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**A Worm in the Apple?
The Implications of Seniority-Based Teacher Layoffsⁱ**

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Budget cuts have resulted in *“the most rampant layoffs of teachers and other government employees in decades,”* as *“72,700 education jobs were eliminated in September (2010) on a seasonally adjusted basis.”*

-Washington Post and New York Times, October 8, 2010

Introduction

Stories abound about the staffing cuts that will have to be made currently, and in the next couple of years, as the ripple effects of the economic crisis impact local and state education budgets. Major budget cuts make teacher layoffs a near inevitability. This raises two very timely questions: what now determines which teachers are laid off, and is that policy best for students?

A significant body of empirical research shows that the specific teachers to which students are assigned can have dramatic effects on their achievement. Research by economist Eric Hanushek (1992), for instance, estimates that the difference between having a very effective versus a very ineffective teacher can be as much as a full year’s learning growth.ⁱⁱ So are the significant differences in teacher effectiveness part of the equation when making tough decisions about which teachers will lose their jobs?

The research I describe here suggests that the answer to this question is a definitive “no.” Empirical analysis reflects what is hard-wired into collective bargaining agreements (CBAs): seniority is the most important factor when deciding which teachers are laid off. Not only does this seniority-driven system not consider teacher effectiveness, but it also results in substantially more teachers being laid off to achieve specific budget targets because senior teachers, whose jobs are protected, earn more than novice teachers. This research also tellingly finds that the novice

teachers laid off are often more effective than the senior teachers left behind.

Looking at Washington state data on teacher effectiveness and teacher layoffs, we find that current layoff policy could lead to students losing 2 to 4 months of learning in the year after the layoffs.

I. When it Comes to Teacher Layoffs, Seniority Usually Rules the Day

Widespread teacher layoffs are a new phenomenon brought on by the budget crisis.ⁱⁱⁱ But, layoffs do on occasion happen, so it is not surprising that the layoff process is addressed in collective bargaining agreements. The overwhelming majority of these agreements include “last hired, first fired” seniority provisions. For example, all of the 75 largest school districts in the nation use seniority as a factor in layoff decisions, and seniority is the *sole* factor that determines the order of layoffs in over 70 percent of these districts.^{iv}

The fact that seniority-based layoff policies may be incompatible with maximizing student achievement has not gone unnoticed; calls to reform teacher layoff policies have recently appeared in a number of newspaper editorials and policy briefs (e.g. Daly and Ramanathan, 2010; NCTQ, 2010, The New Teacher Project, 2010). The incompatibility arises because, while more teacher experience is typically associated with better productivity (e.g. Rockoff, 2004), there are many teachers early in their careers who are more effective than teachers with greater experience (e.g. Gordon, et al 2006). Consequently, strict adherence to seniority when it comes to determining teacher layoffs will cause at least some very effective teachers to lose their jobs.

The impact of seniority-based layoffs on student achievement is explored in a 2010 study by Don Boyd and colleagues, which simulates the effect of seniority-based versus effectiveness-based (measured by value-added methods) layoffs.^v Notably, the study shows that the group of teachers that would be laid off under the seniority system are largely different than the teachers who would be laid off under the effectiveness alternative, and importantly, they also show that the typical teacher laid off under an effectiveness-based system is far less effective.^{vi}

Seniority-based layoff systems also result in a greater number of teacher layoffs. To achieve a given budget reduction target, school districts would need to lay off relatively more junior teachers than senior teachers (as junior teachers have lower salaries), meaning that a seniority-based layoff policy will cause class sizes to rise more than they otherwise would.^{vii} The aforementioned Boyd et al. study, as well as a report by Marguerite Roza (2009), find that reduction goal of cutting teacher salaries by 5 percent requires terminating about 5 percent of teachers under an effectiveness-based system and about 7 percent under a seniority-based system (since the teachers laid off earn less).

Some districts are trying to move away from seniority-based layoffs despite the language in collective-bargaining agreements. Chicago School Board members, for example, recently agreed to lay off the worst-rated teachers—as measured by principal performance evaluations—regardless of seniority (Rossi 2010). But performance-based exceptions to the seniority-based rule are relatively rare, occurring in only 20 percent of the 75 largest districts. The situation in Washington State—the focus of this report—looks similar. A review of the collective bargaining

agreements currently operating in the ten largest school districts in Washington shows that *all* use seniority as a basis for determining layoffs within certificated categories^{viii}, and eight of these districts use seniority as the *only* determinant of which teachers get laid off.

Unfortunately, up until now there has been almost no research on the determinants of *layoffs* in education.^{ix} In this report I describe findings from a new study I co-authored with Roddy Theobald, in which we use data from Washington State to assess the factors that predict which teachers are targeted for being laid off.^x This study also estimates teacher effectiveness (the term “teacher effectiveness” is used interchangeably with “teacher performance” throughout) so as to test whether school districts appear to consider it when making layoff decisions. As noted above, not surprisingly, we find that seniority plays an outsized role in determining which teachers are targeted for being laid off, while effectiveness does not appear to play any role whatsoever. We also use the data to assess whether a policy that replaced seniority with teacher effectiveness as the primary layoff criterion would affect student achievement. Our simulations suggest it would significantly improve student performance over the use of a seniority-driven system.

