FINANCIAL INCENTIVES IN D.C. PUBLIC SCHOOLS

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Dedication

This APP would not be possible without Veronica Katz (MPP ’13, PhD ’16). Collaboration with Veronica has been both extremely productive and instructive, and I am so grateful for her partnership.

I also want to thank Jim Wyckoff for his mentorship in general, as well as his flexibility and guidance with respect to this work specifically.

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Executive Summary

Problem statement: Attracting and retaining high-quality teachers in low-income and low-performing schools is a policy imperative, as high-quality teachers play an outsized role in improving student outcomes. In light of this imperative, policymakers have conducted substantial revisions to the financial incentives in D.C. Public Schools (DCPS) with the express purpose of increasing the share of high-quality teachers in low-income, low-performing schools. This impact evaluation assesses the degree to which these policy goals were achieved.

Approach: Using a difference-in-differences strategy, I first assess whether policy changes increased the retention of Highly Effective teachers, compared to effective teachers, in low-income and low-performing schools. Then, I assess whether the policy changes induced Highly Effective teachers, compared to effective teachers, to move from high-income schools to one of the district's low-income or lowest-performing, low-income schools.

Results: After changes to the district's financial incentives, the likelihood of retaining a Highly Effective teacher in a low-income school increased, on average, by an additional 4.5 percentage points above the likelihood of retaining an Effective teacher who was unaffected by the new incentives. However, there was no significant difference in the likelihood of retaining a high-performing teacher in one of the lowest-performing, low-income schools. Additionally, there was no significant overall increase in the likelihood that a high-performing teacher transfers from a high-income school to any type of low-income school in the post-period.

Implications: In the DCPS context, financial incentives appear to be an effective policy lever for improving the retention of Highly Effective teachers in low-income schools. However, these effects did not redound to the lowest-performing, low-income schools, suggesting that financial incentives alone may not be sufficient to induce the retention of high-quality teachers in some of the hardest to staff schools. Similarly, financial incentives do not appear to have changed the mobility of Highly Effective teachers from high-income to any type of low-income school, suggesting that financial incentives may not be Effective in inducing teacher mobility in this context.

Recommendations: The financial incentives described in this report had an effect on retention in low-income schools such that I recommend they are retained as a policy. However, I urge policymakers in DCPS to continue probing the decision-making processes of teachers, with respect to retention and mobility. Descriptive evidence suggests a few potential areas in which future policy could aim to improve teacher retention at the district's low-income or lowest-performing, low-income schools. An intervention providing information to teachers about the probability of evaluation rating portability may be one avenue towards inducing future mobility to the hardest to staff schools.

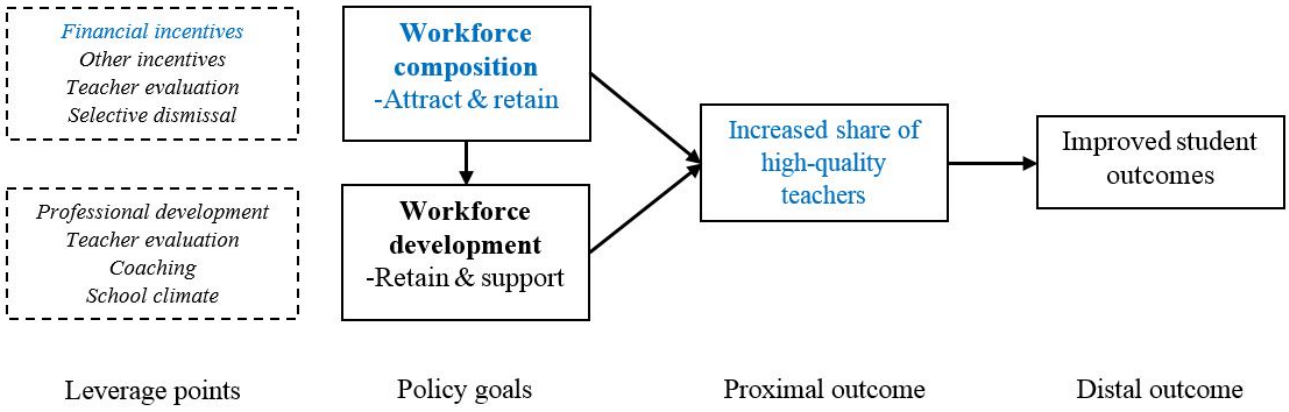
1.1. Motivation

Disparities in educational outcomes persist, despite decades of research and reform. Recent research has coalesced around the idea that teacher quality plays an outsized role in reducing these disparities in student outcomes (Aaronson, Barrow, & Sander, 2007; Chetty, Friedman, & Rockoff, 2014; Goldhaber & Hansen, 2012; Hanushek, 2011; Jackson, 2016; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). Unfortunately, there is substantial empirical evidence that teachers in low-income and low-performing schools are less qualified (Clotfelter, Ladd, Vidgor & Wheeler, 2006; Goldhaber, Lavery, & Theobald, 2015; Lankford, Loeb, & Wyckoff, 2002) and perform worse on evaluation metrics like value-added scores (Isenberg et al., 2013; Goldhaber, Lavery, & Theobald, 2015; Max & Glazerman, 2011; Steele, Pepper, Springer & Lockwood, 2015). There is some evidence to suggest that these differences are driven by teachers at the lower end of the distribution of teacher quality – there is a greater proportion of less-qualified, low-performing teachers in low-income schools. High-performing teachers are similar in qualifications and performance across income contexts (Sass, Hannaway, Xu, Figlio, & Feng, 2012). Therefore, increasing the share of high-performing teachers in low-income and low-performing schools is a promising pathway to making the distribution of teacher quality more equitable across contexts.

Improving teacher quality, particularly in low-income schools where low student achievement persists, is a research and policy imperative that many reforms currently target. There are two primary levers used to improve teacher performance and resulting student outcomes: changing the composition of the workforce or developing the existing

workforce. This review focuses on financial incentives as a policy lever used to advance the goal of changing the workforce composition in low-income schools. This pathway is highlighted in Figure 1 below as a piece of the broader theory of change regarding improved student outcomes. To illustrate this pathway, I present evidence surrounding common policy levers to improve teacher quality in low-income schools, focusing on financial incentives.

Figure 1: Theory of Change



1.2. Review of Extant Evidence

There is empirical evidence of the many reasons why teachers may not want to teach in low-income or low-performing schools: preferences for positive working conditions characterized by higher principal quality or more collegial environments (Boyd et al., 2011; Kraft, Marinell, & Yee, 2016; Ladd, 2011; Simon & Johnson, 2015), preferences for teaching positions in familiar geographic contexts (Boyd, Lankford, Loeb, & Wyckoff, 2005), and even preferences for white student populations, particularly for white teachers (Hanushek, Kain, & Rivkin, 2004; Scafidi, Sjoquist, & Stinebrickner, 2007). All of these

preferences contribute to inequitable sorting either through attrition of the existing workforce or difficulty attacting new talent.

We can also see differences in preferences by teacher qualifications. One study shows that more qualified teachers are less responsive than their less qualified peers to salary incentives (Clotfelter, Ladd, & Vigdor, 2011). Rather, these more qualified teachers were more sensitive to student demographics, contributing to the inequitable distribution of teacher quality (Clotfelter et al., 2011).

While preferences about job characteristics are important in teacher decision making, most economic theory supports the idea that financial compensation plays an important role as well. A survey conducted to better understand the relative importance of financial compensation compared to equally costly workplace improvements clearly shows teacher preference for direct financial compensation (Goldhaber, DeArmond, & DeBurgermaster, 2011). For example, 83% of teachers preferred a $5,000 salary increase over a two-student decrease in class size, suggesting that while workplace conditions are most proximal to teacher experiences, financial incentives potentially have a larger payoff in teacher decision-making (Goldhaber et al., 2011). While they did not have data on teacher performance, their results suggest that veteran teachers were less supportive of financial policy changes than their earlier-career peers, echoing the findings of Clotfelter and colleagues (2011).

There is also a substantial body of research to support the idea that salary schedules are relevant factors in teacher decision-making (Baugh & Stone, 1982; Borman & Dowling, 2008; Gritz & Theobald, 2006; Hendricks, 2014; Imazeki, 2005; Loeb & Reininger, 2004). In simulations, researchers found that the greater the segregation, the larger the

salary differential must be to overcome teacher resistance to mobility, and the salary differentials required to induce mobility of more qualified teachers are on the order of 40-50 percent of current salaries, an incredible amount given current policies (Clotfelter et al., 2011).

Recent research has pursued other types of financial incentives, like financial awards and performance pay to influence teacher behavior in recruitment and retention decisions. Experimental evidence from California found that a $20,000 award for teaching in low-performing schools increased the probability that high-performing teacher candidates accepted a position at a low-performing school by 28 percentage points (Steele, Murnane, & Willet, 2010). Similarly, experimental evidence from ten school districts in seven states found that offering a $20,000 award to high-performing teachers for transferring to a high-needs school with targeted vacancies improved student achievement in those schools (Glazerman, Protik, The, Bruch, & Max, 2013). However, this same experiment was only able to attract 5% of the eligible high-performing teachers, highlighting the difficulty in inducing teacher mobility to high-needs schools even with strong financial incentives (Glazerman et al., 2013). Even more worrisome is the fact that retention rates dropped for the high-performing teachers after the award period ended (Glazerman et al., 2013). Therefore, while it appears that these types of incentive programs hold promise for increasing the share of high-performing teachers at low-income and low-performing schools, they also present issues with scope (i.e. recruitment of a substantial portion of teachers) and persistence (i.e. effects disappear when the award period ends).

