient on quadratic term (Avg.)	72.88	80.29	85.00	69.98
Proportion Spiking in				
T (Final year)	0.15	0.19	0.20	0.20
T-1		0.21	0.24	0.26
T-2			0.16	0.20
T-3				0.17
Magnitude among spiking (Avg.)	$11,583	$17,548	$24,622	$37,519
Observations	13,163	13,163	13,163	13,163
Panel C: Falsification test using non-exiting TRSIL employees				
Model Fit (Avg. R-squared)	0.91	0.91	0.91	0.90
Coefficient on quadratic term (Avg.)	42.73	46.36	39.57	32.66
Proportion Spiking in				
T (Final year)	0.10	0.15	0.19	0.21
T-1		0.11	0.17	0.20
T-2			0.12	0.18
T-3				0.13
Magnitude among spiking (Avg.)	$9,019	$16,935	$30,988	$48,701
Observations	26,880	26,880	26,880	26,880

Notes: Panel A reports results for TRSIL employees who exit employment, and Panel B reports results for exiting CTPF employees. Panel C presents falsification results using non-exiting TRSIL individuals who are observed in all years of the data, and a randomly selected pseudo-final year. Model fit is summarized by adjusted R-squared terms. Each regression includes school year and school year squared, and average coefficients on the quadratic term are reported in the second row. Prevalence is a sum over an indicator for whether an individual has compensation exceeding the CI given by equation (3). The total magnitude of salary spiking is measured as the sum over difference $S_{iT} - \hat{S}_{iT}$ *for each year an individual is identified as spiking.*

Figure A.1 Residuals according to year until exit, by fitted and forecast



Notes: The figure indicates residuals from the model presented in Table 1, column (4). Each point represents the average residual for a given year of employment relative to their separation across all individuals in the sample. The vertical line indicates that points to the left are fit to the model, while points to the right compare salary to forecasted salary.