II. Data and Analysis

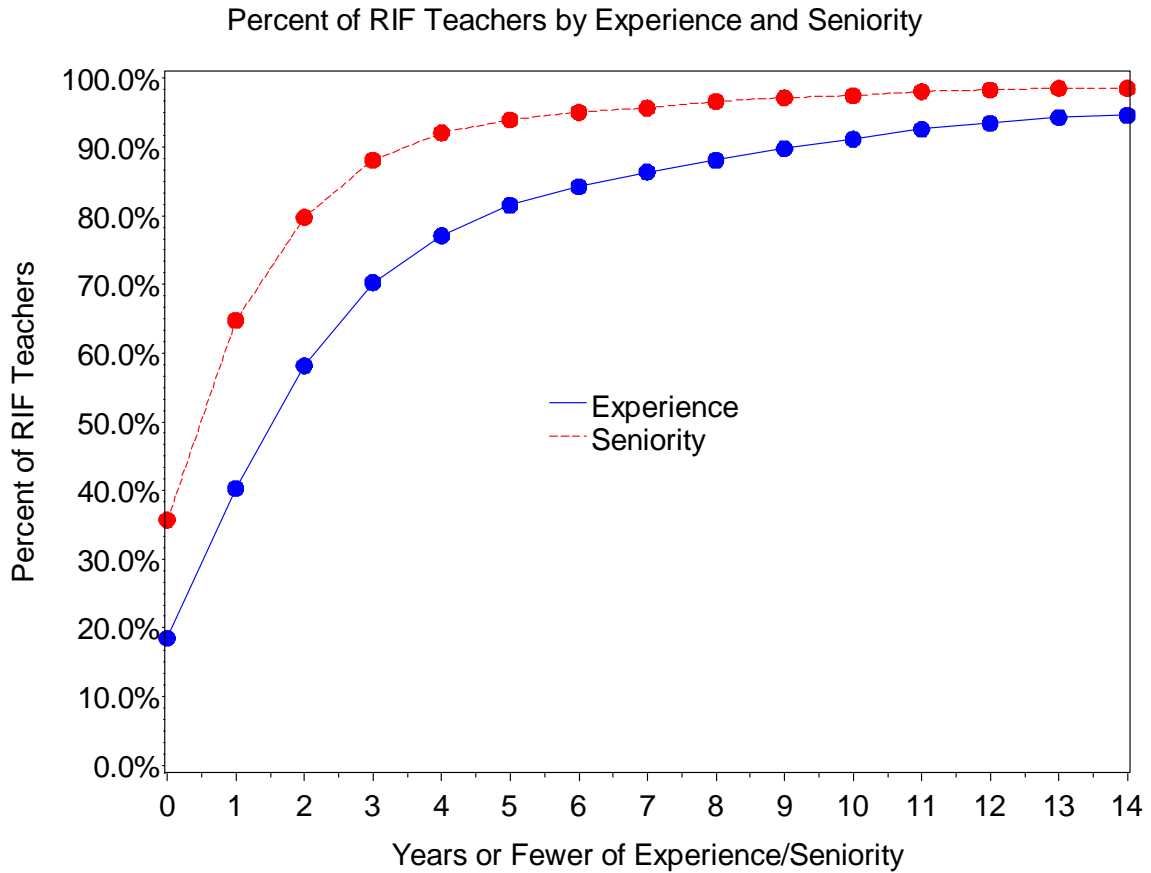
The findings on the targeting of teachers for layoffs are based on a unique dataset from Washington State that links teachers to their schools and, in some cases, their students; it also includes information on those teachers who received reduction-in-force (“RIF”) notices in the 2008-09 and 2009-10 school years (the

terms “RIF notice” and “layoff notice” are used interchangeably). The study is possible because Washington State’s Professional Education Standards Board (PESB) collected information on which teachers were sent RIF notices.^{xi}

Over a two-year period, Washington school districts gave 2650 layoff notices to school employees: 2087 in the 2008-09 school year and an additional 563 in 2009-10. Of the teachers who received a layoff notice, we focus on 2094 regular classroom teachers (1717 teachers who received layoff notices in 2008-09 and 407 teachers who received layoff notices in 2009-10, with 130 teachers who received layoff notices in both years). As it turns out, the great majority of teachers who received RIF notices in 2008-09 were still employed in Washington’s public schools in the next school year (Plecki et al., 2010). Some were not actually laid off, either because school districts were too conservative when they originally sent out layoff notices in the spring and ended up having available funds to protect employee jobs, or because the infusion of federal monies staved off some job losses. Another reason why teachers were still employed may be that they found employment in different districts. Still, the RIF notices offer a clear picture of which teachers are imminently at risk.

Given the prevalence of seniority job protections in collective bargaining agreements, it comes as no surprise that most teachers receiving RIF notices are new in their careers. This point is illustrated by **Figure 1**, which shows the distribution of teachers who received layoff notices in 2008-09 or 2009-10 by experience (years employed in the state) and seniority (years employed in the district):

Figure 1: Percent of RIF Teachers by Experience (state) and Seniority (district)



NOTE: Data include 2008-09 and 2009-10 RIF notices

Approximately 60 percent of teachers receiving RIF notices (“RIFed teachers”) have two or fewer years of experience, and approximately 80 percent have two or fewer years of seniority in their current district. It is interesting, however, that there are a small percentage of far more experienced/senior teachers who received layoff notices. This implies that there are districts in Washington making judgments about which teachers should be laid off based on criteria other than seniority alone.

Table 1 provides mean values of select teacher and school characteristics, broken out by whether a teacher received a RIF notice in 2008-09.^{xiii} Consistent

with the above figure, teachers receiving RIF notices are less experienced and less senior, by about 10 and 8 years respectively.

