Inter-American Development Bank

IDB WORKING PAPER SERIES Nº IDB-WP-1080

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Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Can financial incentives help disadvantaged schools to attract and retain high-performing teachers?: evidence from Chile / Gregory Elacqua, Diana Hincapié, Isabel Hincapié, Verónica Montalva.
p. cm. — (IDB Working Paper Series ; 1080)
Includes bibliographic references.
1. Teacher turnover-Chile-Prevention. 2. Teachers-Salaries, etc.-Chile. 3. Teachers-Recruiting-Chile. 4. Teachers-Selection and appointment-Chile. 5. Incentive awards-Chile. 6. Teacher effectiveness-Chile. 7. Employee retention-Chile. I. Elacqua, Gregory M., 1972- II. Hincapié, Diana. III. Hincapié, Isabel. IV. Montalva, Verónica. V. Inter-American Development Bank. Education Division. VI. Series.
IDB-WP-1080

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Can financial incentives help disadvantaged schools to attract and retain high-performing teachers? Evidence from Chile

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November 2019

Abstract

The extensive sorting of more talented teachers into the most advantaged schools contributes to the wide socioeconomic achievement gaps in Latin America. The Chilean Pedagogical Excellence Assignment (AEP, for its Spanish acronym) is a unique program in the region that provides monetary incentives to talented teachers with an additional bonus if they work in disadvantaged schools. The eligibility rule of this program allows us to implement a sharp regression discontinuity design to estimate the causal impact of winning the award on the school choice decisions of talented teachers. By exploiting the fact that teachers from both disadvantaged and non-disadvantaged schools at baseline are eligible for the program, we estimate heterogeneous effects along this key dimension. We find that while obtaining the award was successful at increasing the retention of talented teachers in disadvantaged schools, teachers in non-disadvantaged schools seem to be using the award as a quality signal to stay or move to high-performing schools. This suggests that factors that may explain these heterogeneous results, such as sunk costs of teaching at disadvantaged schools, loss aversion and asymmetric information, played an important role in the effectiveness of the AEP program on achieving its equity goal. Our results shed light on the complexities involved when designing this type of program.

Keywords: teachers, financial incentives, turnover rates, disadvantaged schools

JEL codes: I21, J45, J63, M52

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We are grateful to an anonymous referee and to seminar participants at the Education Seminar of the Inter-American Development Bank and the Latin American and the Caribbean Economic Association (LACEA) conference for helpful comments. The Center of Studies of the Ministry of Education of Chile provided access to key databases. The findings expressed in this paper are those of the authors and do not necessarily represent the views of the Inter-American Development Bank or of the Haas School of Business of the University of California Berkeley.

1. Introduction

Having an effective teacher can dramatically improve students' educational and long-term outcomes (Araujo et al., 2016; Chetty et al., 2014; Hanushek and Rivkin, 2012). Recent work in Latin America has also found that the impact of effective teachers is significantly larger for disadvantaged students (e.g. Cruz-Aguayo and Schady, 2018). Yet, there is evidence of large inequities in access to high-performing teachers between students from different socioeconomic backgrounds in this region (Bertoni et al., 2018)[1]. These inequities arise partly because of teacher sorting that occurs when the most effective teachers disproportionally choose to teach in high-performing schools, driving the most ineffective teachers to teach in disadvantaged and low-performing schools. Moreover, disadvantaged schools usually have difficulties attracting teachers in general and therefore face greater teacher shortages. This has motivated policymakers to design strategies to attract teachers to disadvantaged schools as a means of narrowing the socioeconomic achievement gaps (Elacqua et al., 2018).

Most policies to attract teachers to disadvantaged schools offer salary incentives and non-monetary incentives such as housing or the opportunity for a more rapid career path advancement (Bertoni et al., 2018a; OECD, 2018). However, in Latin America most targeted incentives to work in disadvantaged schools are not related to teachers' performance and recent evidence suggests that these incentives have mostly benefited novice and temporary teachers with pay increases (Bertoni et al., 2018; Hinze-Pifer & Mendez, 2016). This evidence suggests that incentives to work in disadvantaged schools are mostly going to teachers that research has found to be less effective (Elacqua et al., 2018). To address this issue, some school systems have developed programs specifically to attract high-performing teachers to disadvantaged schools.