1.3. Direction of this Report

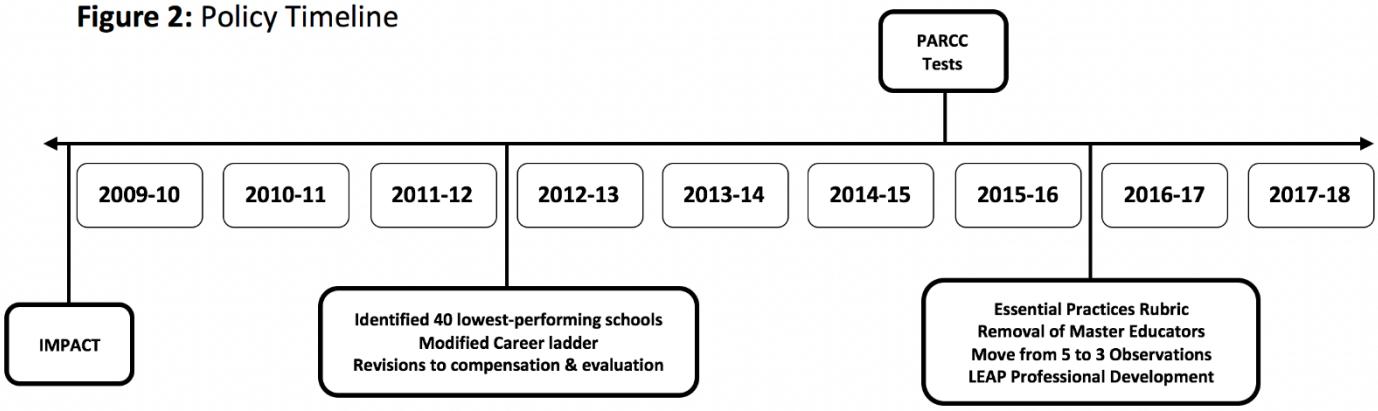
Our study assess the degree to which a similar incentive program increased the share of high-performing teachers at low-income and low-performing schools. We leverage revisions to IMPACT, the teacher evaluation system in Washington, D.C. Public Schools, that were intended to concentrate financial incentives in the highest-need schools. This study proceeds as follows: in section 2, I overview the context of the study and outline the scope of our analysis. In section 3, I describe the specifics of the financial revisions that were made to the initial IMPACT policy. In section 4, I describe the methods used and report descriptive statistics, and in section 5, I present results. In section 6, I unpack some of the potential mechanisms that drive teacher decision making about teacher retention and mobility. Finally, in section 7, I make recommendations to policymakers in DCPS.

2.1. Context

Washington, D.C. Public School District (DCPS) has been on the cutting edge of reform for almost a decade. In 2009, under the leadership of then-Chancellor Michelle Rhee, the district implemented a uniquely high-powered teacher evaluation system that included substantial financial incentives for high performance and selective dismissal for low performance. Called IMPACT, this system used multiple measures to evaluate teacher performance including both value-added for tested grades and subjects and classroom observations. Two annual observations were conducted by newly hired external evaluators called master educators. School administrative staff like principals or vice principals conducted three other observations, for a total of five annual classroom observations per teacher. The Teaching and Learning Framework (TLF), a Danielson-derived rubric, guided

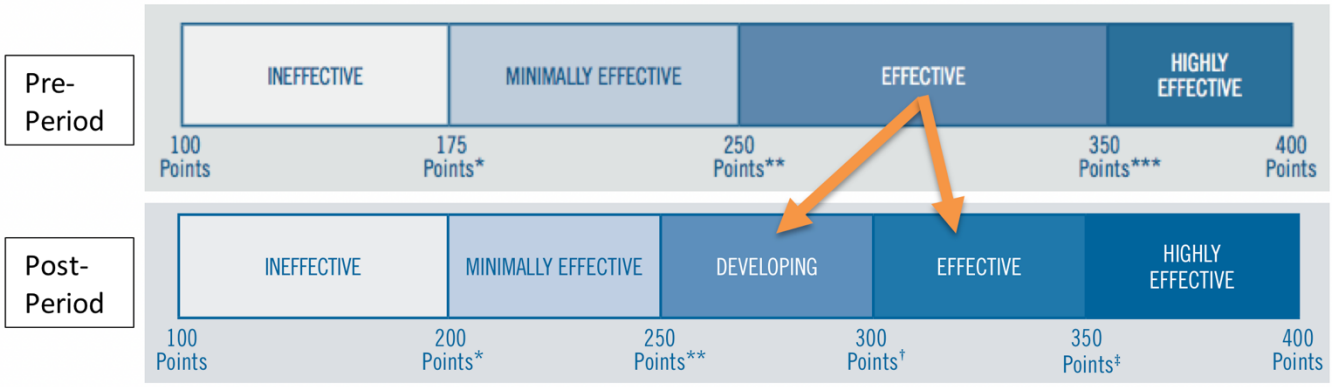
observations along content-generic instructional domains like leading well organized, objective driven lessons, or providing students with multiple ways to engage with content. To conceptualize the transitions in DCPS over the last nine years, Figure 2 below provides a timeline of important events related to this analysis.

Figure 2: Policy Timeline



In 2012, the district revised the financial incentives put forward by IMPACT to reallocate resources towards the low-income and the lowest-performing schools in the district, which I detail in section 3. These reforms included the modifications of the evaluation system to include five rather than four performance categories, which influenced our decision to use the "Effective" range dictated in the post-period as our comparison group. Figure 3 below highlights the changes to evaluation categories that are relevant to our analysis.

Figure 3: Modifications to Evaluation Performance Categories

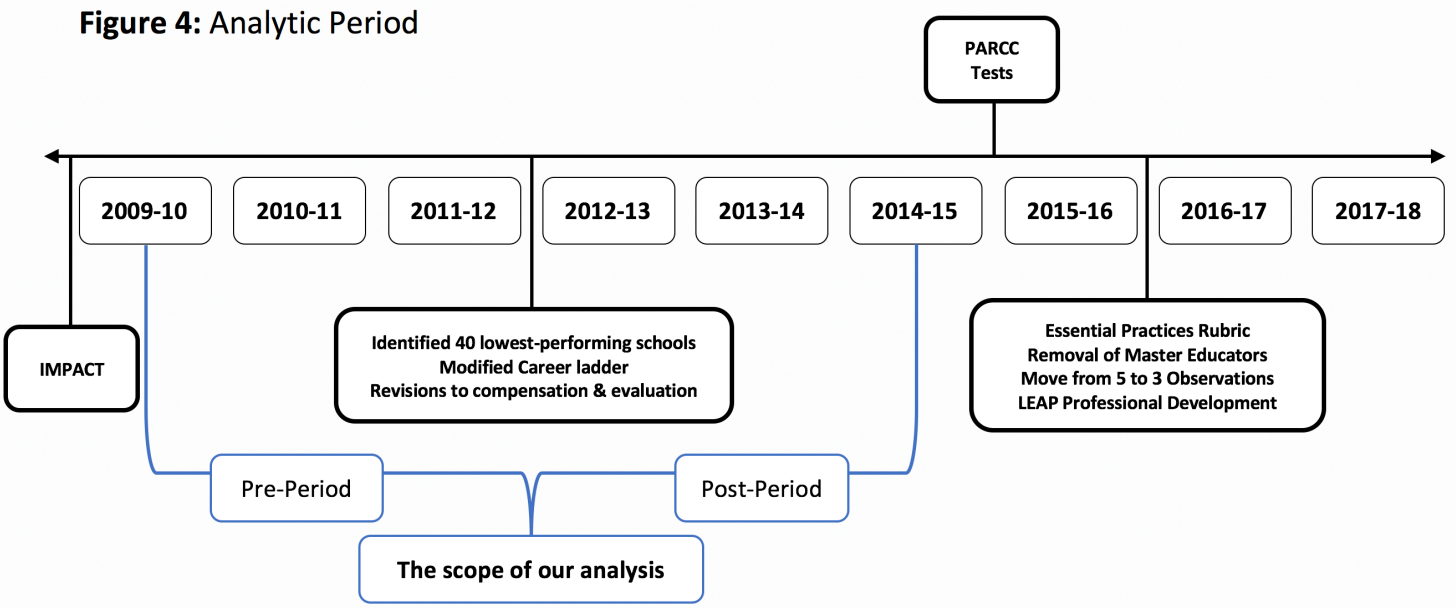


In 2014, DCPS piloted the PARCC student achievement tests, and so value-added measures were temporarily omitted from the IMPACT scores of teachers who taught tested grades and subjects. In 2015, these tests were officially incorporated into school-based accountability measures. Thus, our ability to detect differences in school-level student achievement in the pre- and post-periods are limited to the pre-PARCC years (2013-2014).