The experience of teachers generally has a large effect on teacher salaries because school districts in Washington State, as well as the great majority of school districts throughout the country, utilize the single salary schedule to determine teacher compensation. Under this system teacher salaries are determined solely on their degree and experience levels. As Table 1 shows, in addition to being relatively more junior, RIFed teachers are also far less likely to hold an advanced degree; consequently, there is an average difference of about \$15,000 in salary between the average RIFed and non-RIFed teachers.

Had all 1717 teachers who received RIF notices in 2008-09 actually been laid off, the direct salary savings in the state would have been \$5,521,238. As noted above, one of the critiques of seniority-based layoffs is that it is necessary to lay off more teachers in order to attain a specified budget objective than would have been laid off using alternative criteria. As an illustration of this, if teachers receiving layoffs were to earn the average salary in each district (rather than the lower salaries received by relatively junior teachers), then the number of layoffs statewide would have only needed to be 1349 in order to attain the same (or greater) budgetary savings.^{xiii} This example aptly illustrates the trade-offs between salary and teacher quantity that arises in the case of a seniority-based system: were layoffs more uniformly distributed throughout the teacher workforce, rather than concentrated amongst the most junior teachers, approximately 20 percent fewer teachers would need to be laid off to achieve a comparable budgetary savings.

Table 1 also shows differences between the RIF and non-RIF samples in terms of teacher endorsements – the specific subjects and grade levels that an individual is qualified to teach according to the state. There is some slight evidence to suggest that school districts are protecting teachers in high-needs subjects; 13 percent of RIFed teachers fell into a high-needs category while 15 percent of non-RIFed teachers did.^{xiv} Finally, it is worth noting that teachers receiving a RIF notice tended to be in smaller schools, but contrary to existing research (UCLA/IDEA 2009; Sepe and Roza 2010), they were not, in general, more likely to be teaching in schools with high proportions of minority students or lower achievement levels on the Washington State Assessment of Student Learning (WASL).^{xv}

School-level measures can mask a significant degree of teacher sorting across classrooms within schools. Fortunately, a subset of teachers and students can be linked together through the proctor on each student’s state assessment.^{xvi} This allows for the estimation of value-added models (VAMs) of teacher effectiveness based on students’ achievement on the WASL. There is a growing body of literature that uses VAMs in an attempt to identify the contribution that *individual* teachers make toward student learning gains (e.g. Aaronson et al., 2007; Goldhaber and Hansen, 2010a).^{xvii}

In the 2008-09 school year there are 6545 teachers in Washington State for whom teacher effectiveness can be estimated, and 145 of these teachers received a RIF notice in 2008-09 school year.^{xviii} **Table 2** reports *classroom*-level sample statistics for this VAM subset of teachers.^{xix} These classroom-level characteristics present a slightly different picture of differences between RIFed and non-RIFed

teachers than the school-level characteristics. For instance, compared to the school-level aggregates, the classroom-level measures for percentage of poor students are relatively higher for RIFed teachers and the percentage of white students is relatively lower. Also, the average student achievement in classrooms with RIFed teachers is lower than the average achievement in other classrooms. The dichotomy between the school- and classroom-level findings suggests there are within-school inequities in the distribution of teachers.

In order to provide a contextualized picture of the factors influencing layoffs, it is necessary to estimate multivariate models of the likelihood that teachers receive a RIF notice. This model describes how one factor influences the probability of a RIF notice, *holding other factors in the model constant* (the terminology used below is “all else equal”). So, for instance, it is possible to infer whether being in a particular type of school (e.g. a high-poverty school) influences the probability apart from the fact that teachers with certain credentials may be more likely to be employed in some schools. Again, there are many ways that these models may be specified, but as is described in Goldhaber and Theobald (2010), the mainline findings, described below, are largely unaffected by the choice of model specification.

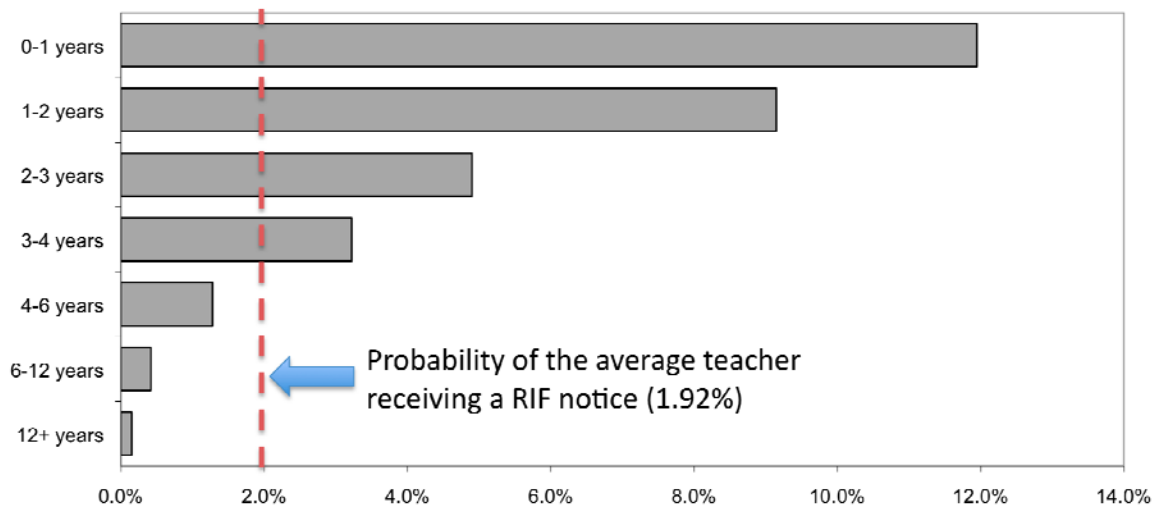
III. It’s Not the Only Factor, But Seniority Rules the Day