Our paper contributes to the scarce literature that evaluates the effectiveness of monetary incentives to retain or attract high-performing teachers to disadvantaged schools. We evaluate the impact of the Chilean Pedagogical Excellence Assignment program (AEP, for its Spanish acronym), which was designed to reward high-performing teachers teaching at disadvantaged schools, on the school choice

[1] By effective teachers we mean teachers that promote learning among their students. An established method in the literature to measure teachers' effectiveness is teacher value-added. Given that this measure is rarely available, most studies use other indicators as proxies of teachers' effectiveness. Evidence shows that teachers with more than three years of experience, with good knowledge of the subject they teach and with good classroom practices are more effective teachers (for a review, see Elacqua et al. (2018)). In this paper we refer to teachers that have these characteristics as talented teachers or high-performing teachers. When these measures are not available, some papers use other indicators such as education level or type of training. We refer to teachers with high scores in these measures as more qualified teachers. Even though these measures are usually not correlated with teacher effectiveness, inequality in the distribution of teachers according to these characteristics may still indicate inequality in the distribution of effective teachers.

decisions of these teachers. Most countries in Latin America do not have standardized teacher-evaluation policies and very few have linked targeted monetary incentives to work in disadvantaged schools to teacher performance. The Chilean AEP is a notable exception. First, AEP incentives are linked to a multi-dimensional measure of teacher performance that includes subject and pedagogical knowledge tests and a portfolio that incorporates classroom observations that previous evidence has suggested can identify effective teachers (Elacqua et al., 2018; Santiago, 2013; Taut and Sun, 2014). Second, it includes an equity component according to which talented teachers receive a considerably greater incentive if they work in disadvantaged schools.

In this paper, we test for heterogeneous effects of the program depending on whether the teacher was already in a disadvantaged school or not at the time of application. There are several reasons to believe this is a key dimension to test for heterogeneous effects. For instance, it may be easier for teachers that already work in a disadvantaged school to continue teaching in this type of school than for teachers to transfer into a disadvantaged school. Also, teachers that work in disadvantaged schools may be averse to stop receiving the extra incentive if they change schools. To the best of our knowledge, there are three other studies that evaluate programs that provide incentives to talented teachers to work in disadvantaged schools. The studies evaluate programs in the United States, and they cannot test for heterogeneous effects in this dimension given the programs' characteristics. The three studies find evidence that this type of programs can be effective. Steele et al. (2010) found that a US$20,000 incentive was effective at attracting talented novice teachers to low-performing schools. Clotfelter et al. (2008) found that a US$1,800 per year retention bonus for high-performing teachers who were already working in disadvantaged schools significantly reduced teacher turnover in these schools in North Carolina by 17%. For teachers who did not work in disadvantaged schools, Glazerman et al. (2013) found that a US$20,000 bonus can convince them to transfer to a disadvantaged school. However, only 5% of the teachers targeted transferred. The results of Clotfelter et al. (2008) and Glazerman et al. (2013) suggest that incentives are more effective for teachers that already work in disadvantaged schools. In this paper, we can test this directly.

Moreover, we evaluate whether the effectiveness of the program depends not only on the characteristics of the teachers, but also on the characteristics of the award itself. To explore this, we exploit the fact that teachers received different amounts of the AEP monetary incentive based on their performance level. By comparing the impact of the program between teachers who won the award relative those who did not win and between teachers who won different levels of the award, we can test whether factors such as the diminishing sensitivity to larger incentives and the non-pecuniary aspect of the award are relevant for the effectiveness of the program.