In 2016, DCPS rolled out a comprehensive professional development program called **LE**arning Together to **A**dvance our **P**ractice (LEAP). This multi-pronged intervention included weekly team-based learning seminars, with follow up observation and debrief. Every school in the district hired LEAP leaders to lead content-specific learning communities. This comprehensive initiative was implemented simultaneous to the removal of master educators and the decrease in the number of teacher observations conducted in the IMPACT evaluation system. For this reason, the number of years we include in the post-period is limited to the pre-LEAP reform period (2013-2015).

Figure 4 below superimposes the frame for this analysis on the broader timeline from Figure 2, highlighting the pre-period as the three years prior to the policy changes but after the initial implementation of IMPACT, and the post-period as the three years after the policy changes but before the change to student testing.

Figure 4: Analytic Period



3.1. Revision to Incentives

Our analysis focuses on the revisions to the financial incentives available to Highly Effective teachers put forward by the teacher evaluation policy, IMPACT, in the 2009-2010 school year. The revisions that were first implemented in the 2012-2013 school year differed for Highly Effective teachers by school poverty status. Table 1 depicts the changes implemented for Highly Effective teachers in high-income schools. These teachers were originally eligible for an annual bonus of up to $12,500, and a salary increase equivalent to that of a teacher with a master's degree and three additional years of experience. The policy revisions in the 2012-2013 school year decreased the bonus eligibility to just $3,000 per year and removed the potential for a salary increase entirely.

Table 1: Financial Revisions at High-Income Schools

School Type	Incentive Type	Before 2012-13	As of 2012-13
High-Income	Bonus	$12,500	$3,000
	Salary Increase	MA + 3 years	None

Table 2 depicts the changes implemented for Highly Effective teachers in low-income schools. These teachers were originally eligible for an annual bonus of up to $25,000, and a salary increase equivalent to that of a teacher with a master's degree and three additional years of experience. The policy revisions in the 2012-2013 school year decreased the bonus eligibility to $10,000 per year but offset this decrease in bonus eligibility with an increase in salary eligibility. As of the 2012-2013 school year, Highly Effective teachers at low-income schools were now eligible for a salary increase equivalent to that of a teacher with a PhD and five additional years of experience.

Table 2: Financial Revisions at Low-Income Schools			
School Type	**Incentive Type**	**Before 2012-13**	**As of 2012-13**
Low-Income	**Bonus**	**$25,000**	**$15,000**
	Salary Increase	**MA + 3 years**	**PhD + 5 years**

Additionally, district leaders defined a new type of school status, called a "Target 40" school. These schools were identified from the existing pool of low-income schools and were highlighted as the lowest-performing of the low-income schools. The largest financial incentives were reserved for Highly Effective teachers in these Target 40 schools. Table 3 depicts the changes that took place for Highly Effective teachers in Target 40 schools. These teachers were originally eligible for the same financial incentives delineated in Table 2, as they were originally classified as part of the broader pool of low-income schools when IMPACT was initially implemented in the 2009-2010 school year. The policy revisions that took place in the 2012-2013 school year allowed for the retention of these teachers' annual bonus eligibility and increased their salary eligibility. As of the 2012-2013 school year, Highly Effective teachers at Target 40 schools were now eligible for a salary increase equivalent to that of a teacher with a PhD and five additional years of experience.

Table 3: Financial Revisions at Target 40 Schools			
School Type	**Incentive Type**	**Before 2012-13**	**As of 2012-13**
Low-Income, Target 40	**Bonus**	**$25,000**	**$25,000**
	Salary Increase	**MA + 3 years**	**PhD + 5 years**

4.1. Analytic Strategy

We use a difference-in-differences design to assess whether the revised financial incentives were effective in improving Highly Effective teacher retention in low-income and Target 40 schools as well as mobility to low-income and Target 40 schools. Equation 1 below models a typical difference-in-differences framework, where Y_{ijt} represents teacher-level retention and mobility for a Highly Effective teacher *i* in school *j* at time period *t*. P represents the post period, and δ represents the outcome of interest for the change in Y_i for Highly Effective teachers above and beyond those of teachers rated Effective. X_{ijt} represents a rich set of teacher-level covariates, and Z_{jt} represents a rich set of school-level covariates.[i] When assessing teacher mobility in this framework, we condition on the sample of teachers who were Highly Effective at a high-income school.

$$Y_{ijt} = \alpha + \beta_1(HE_{ijt}) + \beta_2(P_t) + \delta(HE_{ijt} * P_t) + \beta_3(X_{ijt}) + \beta_4(Z_{jt}) + \varepsilon_i \qquad (1)$$

4.2. Treatment

The treated teachers in our analysis are those teachers who are rated Highly Effective in school *j* in time *t,* as these are the teachers eligible for the financial incentives associated with IMPACT. We use two comparison groups to mitigate a potential complication with the control group. Our preferred specification is the full sample of Effective teachers who were rated Effective according to the revised evaluation categories.

Figure 5: Teacher LIFT Stages

That is, any teacher *i* in school *j* at time *t* who scored between 300-349 points on the IMPACT rubric serves as our comparison group. However, as shown in Figure 5, one aspect of the policy revision entailed the creation of teacher "LIFT" stages, wherein teachers who were repeatedly Effective or Highly Effective were eligible for additional compensation. Therefore, we create a second comparison group to exclude teachers eligible for the compensation associated with the "advanced" stage. In the classic tradeoff between bias and precision, this represents a sacrifice in precision in exchange for less bias. However, we prefer the first specification as the sample is more stable, not sensitive to the inclusion of covariates, and conceptually would introduce only attenuation bias, as a small portion of our comparison group was exposed to a small portion of treatment. However, we present results from both comparison groups throughout as a robustness check.

4.3. Descriptive Statistics

Table 4 presents descriptive statistics comparing school-level characteristics across school poverty type. It is first worth noting that the majority of schools in DCPS are classified as low-income or Target 40. The school-level demographics at each of these school types is also substantially different across multiple domains. First, the racial composition at each school type is very different, with high-income schools constituting the largest share of white students and the smallest share of black students. Low-income schools that are not Target 40 have the largest share of Hispanic students, while Target 40 schools have the largest share of black students. While only a quarter of students at high-income schools qualify for free and reduced-price lunch, more than 80% of students at low-income and Target 40 schools do. The suspension rate at Target 40 schools towers over the

rates of low-income and high-income schools, at almost 50%.[1] The proficiency rates in reading and math are 75% at high-income schools, while closer to 44% at low-income schools. At Target 40 schools, just a quarter of the student population is proficient in reading or math. Finally, student enrollment across school types differs dramatically, with the average high-income school enrolling more than 700 students, while the average low-income or Target 40 school enrolls just about 450 students annually.

Table 4: Average School-Level Demographics, by School Poverty Status

	High Income	Low Income	Target 40
White	0.37	0.02	0.01
	(0.18)	[0.00]	[0.00]
Black	0.36	0.57	0.90
	(0.18)	[0.07]	[0.03]
Hispanic	0.17	0.38	0.08
	(0.13)	[0.07]	[0.03]
Other Race	0.10	0.03	0.01
	(0.03)	[0.01]	[0.00]
Free and Reduced-Price Lunch	0.25	0.82	0.83
	(0.11)	[0.01]	[0.01]
Suspension Rate	0.11	0.18	0.54
	(0.10)	[0.04]	[0.09]
Percent Proficient in Reading	0.76	0.42	0.25
	(0.12)	[0.01]	[0.01]
Percent Proficient in Math	0.75	0.46	0.25
	(0.14)	[0.02]	[0.01]
Enrollment	722	442	451
	(476)	[281]	[201]
School-Year Observations	120	247	254

Note: Descriptives are averaged across five years (2010-2015) and are weighted by student enrollment. Standard deviations in parentheses in column one; standard errors in brackets in columns two and three, clustered at the school level. Proficiency rates are from the DC CAS test and are only available until 2013, when the district moved to PARCC tests.

Table 5 presents descriptive statistics about teacher-level characteristics at each school type. The crucial differences here are the disparities in the share of Effective and Highly

[1] It is worth noting that these suspensions may represent the repeated suspension of the same student; our data does not allow us to disentangle incidents of suspension from the number of students suspended.

Effective teachers. About 40% of teachers at high-income schools are Highly Effective, but that number drops to about 20% and then 13% at low-income and Target 40 schools, respectively. The discrepancy in teacher experience between high-income, low-income, and Target 40 schools is statistically significant but substantively small (about half a year), and the share of white teachers is much higher in high-income schools compared to low-income and Target 40 schools. Inversely, the share of black teachers is much higher at low-income and Target 40 schools, compared to high-income schools. The share of Hispanic teachers is less than 10% at each school type.