The results I describe below are based on a model that estimates the probability that a teacher receives a RIF notice in 2008-09 as a function of individual teacher, school, and district variables, including: the teacher’s seniority, degree

level, college selectivity, race, and gender; the school's size, student/teacher ratio, demographic composition, and urbanicity; the district's size, per-pupil expenditure, and funding sources; and district indicators, implying that the comparisons are the probability of layoffs *within* districts.^{xx}

As expected, seniority plays a very important role in determining whether teachers receive layoff notices.^{xxi} This is illustrated by **Figure 2**, which shows the estimated increase in the probability of a teacher receiving a RIF notice with changes in district seniority, and degree level.^{xxii} A first-year teacher is about ten times as likely, all else equal, to receive a RIF notice than a teacher in her 4th–6th year in a district; teachers with more than 6 years of seniority have very nearly a zero probability of receiving a layoff notice.

Figure 2: Estimated probability of RIF notice by seniority



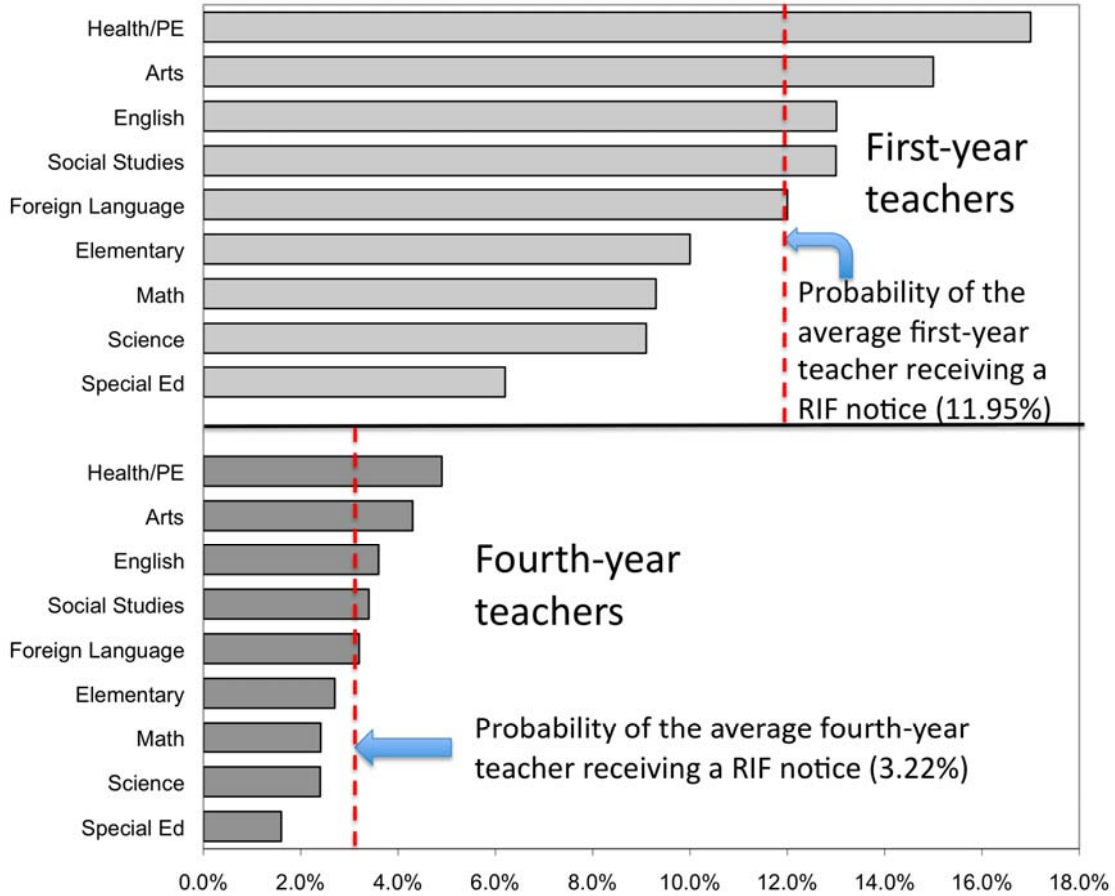
Interestingly, seniority is not the only factor influencing the likelihood that teachers receive a RIF notice. Like many states, in Washington there is concern over the difficulty of hiring high-quality teachers in STEM (science, technology, engineering, and math) fields and who are qualified to teach special education. This

concern is reflected in the study's findings: there is evidence that districts are protecting teachers with advanced or hard-to-recruit skills. Specifically, all else equal, teachers holding an endorsement/qualification in a "high-needs area" are significantly less likely to receive layoff notices than those with, for instance, an endorsement in elementary education. Moreover, there is evidence that school districts are behaving strategically to protect teachers who have endorsements in multiple areas and therefore provide flexibility in terms of the classes they can teach: each additional endorsement is estimated to lower the probability that a teacher receives a RIF notice by a small amount.