We use longitudinal data on Chilean teachers to estimate whether winning the AEP award influences which type of school teachers choose to work at. Specifically, we estimate whether winning the award makes teachers more likely to work in a disadvantaged school or in a high-performing school one or two years after applying for the award. The eligibility rule of the program allows us to implement a sharp regression discontinuity design to capture the causal effect of winning the award. Our main result indicates that targeted monetary incentives increased the retention of talented teachers in disadvantaged schools. The probability of these teachers working in a disadvantaged school two years after they applied to the program increased between 22 to 29 percentage points if they won the award. In contrast, we do not find any impact on the probability of working in a disadvantaged school for teachers who were not already teaching in this type of schools when they applied. Moreover, these teachers were more likely to stay or move to high performing schools, presumably using the award as a signal of their quality to teach at their preferred schools. This result is consistent with what Berlinski and Ramos (2018) found for the first version of the AEP program that did not include the equity component. We do not find significant differences in the results when instead of comparing teachers who won the award relative those who did not win, we compare teachers who won different levels of the award. Our results are robust to several specifications such as alternative bandwidths and different treatments for those teachers who left the system.

The rest of the paper is organized as follows. Section 2 provides background information, particularly about the unequal distribution of more qualified teachers in Chile and about the AEP program. Section 3 describes the data and empirical strategy to assess the impact of this program on the sorting of high-performing teachers. Section 4 reports our results, and finally, section 5 concludes and discusses the relevance of this evidence for the design of strategies to attract high-performing teachers to disadvantaged schools.

2. Background

2.1. Unequal distribution of qualified teachers in Chile

Studies in different countries have found that the distribution of high-performing teachers is unequal across different types of schools (Glazerman and Max, 2011; Isenberg et al., 2013; Sass et al., 2012; Steele et al., 2015; Akiba et al., 2007). Chile is not the exception. Several studies show that higher performing or more qualified Chilean teachers sort into more advantaged schools. For instance, Ortúzar et al. (2009) find that teachers who graduated with honors, studied for nine semesters or more, or who studied pedagogy in an accredited institution are less likely to work in low performing schools. Similarly, Cabezas et al. (2011) find that teachers who studied in private schools, had high scores on the college admission standardized test (PSU), and obtained graduate degrees, are more likely to work in private schools in affluent neighborhoods. Rivero (2015) shows that less qualified teachers sort into rural or public schools in low-income communities and Bertoni et al. (2018) find that students from rural areas in Chile are more likely to have novice teachers than their urban counterparts.

In Chile, like in most countries of the Latin American region, the unequal distribution of high-performing teachers is a byproduct of teachers' preferences and the market-based mechanisms of the country to assign teachers to schools.[2] The Chilean primary and secondary school system has three sectors: i) private non-voucher schools, which enroll around 9% of students, are privately managed and financed by tuition fees (i.e. do not receive public funding); ii) private voucher schools, which enroll around 55% of students, are privately managed but receive public subsidies, and (iii) municipal schools, which enroll around 36% of students, are publicly managed (by municipalities) and are solely financed with public funds. Private voucher and non-voucher schools are governed by the same Labor Code that regulates private firms (*Código del Trabajo*) and therefore follow traditional market rules that provide firms autonomy to hire and dismiss employees.[3] Municipal schools are governed by the Teacher Statute (*Estatuto Docente*). In order to recruit teachers, each municipality establishes the rules

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[2] The mechanisms to assign teachers to schools can be classified in two broad categories: (i) those determined by the central authority, such as in Singapore and South Korea, and (ii) those determined by the market forces (teachers choose where to apply for work), as is the case in most Latin American countries (Elacqua et al., 2018; Lewin, 2000; Mulkeen et al., 2007).

[3] One difference between the two sectors is that the mandatory teacher minimum wage applies only in the private voucher sector.

for a public contest for permanent teachers, but in general teachers choose the schools they want to apply to and are selected based on their merits (such as seniority, education and scores on psychological and knowledge tests) (Elacqua et al., 2018; Bertoni et al., 2018). In practice, the market-based mechanisms are present in the three sectors of the Chilean education system which implies that more academically talented teachers are able to choose the school of their preference.[4] This results in an unequal distribution of talented teachers as teachers often tend to prefer schools with higher socioeconomic characteristics (SES).