Table 5: Average Teacher Characteristics, by School Poverty Status

	High Income	Low Income	Target 40
Female	0.72	0.73	0.70
	(0.45)	[0.04]	[0.02]
IMPACT Score	335	307	299
	(39.3)	[5.04]	[2.03]
Highly Effective	0.41	0.20	0.13
	(0.49)	[0.02]	[0.02]
Effective* & Highly Effective	0.84	0.62	0.55
	[0.37)	[0.04]	[0.02]
Experience	6.45	6.09	6.00
	[2.76)	[0.31]	[0.20]
White	0.57	0.32	0.29
	[0.49)	[0.04]	[0.02]
Black	0.32	0.56	0.63
	[0.47)	[0.05]	[0.03]
Hispanic	0.06	0.08	0.03
	[0.24)	[0.02]	[0.00]
Other	0.04	0.04	0.04
	[0.20)	[0.00]	[0.01]
Missing Gender	0.01	0.03	0.02
	[0.10)	[0.01]	[0.00]
Missing Race	0.15	0.20	0.21
	[0.36)	[0.02]	[0.01]
Missing Experience	0.01	0.01	0.01
	[0.09)	[0.01]	[0.00]
Teacher-Year Observations	3,873	6,961	7,154

Note: Descriptives are averaged across five years [2010-2015) and are weighted by student enrollment. Standard deviations in parentheses in column one; standard errors in brackets in columns two and three, clustered at the school level. *Effective captures just the top half of the Effective category, the primary counterfactual in the retention and mobility analysis.

5.1. Results

I first present descriptive, graphical evidence of the trends in teacher retention and mobility in the pre- and post-periods. Then, I present empirical, causal evidence from the difference-in-differences analytic model.

5.2. Descriptive Results

Figure 6 below presents descriptive evidence of the increase in the share of retained Highly Effective compared to retained Effective teachers in low-income schools after the financial incentives were revised prior to the 2012-2013 school year. While we see the share of retained Effective teachers remains relatively stable in the post period, the share of retained Highly Effective teachers increases above 90% in the post period before dipping back to original levels by the third post-year.

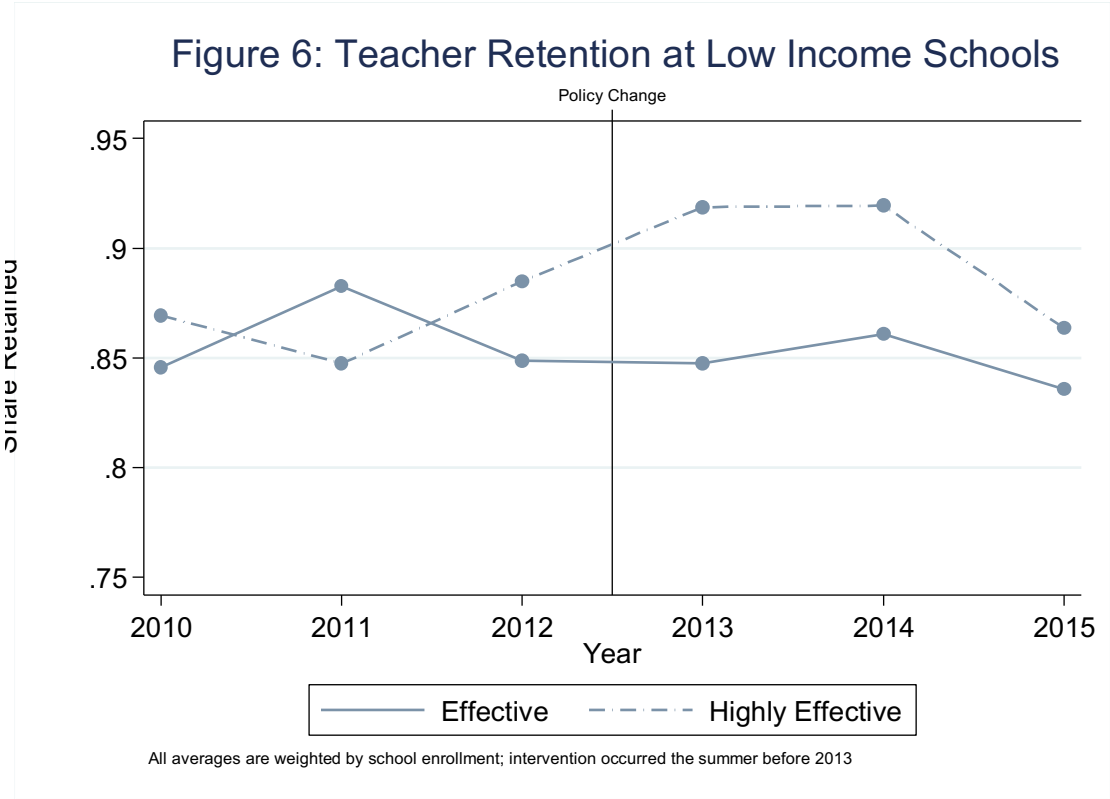


Figure 7 below presents descriptive evidence of the retention rates of Highly Effective compared to Effective teachers at Target 40 schools. While we see an uptick to original retention levels by the final post-period year, there does not seem to be a discernable trend at these lowest-performing, low-income schools.

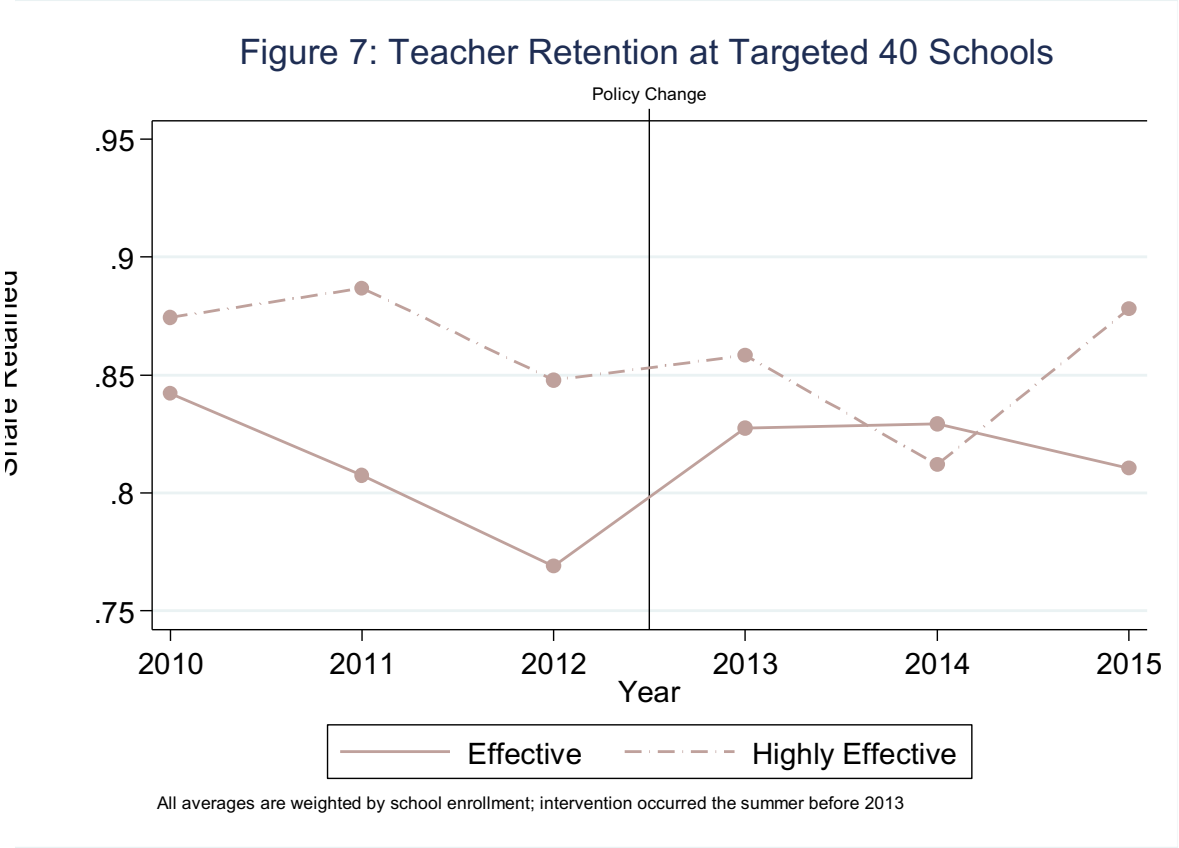


Figure 8 below presents descriptive evidence of retention rates of Highly Effective compared to Effective teachers at high-income schools. What we see in the post-period at these schools is a decrease in both the share of retained Highly Effective and Effective teachers. This provides the first evidence that these policies may have induced high-

performing teachers to move to low-income or Target 40 schools, or to leave the district entirely.