The magnitude of the endorsement effect is illustrated in **Figure 3**, which shows the effects of endorsements with different levels of seniority.^{xxiii} This figure illustrates that a first-year teacher (focus on the upper panel of the figure) who is endorsed in one of the high-needs areas of math, science, and special education is about 40 to 60 percent less likely to receive a RIF notice than a first-year teacher whose endorsement is in health, PE, or the arts. But also notice that while endorsement area influences the probability of being targeted for a layoff, its effect is swamped by the influence of seniority. For example, the most junior teachers who have an endorsement in special education (the area with the lowest probability of being laid off) are still more likely to receive a layoff notice than fourth-year teachers who have an endorsement in health or PE (the subject that makes them most vulnerable to receiving a layoff notice.) Moreover, the probability of a teacher with 12 or more years of seniority receiving a RIF notice was less than 0.5% regardless of the teacher's endorsement area. These results indicate that seniority

generally trumps educational qualifications when it comes to teacher layoffs.

Figure 3: Estimated probability of RIF notice by endorsement area (first-year and fourth-year teachers)



Finally, the findings from the statistical model confirms what was suggested in the table of means: holding constant the other variables in the model, RIFed teachers were not, in general, more likely to be teaching in schools with high proportions of minority or poor students. This is a bit of an empirical surprise since one might have assumed that faced with tough choices about which schools loose teachers, districts would be inclined to target layoffs to schools with more vulnerable student populations (which may or may not be high minority/high poverty schools) because those schools have less politically active parent

populations. However, it is important to keep in mind that this is an all else equal finding; often all else is *not* equal. For instance, this finding does not necessarily mean that poor or minority students are not more likely to have their teachers laid off since they may tend to be served by more junior teachers who are clearly more likely to receive a layoff notice. I return to this point below in the “Policy Implications” section of the report.

Is Teacher Effectiveness Considered in RIF Decisions?

As I noted above, there is no universally accepted method for estimating teacher effectiveness, nor is it clear theoretically what measure administrators might care most about. For instance, while some might argue for using an absolute standard where teachers are compared regardless of their experience levels, one might also make the case that administrators judge teacher potential, and, if so, judge teachers in the context of where they are in their careers. This implies administrators might wish to protect the jobs of junior teachers who show a great deal of potential, in the sense that they are very effective relative to other junior teachers, even if they are less effective than more senior teachers. It is also unclear at what point administrators judge teachers. Are they concerned mainly with performance in the year in which a layoff decision is made? Or are they concerned with performance in the year prior to that, when there is likely to be more definitive information about how well a teacher’s students did on a state assessment? Or alternatively, do they judge an entire teacher’s career when making decisions? Given that the answers to these questions are unclear, it is worthwhile estimating the probability of RIF models with a variety of different teacher effectiveness

measures to test the sensitivity of the findings.^{xxiv}

As it turns out, the findings are the same no matter how the data are sliced (in terms of estimating teacher effectiveness). Goldhaber and Theobald (2010) show that teacher effectiveness does not show up as a statistically significant predictor of the likelihood that a teacher receives a layoff notice no matter how value-added effectiveness is judged. This finding clearly implies that this student-achievement measure of effectiveness plays very little or no role in determining which teachers are targeted for a layoff.

IV. Policy Implications

The above findings almost entirely comport with what one might expect given strong seniority protections in collective bargaining agreements. As noted in the first section of this report, all of the collective bargaining agreements governing policy in the ten largest school districts in Washington in the 2008-09 school year explicitly mention that seniority must be used as a factor in determining layoffs. For instance, the newly adopted CBA in Seattle mandates that “displacement of staff from buildings, layoff, and recall shall be by seniority, within categories, subject matter areas, or departments,” and stipulates that “the performance ratings (evaluation) of employees shall not be a factor in determining the order of layoff.”^{xxv} Nearly identical clauses are found in the CBAs for Tacoma, Spokane, and most other districts in Washington. Therefore, it is not surprising that seniority is such an important predictor of which teachers received RIF notices, and it's also not surprising that teacher endorsement area plays a role—since many CBAs stipulate

that RIF notices are given by seniority within subject areas or departments. Finally, it is not surprisingly to see that teacher effectiveness is not a factor.

At face value it seems likely that a strict seniority-based policy is not necessarily in the best interests of student achievement. One would hope, for instance, that districts would incorporate some measures of teacher effectiveness into the decision process. Value-added is only one method to assess teachers, not necessarily the right or only one, but assessing the implications of using value-added measures of effectiveness to determine layoffs as opposed to the seniority-driven system in place provides a nice illustration of the impact of system choice on students.

Goldhaber and Theobald assess the implications of using a value-added effectiveness-based system in place of the seniority-based system for the subset of teachers in Washington State for which value-added effectiveness measures can be obtained. The simulation they employ works as follows. First, teacher effectiveness is estimated for student achievement in both math and reading (teachers at the elementary level are typically teaching both subjects to students). Next, for simplicity, the value-added measures are averaged across the two subjects in order to obtain a single estimate of effectiveness for each teacher.^{xxvi} Teachers in each school district are then ranked according to their value-added.^{xxvii} Finally, starting with the least effective teachers in each district and moving up the effectiveness ladder, enough teachers are assigned to a hypothetical layoff pool to achieve a budgetary savings for each district that is at least as great as each district's budgetary savings that would have resulted were all the teachers who received a

RIF notice in 2008-09 actually laid off.