The unequal distribution of teachers in Chile begins when a teacher chooses her first job (Meckes and Bascopé, 2012; Ortúzar et al., 2009; Rivero, 2015; Ruffinelli and Guerrero, 2009) and intensifies with subsequent teacher turnover (Cabezas et al., 2011; Rivero, 2015). Teacher turnover may accentuate inequality if more talented or qualified teachers in disadvantaged schools are more likely to leave the teaching profession or transfer to more advantaged schools and, conversely, if more talented or qualified teachers in more advantaged schools are more likely to stay in those schools. There is evidence of these two types of mobility in Chile. Cabezas et al. (2011) show that teacher transfers increase the unequal distribution of certified teachers. They find that teachers who obtained their degrees from certified institutions are more likely to move from municipal to private voucher schools and that teachers with higher PSU scores are more likely to move from private voucher schools to more advantaged private non-voucher schools. Rivero (2015) finds that teacher retention is higher in high-performing schools relative to more disadvantaged schools, especially for teachers with better credentials.

2.2. AEP program

The Pedagogical Excellence Assignment (AEP program, for its Spanish acronym) was created in 2002 as an initiative of the Ministry of Education to strengthen the teaching profession. Given the perception and suggestive evidence that high-performing teachers were leaving the profession (Rivero, 2015), the main goal of AEP was to retain these teachers in the school system (Araya-Ramírez et al.,

[4] Even though in the municipal sector teacher transfers can also be decided by the municipalities, there are limits to what they can do. While municipalities can reassign teachers to different schools within the network, the Teacher Statute states that teacher reallocation should not imply any personal or professional damage or harm for the teacher. In the privately managed sector, operators manage on average only one school (Elacqua et al., 2015), and therefore there is limited opportunity for teacher reassignment in this sector.

2012). Before AEP, the teacher salary structure mainly considered factors such as seniority and experience, without any link to teaching performance.[5] The program tried to address this challenge by offering a monetary incentive to high-performing teachers.

The version of the AEP program that we evaluate was implemented between 2012 and 2015[6]. The program was implemented nationwide, and teachers in the publicly funded system (private voucher and municipal sectors) could apply on a voluntary basis. Teachers needed to meet two requirements to apply. First, they had to teach a minimum of 20 hours per week. Second, they had to apply to a specific teaching category according to the level and subject that they were teaching.[7] For instance, one possible category was "language teacher in the first cycle of basic education". Another possible category was "philosophy teacher for middle school education". All teacher categories for basic and middle school education were open every year during 2012 - 2015.

To identify talented teachers, AEP uses two instruments: a written test and a portfolio. The government made significant efforts to rigorously evaluate the performance of teachers on both instruments and in this way minimize potential manipulation of the scores. The multiple-choice questions of the written test were automatically evaluated, and the open-ended questions of the test and the work samples of the portfolio were evaluated following scoring rubrics. Moreover, a percentage of the items of both instruments were assigned to two evaluators to monitor the consistency of their scores and all work samples of the portfolio were digitalized to improve monitoring of their evaluation (Rodríguez et. al, 2015).

The combination of the scores on the two AEP instruments determined whether the teacher was eligible to receive a monetary incentive. The details of the assignment rule are outlined in subsection 3.3. The amount of the incentive teachers who won the award would receive differed depending on their performance in a way proportional to their salaries. There were three award levels: the incentive reached 33 percent of base salary in the first level, 22 percent in the second one and 11 percent in the

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[5] The National Evaluation System of Teacher Performance (SNED for its Spanish acronym) was already in place at that time but it was a collective performance incentive, in other words, all teachers within the school received the incentive.

[6] This was the second and last version of the program. In 2016 the AEP program was replaced by another program created by the new Teacher Professional Development Law of that year (Elacqua et al, 2018). The first version of the program went into effect between 2002 and 2011 and shared many similarities with the second version we evaluate but had also key differences. The most important difference for our purposes is that it did not have the equity component of the second version that provides a greater incentive for high performing teachers working in disadvantaged schools. Also, the amount of the incentive was lower (around 7% of an annual salary) but lasted for a greater number of years (for 10 years instead of 4 years as in the second version of the program).