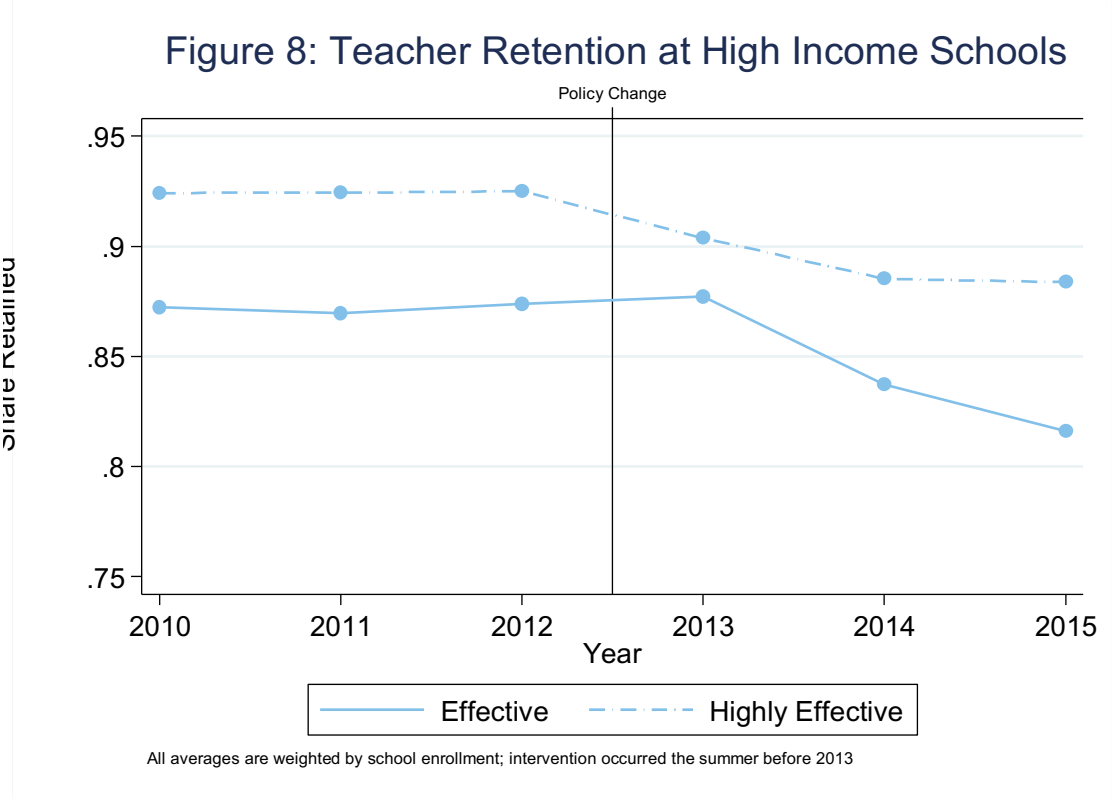
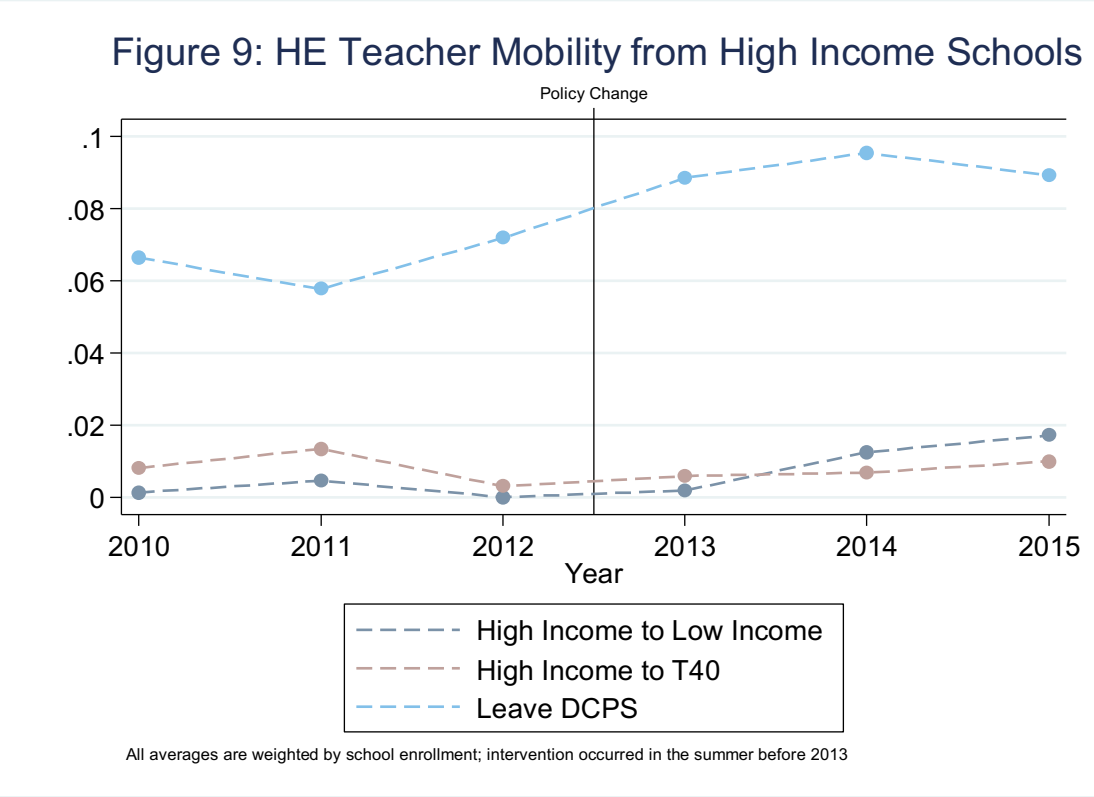


Figure 9 below shows Highly Effective teacher mobility from high-income to low-income and Target 40 schools as well as to positions outside of the district. In the post period, the biggest difference in teacher mobility is the increase in Highly Effective teachers leaving the district altogether. However, there is a small, descriptive increase in the share of Highly Effective teachers moving from high-income to low-income schools, from a pre-period average of just 0.3% to a post-period average of 1.3%. In contrast, the share of Highly Effective teachers moving from high-income to Target 40 schools in the pre-period averaged just 0.8% and fell slightly to 0.7% in the post-period.



5.3. Main Results

The main retention results from the overall difference-in-differences estimation are reported in Table 6 below. The overall effect of the revision to the IMPACT financial incentives in the 2012-2013 school year is positive in low-income schools but there is no discernable effect in Target 40 schools. On average, the likelihood of retaining a Highly Effective compared to an Effective teacher in low-income schools increased by an additional 4.5 percentage points in the post period, which is statistically significant at the 0.05 level. However, the overall results are not significant in Target 40 schools and the point estimates do not reveal a suggestive pattern.

Table 6: Difference-in-Differences Estimates Comparing Retention of Effective versus Highly Effective Teachers, by School Poverty Status

	(1)	(2)	(3)	(4)
	Low-income Schools		Target 40 Schools	
Difference-in-Differences Estimates				
	Treatment A	Treatment B	Treatment A	Treatment B
Highly Effective (HE)	0.009	0.007	0.048*	0.045*
	(0.017)	(0.017)	(0.022)	(0.022)
Post Period	-0.029~	-0.006	-0.007	-0.035
	(0.016)	(0.028)	(0.019)	(0.034)
HE x Post Period	**0.045***	0.019	-0.013	0.016
	(0.022)	(0.032)	(0.028)	(0.040)
Constant	0.634***	0.694***	0.893***	0.942***
	(0.167)	(0.191)	(0.247)	(0.278)
Observations	3,857	2,901	3,273	2,267

Note: All models include school and teacher covariates. Standard errors, clustered at the teacher level, are reported in parentheses (***p<0.001, **p<0.01, *p<0.05, ~p<0.10). Treatment a compares Highly Effective teachers with Effective teachers, while treatment b compares Highly Effective teachers with Effective teachers who were not eligible for financial incentives through another policy mechanism.

As a specification check to ensure that the effects we see in the post-period were not driven by changes already occurring in the pre-period, we interact each of the pre-period years in our model and assess the statistical significance. None of the coefficients on these terms is significant, suggesting that the effects are driven by changes occurring in the post period. We also interact each of the post-period years in our model to assess if there is a particular time point that is driving our effects. What we find from this specification is that the increase in the share of retained Highly Effective teachers compared to Effective teachers in the post-period at low-income schools is driven primarily by the statistically significant positive increase of about 6.5 percentage points in the second year of the post-period, but all three years reflect a positive effect. Both of these results are depicted in Table 7, with the coefficient of interest from the second year of the policy change highlighted in blue.

Table 7: Difference-in-Differences Estimates Comparing Retention of Effective versus Highly Effective Teachers, by School Poverty Status

	(1)	(2)	(3)	(4)
	Low-income Schools		Target 40 Schools	
Difference-in-Differences Estimates				
	Treatment A	Treatment B	Treatment A	Treatment B
Highly Effective (HE)	0.009	0.007	0.049*	0.045*
	(0.017)	(0.017)	(0.022)	(0.022)
Post Year 1	-0.027	0.020	-0.012	-0.075
	(0.021)	(0.042)	(0.022)	(0.048)
HE x Post Year 1	0.046	-0.003	0.010	0.075
	(0.030)	(0.048)	(0.038)	(0.057)
Post Year 2	-0.014	-0.013	0.010	-0.045
	(0.023)	(0.046)	(0.028)	(0.058)
HE x Post Year 2	**0.065***	0.058	-0.048	0.011
	(0.030)	(0.049)	(0.039)	(0.064)
Post Year 3	-0.050*	-0.040	-0.020	0.032
	(0.024)	(0.045)	(0.028)	(0.048)
HE x Post Year 3	0.031	0.017	-0.003	-0.052
	(0.030)	(0.049)	(0.036)	(0.054)
Constant	0.677***	0.737***	0.874***	0.940***
	(0.167)	(0.189)	(0.247)	(0.279)
Observations	3,857	2,901	3,273	2,267
Comparison of Pre-Reform Changes				
Pre-Year 2	0.001	0.001	0.023	0.007
	(0.022)	(0.022)	(0.032)	(0.033)
HE x Pre-Year 2	-0.041	-0.041	0.034	0.031
	(0.043)	(0.043)	(0.060)	(0.060)
Pre-Year 3	0.003	0.010	-0.025	-0.012
	(0.022)	(0.022)	(0.026)	(0.028)
HE x Pre-Year 3	0.003	0.005	0.042	0.040
	(0.039)	(0.039)	(0.053)	(0.052)

Note: All models include school and teacher covariates. Standard errors, clustered at the teacher level, are reported in parentheses (***p<0.001, **p<0.01, *p<0.05, ~p<0.10). Treatment a compares Highly Effective teachers with Effective teachers, while treatment b compares Highly Effective teachers with Effective teachers who were not eligible for financial incentives through another policy mechanism.