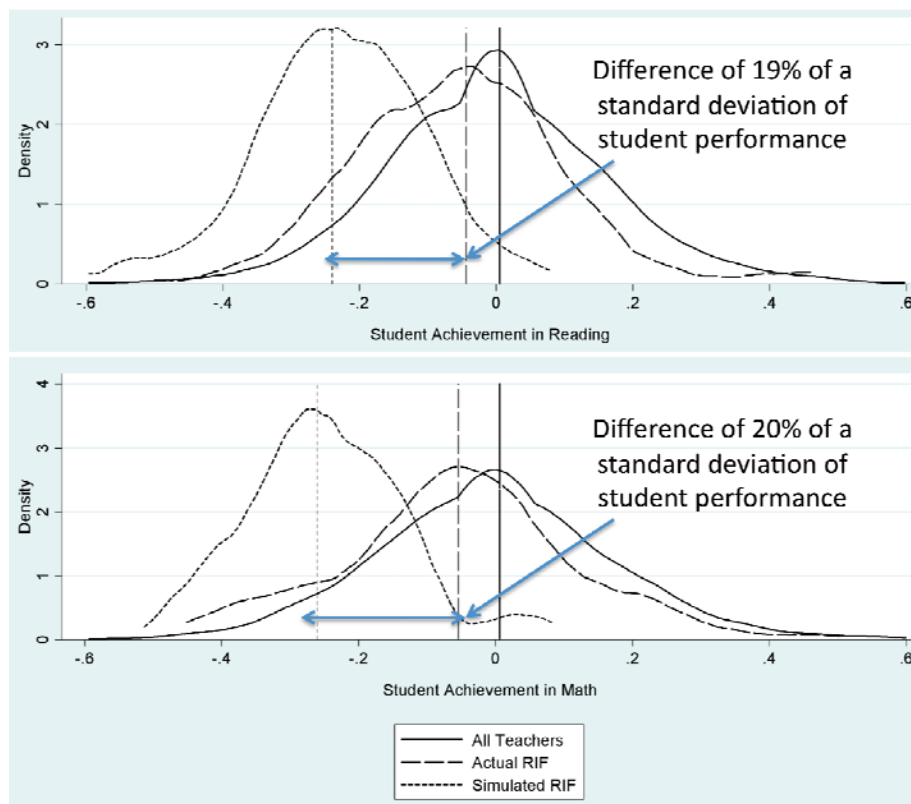
Two things are immediately made apparent from this simulation. First, the two different layoff systems result in very different groups of teachers being targeted: the overlap between the subgroup of teachers who actually received a RIF notice and the subgroup of teachers laid off in the effectiveness-based simulation is less than 20 percent. Second, since more of the teachers who received RIF notices under the effectiveness-based system would be more senior, and consequently would have higher salaries, than the teachers who actually received RIF notices, the effectiveness-based system would result in fewer layoffs. Specifically, the differential in average seniority is approximately eight years, the differential in average salaries is approximately \$14,000, and the effectiveness-based system results would result in just fewer than 10 percent less layoffs than does the seniority-driven system.^{xxviii}

The consequences for students of the choice between these two different systems are profound. Thirty-six percent of those teachers who *actually* received layoff notices were estimated to be more effective than the average teacher who did not, implying there is a lot of room for making more informed effectiveness-based decisions. This is illustrated by **Figure 4**, which plots out the distribution of teacher effectiveness under the simulated effectiveness-based RIF versus the actual effectiveness of teachers who received RIF notices.

The differential in means of the two distributions is about 20 percent of a standard deviation of student achievement in both math and reading.^{xxix} What does this mean in more concrete terms? Estimates for upper elementary grades of the

grade-to-grade gains in student achievement range from 40 percent (Bloom et al., forthcoming) to a full standard deviation on math and reading tests (Schochet and Chiang, 2010). A 20 percent differential between systems is therefore roughly equivalent to between one-fifth to one-half of a school year or 2 to 4 months of student learning. This likely overstates how different the two groups of teachers would have been in the next year since teachers may not be as effective in future years as they are estimated to have been in the past.^{xxx} Still, the magnitude of the differential is striking—roughly equivalent to the differential between students having a teacher who is at the 16th percentile of effectiveness rather than the 50th percentile.

Figure 4: Actual RIFs vs. Simulated Effectiveness-Based RIFs



Because widespread teacher layoffs are a new phenomenon, seniority

provisions had likely not received much public scrutiny in past; they never had to be utilized on such a large scale before. This is clearly not the case today, nor is it likely to be the case in the near future as schools wrestle with the difficult fiscal decisions that accompany tighter budgets. Policymakers are now forced to confront unpalatable decisions about which teachers to let go. They not only face local complaints from parents, who may see their favorite, albeit junior, dismissed (Westneat 2009), but also from organized opposition. For instance, the ACLU filed a lawsuit against the Los Angeles School District, asserting that the use of seniority-based layoffs is unconstitutional, because it disproportionately affects minority students (Song 2010). This lawsuit resulted in the district ending its “last hired, first fired” policy in October 2010. And while teachers’ unions tend to support seniority provisions, it can be argued teachers themselves do not support “quality blind” layoff rules. Survey results from a recent policy brief by The New Teacher Project (2010) show that, when asked which factors they would prefer to be considered when determining layoffs, a larger percentage of teachers preferred factors such as classroom management skills, teacher attendance rates, and evaluation ratings than the percentage of teachers that believed seniority ought to be considered.

Budget cuts have resulted in the first significant teacher layoffs in recent times, despite the significant federal stimulus aid to localities geared toward protecting education jobs (AP 2010; Klein 2010). This situation is unlikely to change in the short-run as state expenditures are expected to drop again in 2011 (Adams 2010). The study described here shows some of the implications of the seniority-driven system used to determine teacher layoffs. Districts do consider

factors other than seniority alone when deciding which teachers are laid off, but seniority certainly has an outsized effect on layoff decisions, and effectiveness (at least measured in value-added terms) appears to play no role at all. Given what research shows about the importance of teachers for student achievement, it is nearly impossible to argue that this is a system with the best interests of students as its bottom line.