The within district mobility results from the overall difference-in-differences estimation are reported in Table 8 below. There is no statistically significant overall effect of the revision to the IMPACT financial incentives in the 2012-2013 school year on the mobility of Highly Effective teachers from high-income schools. However, the point

estimates at low-income schools are positive, and the point estimates at Target 40 schools are negative, suggesting no meaningful effect. As there are no overall detectable effects for mobility, we do not decompose this analysis to see the effects for each year of the pre- and post-period.

Table 8: Difference-in-Differences Estimates Comparing Mobility of Effective versus Highly Effective Teachers, by School Poverty Status

	(1)	(2)	(3)	(4)
	Movement from High to Low		Movement from High to T40	
Difference-in-Differences Estimates				
	Treatment A	Treatment B	Treatment A	Treatment B
Highly Effective (HE)	-0.008	-0.007	0.000	-0.001
	(0.005)	(0.005)	(0.006)	(0.006)
Post Period	0.004	0.002	0.012∼	0.009
	(0.007)	(0.012)	(0.007)	(0.012)
HE x Post Period	0.005	0.006	-0.010	-0.007
	(0.008)	(0.013)	(0.008)	(0.013)
Constant	-0.097	-0.169*	0.046	0.015
	(0.076)	(0.082)	(0.040)	(0.036)
Observations	2,963	2,438	2,963	2,438

Note: All models include school and teacher covariates. Standard errors, clustered at the teacher level, are reported in parentheses (***p<0.001, **p<0.01, *p<0.05, ∼p<0.10). Treatment a compares Highly Effective teachers with Effective teachers, while treatment b compares Highly Effective teachers with Effective teachers who were not eligible for financial incentives through another policy mechanism.

5.4. Summary of Causal Findings

The theory of change initially presented suggested that by attracting and retaining high-quality teachers, student outcomes may improve. The scope of this analysis pertained to the influence of financial incentives in achieving those policy goals on the proximal outcome of interest. Our results suggest that financial incentives had a modest effect on high-quality teacher retention in low-income schools. However, there were no detectable effects of even larger incentives on the retention of high-quality teachers in the lowest-performing schools. Similarly, there was no statistically significant evidence that the financial incentives induced high-quality teacher mobility to low-income or the lowest-performing, low-income schools, although there was descriptive evidence of a small increase (about 1 percentage point) in the post-period. To better understand why these financial incentives may not have hard a large effect in DCPS, I look at some of the workforce conditions that may influence teacher retention in our treatment schools, and then I assess the degree to which concerns about the portability of IMPACT ratings may prevent barriers for teacher mobility in DCPS.

6.1. Potential Mechanisms

When teachers leave a district position, they are incentivized to complete a Declaration of Intent Not to Return (DINR) survey detailing their reasons for leaving. I use both the quantitative counts of teacher reasons for leaving DCPS as well as the qualitative, open-ended responses to better understand why the district's Highly Effective teachers may leave their positions, despite financial incentives. I then use administrative data to examine the portability of IMPACT ratings as a potential reason for the lack of teacher mobility

observed in this period, again despite large financial incentives to do so. These data sources surface some potential mechanisms that policymakers may be more attentive to when thinking about increasing high-quality teacher retention and mobility in some of the hardest to staff schools.

6.2. *Workforce Conditions*

If financial incentives are an insufficient policy lever, we should consider other factors impacting retention decisions. One unanswered question in the literature is the relative importance of financial incentives compared to characteristics of workplace quality. I am able to probe this question using survey data from Highly Effective teachers who left low-income and the lowest-performing schools in this period. I find that there are no noticeable differences in teacher's stated reasons for leaving in the post period by school poverty status for Highly Effective teacher departures.[2] Figure 10 shows relocation outside of Washington, D.C. as the primary reason cited for leaving a position within DCPS in the post period for Highly Effective (treated) teachers across all school types. Table 9 below disaggregates these overall trends by school poverty status.

There are a few trends that deserve qualitative exploration. First, almost 17% of Highly Effective teachers who left high-income schools cited workload as the primary factor, while only about 10% and 5% of similarly Highly Effective teachers at low-income and Target 40 schools, respectively, cited the same reason. Second, about 16% of Highly Effective teachers who left Target 40 schools cited school leadership as the primary reason,

[2] It is not clear what percentage of exiting teachers complete the survey, so our ability to generalize from these descriptive statistics is limited by potential non-response bias.

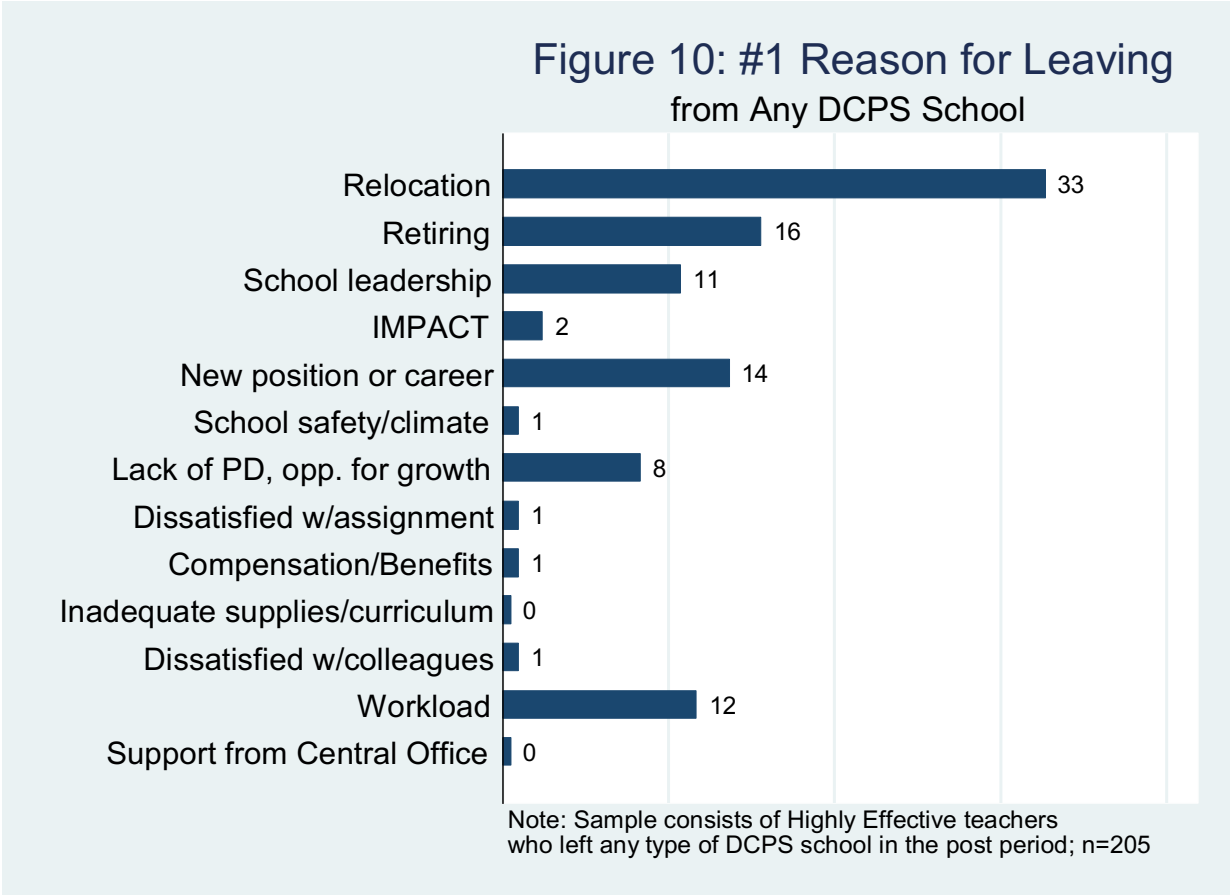


Table 9: Primary Reason for Highly Effective Teacher Departure, by School Poverty Status

	High-income	Low-income	Target 40	Total
Relocation	29	24	14	67
Retiring	14	7	11	32
School leadership	10	3	9	22
IMPACT	1	3	1	5
New position or career	10	9	9	28
School safety or climate	-	1	1	2
Lack of PD, opp. for growth	7	3	7	17
Dissatisfied with assignment	1	1	-	2
Compensation or benefits	1	1	-	2
Supplies or curriculum	-	1	-	1
Dissatisfied with colleagues	-	2	-	2
Workload	15	6	3	24
Support from Central Office	1	-	-	1
Total	89	61	55	205

Note: Table represents raw counts of Highly Effective teachers who left the district in the post-period.

while about 5% and 11% of similarly Highly Effective teachers at low-income and high-income school, respectively, cited the same reason. Finally, less than 5% of teachers at any school type cited IMPACT, school safety and climate, dissatisfaction with teaching assignment, compensation and/or benefits, inadequate supplies or curriculum, dissatisfaction with colleagues, and support from central office as the primary reason for their departure. A small sample of teachers chose to respond to open-ended survey questions probing their decision-making processes.[3] I analyze these responses to surface some potential next steps for research. In particular, I highlight teacher reasons for departure when financial incentives were most appealing (at low-income and Target 40 schools).

Open-ended responses indicate that relocation typically included moving out of state for family reasons. Many teachers cited a spouse's employment out of state or moving to support aging or sick family members. Similarly, teachers described reasons for retirement that are not outside the range of normal retirement considerations, such as age, lifestyle, and health. These responses highlight that the majority of Highly Effective teachers leaving DCPS schools in the post period were doing so for reasons largely unaffiliated with either financial incentives or workplace conditions.

Teachers who leave high-income schools tended to do so for reasons that are outside of the control of school leadership and policy makers. Open-ended responses from teachers who selected workload as the primary reason for their departure frequently mentioned motherhood, childcare, and family responsibilities. In this sense, workload as a

[3] Of the 205 Highly Effective teachers who left their school in the post-period, 69 of them (34%) responded to an open-ended question asking them to explain their reasons for leaving.

category seems to reflect more about work-life balance and family structures than it does about burnout. Teachers who leave the high-needs schools, however, seem to do so because of working conditions.

Open-ended responses from individuals who selected leadership as the primary reason for their departure, however, did surface insights into the kinds of working conditions that push out teachers despite financial incentives. One Highly Effective teacher leaving a low-income school wrote:

I grieve to see Highly Effective-ranked teachers, such as myself, leave each year due to abusive workloads that perpetually push beyond the contract without compensation or adequate recognition in the CSC or personal exchanges. We recruit outstanding young teachers and experienced teachers at ____ and then burn through them… the excellent No-Nonsense Nurturing discipline program is not supported by the administration… I worked tirelessly for 25 years to help make it what it is and am saddened that we are losing the student discipline and teacher pride that was grown under [previous leadership] and the work of outstanding parental involvement.

This teacher highlights issues of burnout, lack of appreciation, and school-wide cohesion around discipline policies, which she largely attributes to the school leadership as her primary motivating factor for departure. These sentiments were echoed by other responses from Highly Effective teachers who similarly selected leadership as the primary reason for departure. One teacher at a Target 40 school wrote:

I was not planning on leaving this year, however school leadership has made it impossible for me to stay. Hiring decisions… directly impacted my class sizes--I have rosters of 47 and 43 students. Three times in the past 2 months teachers have been reprimanded in front of students… and school culture has regressed after making significant strides in my first 3 years at ____. The catalyst for my decision to leave was the following quote from my principal, sent in an all-staff email upon the DINR form becoming available. It was the last blow to my already low morale.

Large class sizes and negative school culture, again largely attributed to school leadership, motivated the departure of this Highly Effective teacher from a school where the financial

incentives were the largest. Another teacher at a Target 40 school, who finished her two-year TFA commitment, said she just didn't feel appreciated by her school administration:

I did not feel valued or appreciated for my work. I did not receive encouragement to stay from leadership until very recently when I brought up the idea of possibly leaving. I now fear retaliation now that I have communicated that I will no longer be returning and the reasons why.

Finally, one teacher expressed concerns with the school leadership use of the IMPACT evaluation system:

Lastly, your IMPACT evaluation system is punitive. I am a group one teacher, I have agreed with the IVA scores I have received, with my observations from master educators, but every year my TAS is not a reflection of what I do as a teacher, but rather a reflection of what my principal needs in order for her to achieve a good IMPACT score.

These qualitative findings suggest a few potential reasons why financial incentives may not be alone enough to retain Highly Effective teachers, particularly in low-income or target 40 schools.

Individuals who cited having other job opportunities echoed some of the same concerns, although one in particular raised the issue of risk aversion in financial decision making. A teacher departing a Target 40 school to teach at a KIPP charter school in the D.C. area summarized his decision-making as follows:

I will be taking a job teaching at KIPP _____, which is offering me a better salary for the 2013-2014 year assuming I earn an "Effective" rating, the most likely rating I'll fall into (potentially could earn Highly Effective or Developing based on student test scores). Over the last three years I have grown impatient with the lack of cultural progress at _____. Although this is the responsibility of the entire staff, it falls on the leadership to put overall systems into place, communicate, and build a working team. In my opinion, the administration at _____ "went through the motions" when attempting to fulfill these responsibilities, which will never be enough, given the challenges facing _____. I didn't feel like I could grow professionally at the rate I wanted to while teaching at _____. Overall unprofessionalism from certain staff members grew wearying to work around.

Despite previous attainment of Highly Effective status, this teacher was clearly uncertain about his future IMPACT rating and made financial decisions based on risk aversion. This uncertainty raises a question about the portability of quality, not just within a school from year-to-year, but across schools when policy induces mobility.

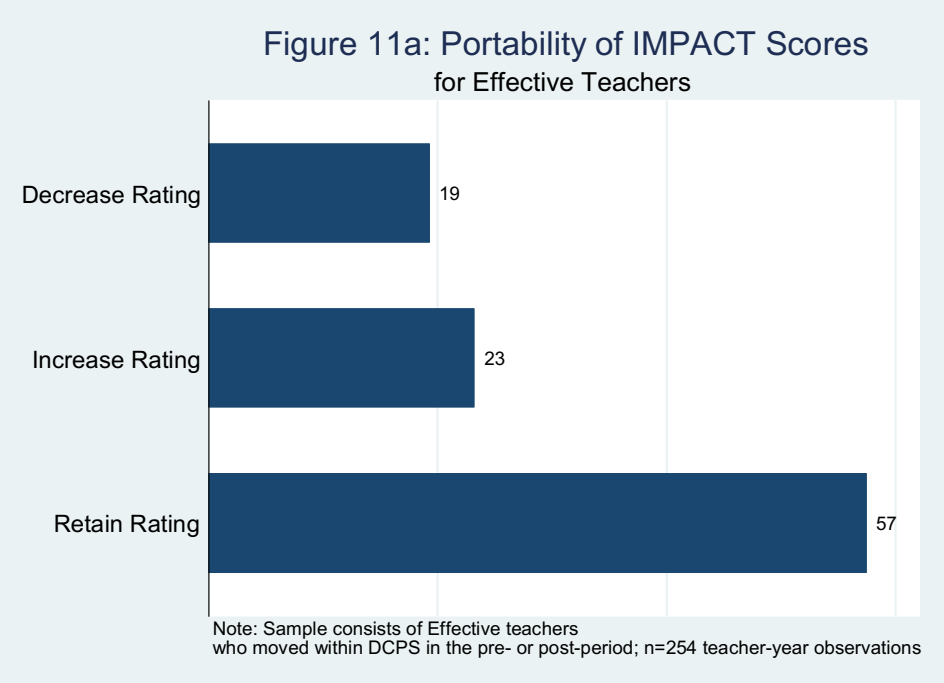
Highly Effective teachers who have personally experienced the benefits of the financial incentives raised in this analysis still cite a multitude of reasons that feed into their retention and mobility decision-making. While the turnover of these teachers is substantively small, policymakers who recognize the value of a Highly Effective teacher should consider possible barriers to retention and mobility, like school culture, leadership, class size, professionalism, and uncertainty.

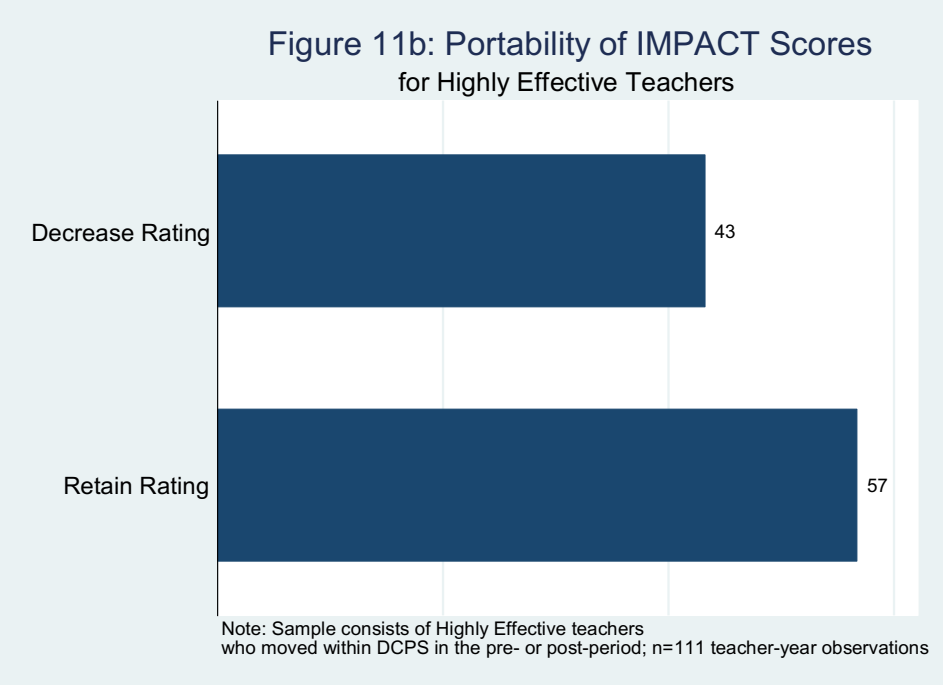
In the next section, I unpack the limited teacher mobility we do observe in DCPS to understand whether risk aversion may play into teacher decision making in this domain as well.