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Tables

Table 1: Selected Summary statistics for RIF and non-RIF teachers in WA

	RIF (N = 1717)	No RIF (N = 53,939)
Teacher Characteristics		
Final salary	\$42,826 (\$11,194)	\$57,898 (\$14,705)
Years of experience in state	3.43 (5.16)	13.66 (9.65)
Years of seniority in district	1.68 (3.26)	9.93 (8.44)
Master's degree or higher	44.32%	64.15%
Most Recent Endorsement Area^{xxxi}		
“High-Needs Area”	13.33%	15.10%
Math	3.55%	3.09%
Science	4.95%	5.12%
English/LA	13.45%	12.40%
Social Studies	7.63%	10.70%
Elementary Ed	45.60%	37.46%
Special Ed	4.83%	6.89%
Health/PE	4.02%	4.42%
Agriculture/Tech/Other	6.23%	8.87%
Arts	6.99%	5.25%
Foreign Languages	1.69%	2.42%
School Characteristics		
% Urban	11.07%	14.96%
% High Schools	28.19%	27.38%
% Middle Schools	15.78%	18.21%
% Elementary Schools	48.40%	48.46%
% Other School Configuration	5.24%	4.85%
School size	707.00 (469.22)	747.30 (519.07)
Student/teacher ratio	17.01 (3.28)	17.11 (4.22)
% free/reduced lunch	39.64%	42.08%
% white students	68.30%	64.00%
% black students	5.81%	5.60%
% Hispanic students	10.45%	15.84%
% other races	15.44%	14.56%
% special education	12.53%	12.40%
% passed English WASL	72.59%	72.54%
% passed Math WASL	51.70%	51.75%

Note: standard deviations in parentheses, data includes only 2008-09 RIF notices

Table 2: Selected Summary Statistics for teachers with VAM estimates

	RIF (N = 145)	No RIF (N = 6400)
<u>Average Teacher Value-Added^{xxxii}</u>		
Value-added in reading	-0.048 (0.17)	0.0013 (0.18)
Value-added in math	-0.054 (0.17)	0.00049 (0.19)
<u>Classroom Characteristics^{xxxiii}</u>		
% free/reduced lunch	45.91%	44.20%
% white students	64.81%	64.41%
% black students	8.00%	5.52%
% Hispanic students	12.48%	16.30%
% other races	14.71%	13.77%
% special education	11.57%	11.76%
% passed English WASL	68.41%	72.00%
% passed Math WASL	48.19%	54.88%

ⁱ The research presented here utilizes confidential data from Washington State supplied by the Office of Superintendent for Public Instruction. I gratefully acknowledge the receipt of these data. Also, this report has benefited from helpful comments from Joe Koski and John Krieg, research assistance by Roddy Theobald, Steve Dieterle, Stephanie Liddle, and Scott DeBurgomaster, and editorial assistance by Jordan Chamberlain. The views expressed in this report do not necessarily reflect those of the University of Washington, Washington State, or the study’s sponsor. Responsibility for any and all errors rests solely with the author.

ⁱⁱ See also, for instance, research on the impacts of individual teachers by Aaronson et al. (2007) or Rivkin et al. (2005).

ⁱⁱⁱ This is not surprising given that per pupil spending has risen every year since 1993 (Digest of Education Statistics 2010). In fact, per pupil spending in the United States has increased every year since 1970 with the exceptions of 1979-80, 1980-81, 1991-92, and 1992-93, and has more than doubled in that time (\$10,041 in 2006-07 compared to \$4489 in 1970-71, as measured in 2007-08 dollars).

^{iv} These figures are compiled based on information from the NCTQ TR3 database (NCTQ 2009). The use of seniority as a determining factor in layoffs is certainly not unique to public education. See, for instance, Abraham and Medoff (1984) and Lee (2004).

^v They assume that each system meets a targeted budget reduction of 5 percent of total teacher salaries. For more detail, see Boyd et al. (2010).

^{vi} The differential is estimated to be 26 percent of a standard deviation of student achievement. This 26 percent may somewhat overstates the true impact of the difference in teacher layoff systems since teacher effectiveness measured in one year may not comport with their effectiveness in the next (Boyd et al., 2010; Goldhaber and Hansen, 2010b; McCaffrey et al., 2009). The authors, however, account for this by comparing teachers under the two regimes in the future. In these estimates they still find a differential of 12 percent of a standard deviation of student achievement—a very large effect given empirical evidence suggesting this to be roughly equivalent to between one half and a full-standard deviation difference in teacher effectiveness. Estimates suggest, for example, that a one standard deviation increase in teacher quality raises student achievement in reading and

math by 10 (Rivkin et al., 2005; Rockoff, 2004) to 26 (Koedel and Betts forthcoming) percent of a standard deviation.

^{vii} For instance, Roza (2009) calculates that if layoffs are done solely on the basis of seniority, a district needing to reduce salary expenditures by 5 percent must instead lay off 7.5 percent of its workforce.

^{viii} Certificated categories include teachers (grouped by subject area taught), nurses, speech therapists, and any other credentialed employees.

^{ix} There are a few studies of teacher *dismissals*. For instance, a recent paper by Jacob (2010) explores the relationships between various teacher, school, and student characteristics and teacher dismissal probabilities among non-tenured teachers in the Chicago Public Schools. Among others, the findings of the paper include an increased likelihood of dismissal for teachers with frequent absences, poorer credentials (measured by competitiveness of the college attended, failure on previous certification exams, and highest degree completed), and certain demographic characteristics, particularly older and male teachers. Jacob considers several measures of teacher effectiveness as well, including an estimate of the teacher's value-added. He finds a statistically significant negative relationship between a teacher's value-added and the probability of being dismissed.

^x "Targeted" is used in the sense that the study focuses on teachers that received a layoff notice. More details about the study can be found in Goldhaber and Theobald (2010).

^{xi} Teachers receiving these notices can be linked with administrative records that include information about their teaching credentials, school assignments, degrees, and compensation.

^{xii} I chose to use only the 2008-09 year because some teachers received a layoff notice in both years of the data, but, at the time this is being written, not all the information about the students being taught by the 2009-10 teachers was available. However, the average characteristics of those receiving RIFs appear to be very similar whether or not the averages are for 2008-09 as in the table, or for 2009-10.

^{xiii} This calculation is based on the actual salaries of teachers in each school district and is derived by aggregating the number of teacher layoffs in each district that would be necessary to achieve the same (or slightly greater) district-level budgetary savings and then aggregating the district-level figures up to the state-level.

^{xiv} The classification of "high-needs" is based on a 2006 report "Educator Supply and Demand in Washington State" (OSPI 2006), which specifies there are 14 endorsement areas for which there are "high degrees of shortage," all of which fall into math, science, or special education areas.

^{xv} The WASL is the state's annual statewide assessment test for 3rd through 8th grade and 10th grade students.

^{xvi} The proctor of the state assessment was used as the teacher-student link for at least some of the data used for analysis. The 'proctor' variable was not intended to be a link between students and their classroom teachers so this link may not accurately identify those classroom teachers.

^{xvii} The basic idea behind value-added is to predict the achievement levels of students based on: 1) their prior achievement; 2) their background characteristics (e.g. whether they are receiving free or reduced price lunch); 3) schooling resources (e.g. per pupil expenditure and class size). Differences between the prediction of student achievement and actual achievement are attributed to teachers and these differences aggregated to the classroom level are treated as a measure of teachers' performance or effectiveness. There is no universally accepted method for calculating a teacher's value-added contribution and research shows that methodology and context can influence the measure (Ballou, Sanders,

& Wright, 2004; McCaffrey et al., 2004; Rothstein, 2010; Rubin, Stuart, & Zanutto, 2004; Tekwe et al., 2004). For this reason, it is worth estimating effectiveness in a variety of different ways to see if the results are sensitive to the particular way that teacher effects are calculated.

^{xviii} In Goldhaber and Theobald (2010), we classify a sample of roughly 55,000 employees as “teachers” because they fall into duty routes 31-33, which (according to the state’s S-275 codebook) includes “teaching staff” (as opposed to “certificated administrative staff”, “educational staff associates”, “certificated instructional staff”, “other certificated staff”, and “classified staff”). Thus, the 6545 teachers for whom I estimate effectiveness represent approximately 12 percent of all teachers employed in the state. As noted above, at the time this report was being written, the 2009-10 student achievement data was not yet available so it was not possible to include it in the analyses.

^{xix} The classroom-level statistics include all the students in the teacher’s class, not just the students whose test scores are used to generate the teacher’s VAM estimate.

^{xx} The within-district comparison is important because it is conceivable (and there is some evidence of this in Goldhaber and Theobald, 2010) that differences across districts in the proportion of teachers employed in an area could affect the findings where the statistical model not designed to be a within-district comparison.

^{xxi} The effect of seniority is unlikely to be linear: the difference between years 1 and 2 of seniority should be different than the difference between years 21 and 22, for example. Thus, we interpret the marginal effects of seniority later in this section when we discuss non-linear effects (Table 3).

^{xxii} These estimates are based on the specification in Column 2 of Table 3 in Goldhaber and Theobald (2010), and they are calculated assuming that all other teacher and school variables are set at the median values for teachers in the state.

^{xxiii} These estimates are based on the specification in column 2 of Table 3 in Goldhaber and Theobald (2010), and they are calculated assuming that all other teacher and school variables are set at the median values for teachers in the state.

^{xxiv} See Goldhaber and Theobald (2010) for more detail about the various teacher effectiveness measures that were tested.

^{xxv} Article XII, Sections A and C.

^{xxvi} This is not necessarily the most sophisticated way of generating a cross-subject estimate of teacher effectiveness, but we believe the simplicity of this method might be the best reflection of how districts would be likely to implement such a policy.

^{xxvii} The specification used to generate the value-added estimates and ranking is from Column 3 of Table 4 in Goldhaber and Theobald (2010).

^{xxviii} For more detail about this simulation, see Goldhaber and Theobald (2010).

^{xxix} These estimates are slightly smaller than the estimate in Boyd et al (2010) that the difference is 0.26 standard deviations in student achievement. This is likely due, at least in part, to the fact that we are interested in simulating a statewide policy/practice that operates within districts. Our findings on differences in effectiveness between the two different systems would have been even larger had we ignored district boundaries (because there are some teachers who would not be RIFed based only on within-district comparisons, but would be based on teacher comparisons between districts).

^{xxx} Boyd et al., for instance, show that the 26 percent of a standard deviation difference between teachers is reduced to 12 percent when teachers are judged in the year following a hypothetical layoff.

^{xxxi} For ease of comparison we only present statistics for a teacher’s most recent endorsement area.

^{xxxii} The specification for these teacher VAM estimates pools across all years of data, and each estimate is calculated and standardized within the grade level.

^{xxxiii} Classroom statistics are from the most recent year we can calculate that teacher's value-added.