6.3. *Portability of Quality*

While the literature treats teacher quality as largely fixed, it is not empirically clear that moving a high-performing teacher to a low-performing school would result in an increased share of "high-performing" teachers. In other words, is teacher quality related to match between teachers and schools or is it portable, at the highest levels, from one school context to another? Using administrative data from the teacher evaluation system in Washington, D.C., I find that a majority of teachers who move to schools within the district retain their prior year IMPACT rating category. However, a non-trivial portion of teachers

(19% of Effective and 43% of Highly Effective teachers) actually find their IMPACT rating decrease after their move, suggesting that teacher uncertainty with respect to IMPACT may be one barrier to mobility. That is, a high-performing teacher may be wary of risking their IMPACT rating through moving to a more challenging context, despite the financial incentives to do so. Figure 11a below illustrates the variability in the portability of IMPACT scores for Effective teachers who move within the district, while Figure 11b demonstrates the same portability for Highly Effective teachers. Taken together, these figures show that



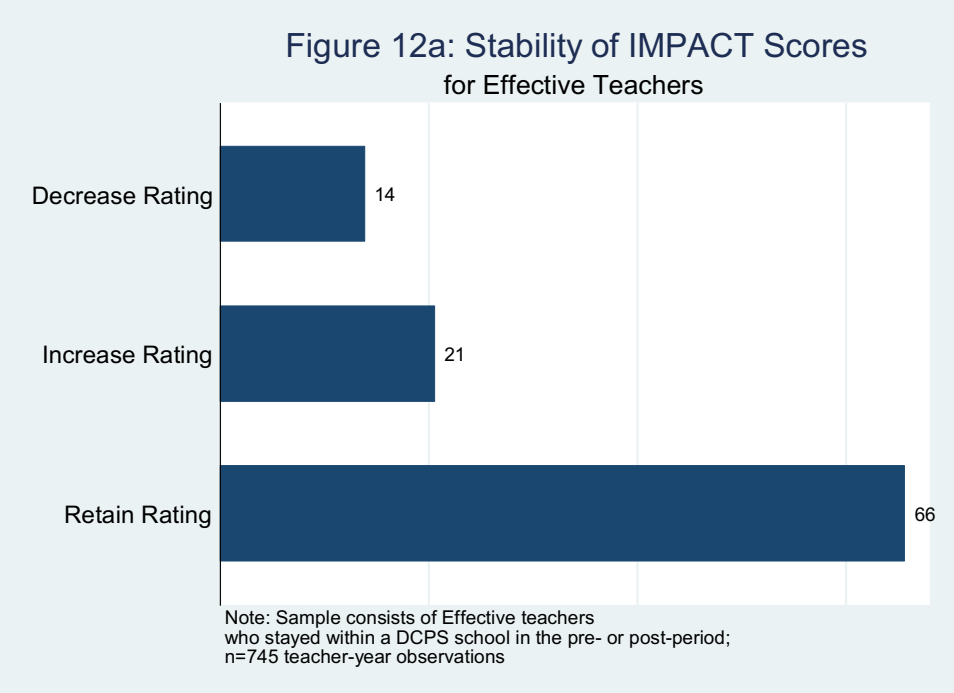


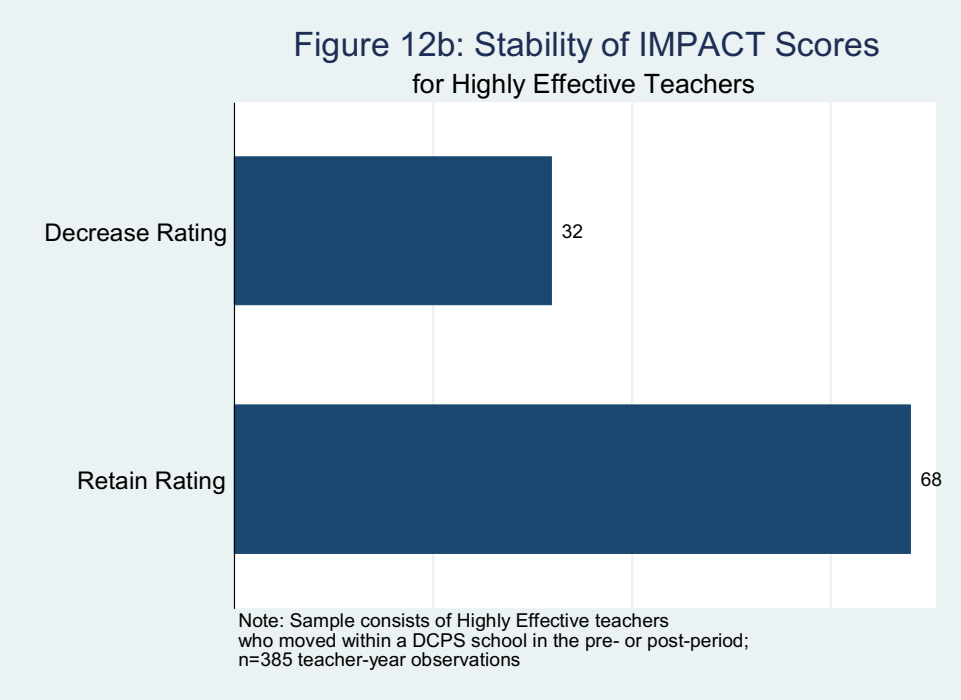
the majority of high-performing teachers (either Effective or Highly Effective) retain their rating after switching schools. However, about 43% of Highly Effective teachers experience a decrease in their IMPACT rating, which may be substantively large enough to discourage some teachers from moving to a more challenging school and risking the loss of financial rewards associated with the highest performance category.

It is important to consider, however, the stability of the rating system even in the absence of a school-based move. There are a number of reasons why a teacher's score may change year-to-year, even within the same school. For example, the yearly shift in classroom composition may reveal particular teacher strengths, the leadership within the building may influence teacher actions, or a teacher's peers may improve or constrain their practice. Figures 12a and 12b below show the stability of Effective and Highly Effective teacher ratings, respectively, for teachers in our sample that stay in the same school. This sample is limited to teachers who, at one point in their career, move to another school in

the district (of any type). Effectively, these graphs compare the stability of the IMPACT ratings for the same teachers presented in Figures 11a and 11b, but for the years in which they stay in the same school. The comparison, then, is not biased by differential selection into the sample by the type of teacher who may choose to move to another school at one point in their career.

While there is some instability in ratings from year-to-year for these high-performing teachers during the years in which they stay at a particular school, Figures 12a and 12b show that for the most part, teachers on the upper end of the quality distribution tend to retain their IMPACT rating. About 68% of the time, a once-Highly Effective teacher within the same school will score Highly Effective again. The same is true about 66% of the time for Effective teachers. About 20% of the time, a once-Effective teacher will move up to the highest rating of Highly Effective.





These descriptive results stand only in slight contrast to the stability of teacher ratings in the same sample of teachers after a school-based moved. After moving schools, these high-performing teachers tend to retain their ratings about 57% of the time, which is only about 10 percentage points lower than the typical ratings retention for teachers who stay in the same school. In general, while teachers may perceive uncertainty with IMPACT ratings as a barrier to mobility, it is not clear that there is a much larger risk than is typical for year-to-year stability of ratings for teachers considering a within-district move.

7.1. Policy Recommendations

Financial incentives in DCPS improved the retention of Highly Effective teachers in low-income schools. However, we found that they did not have a detectable effect in the lowest-performing, low-income schools. Descriptive findings suggest a number of barriers to teacher retention and mobility in DCPS that may not be improved by financial incentives.

Many teachers cited workplace conditions that dissuaded their retention, like negative school culture, poor administrative leadership, and class size. Additionally, teachers may be concerned about the portability of their IMPACT ratings and the financial incentives associated with those ratings. I highlighted that in this particular time period, there is actually little empirical evidence to support this cause for concern.

School systems looking to implement financial incentive policies like the ones described in this analysis should be cautiously optimistic; it seems like teachers may respond to these types of incentives. However, they should also be attentive to the conditions in which teachers work, as financial incentives may only go so far in retaining teachers in the absence of other supportive policies. Similarly, providing information to teachers about the potential benefits and risks of moving to a higher-needs school may ameliorate some of the risk aversion associated with such a large decision. The work of a teacher is fundamentally embedded in the processes and norms of the school unit, and district-wide policymakers must stay attuned to the ways in which high leverage incentives may be experienced by teachers at the school level.

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[i] School covariates included school type, enrollment, racial demographic information, and suspension rate. Teacher covariates included gender, race, IMPACT group, graduate school, years of experience, as well as a full panel of missing variables that ensured the inclusion of the widest sample.