[7] All teachers could apply regardless of their employment status. Data shows that a similar share of teachers apply regardless of whether they are tenured or with a fixed-term contract.

third one. Moreover, teachers in disadvantaged schools received an additional incentive of 40 percent of the award (equity component) (Bruns and Luque, 2014).[8,9] The government established that disadvantaged schools were those where 60% or more of the students enrolled were classified as low SES students.[10] The amount of the award would be adjusted accordingly if the teacher moved from a disadvantaged to a more advantaged school and vice versa.[11]

As discussed above, incentive programs without an equity component can unintentionally increase the unequal sorting of high-performing teachers. Awarded teachers may use the award as an observable signal of their quality to work in their preferred school, usually a high achieving and high SES school. Berlinski and Ramos (2018) study the effect of the first version of AEP, which did not have the equity component, on teachers' retention and between-school mobility. While they find no effect on transitions out of the school system, they find an increase in between-school mobility. The mobility patterns are consistent with the award providing a signal of teacher quality: among teachers from low-performing schools, winning the award makes them 13 percent more likely to be teaching at a high-performing school at some point during the five after they won the award.

The introduction of the equity component in the AEP program in 2012 could potentially counteract the undesirable effect on equity of the first version of the program found by Berlinski and Ramos (2018). Moreover, the additional incentive to work in disadvantaged schools may reduce the transfers that contribute to the unequal distribution of high-performing teachers. If the incentive is large enough, awarded teachers may be more likely to stay or move to disadvantaged schools. However, if the bonus is not large enough to make disadvantaged schools more desirable, the awarded teachers may use the bonus as a signal of their quality to stay or move to high-performing schools. Finally,

[8] For a full-time teacher, the monthly bonus was $150,000 Chilean pesos in the first level, $100,000 Chilean pesos in the second level, and $50,000 Chilean pesos in the third and last level (Rodríguez et. al, 2015).

[9] There were requirements that awarded teachers had to meet in order to keep receiving the incentive: they should continue teaching at least 20 hours a week in the public system (municipal and private voucher schools) and have not been subject to administrative sanctions. Moreover, they should achieve a high level on performance evaluations (Rodríguez et. al, 2015). This especially applies to municipal teachers as they are required to take performance evaluations regularly. This requirement aimed to prevent teachers from reducing their effort levels after winning the AEP award.

[10] These students are called "priority students". The Law 20,248 considers students to be "priority students" if their socioeconomic conditions hinders their opportunity to succeed academically. The government uses several variables for this classification, including participation in a social program called "Chile Solidario", a socioeconomic index, family income and parents' education, among others.

[11] If the teacher does not change schools but the classification of the school at which she works changes from non-disadvantaged to disadvantaged or vice versa, the amount of the incentive would also be adjusted accordingly.

both effects could be in play making schools that are both disadvantaged and high performing more attractive.

2.3 The role of AEP on teachers' decisions

The main goal of this paper is to study the effect of the AEP program that went into effect between 2012 and 2015 on the type of school talented teachers choose to work in. By providing monetary incentives to talented teachers, a first effect that this program can potentially have is to increase retention of these teachers in the school system in general. It can also have an impact on the type of school teachers choose to work in. On the one hand, as discussed above, talented teachers could use the award as a signal of their quality to try to work in their preferred high performing schools. On the other hand, if the amount of the equity component is large enough, the program may have the opposite effect making awarded teachers more likely to work in disadvantaged schools.

For the equity component to influence teachers' turnover decisions[12], the additional monetary incentive to work in disadvantaged schools would have to compensate for other working conditions that dissuades teachers from working in these schools, such as less attractive locations, poor leadership, and students that are more challenging to teach. This goal was ambitious since evidence suggests that teachers have strong preferences for more advantaged schools. Hanushek et al. (2004) show that teacher mobility is more correlated with the characteristics of the students than to salary benefits. Jackson (2009) provides compelling evidence that higher quality teachers prefer non-minority students even after accounting for other working conditions. Nevertheless, monetary incentives can make a difference. Hanushek et al. (2004) document that the increased probability of teachers leaving schools after a one standard deviation decrease in average achievement can be neutralized with a 10-15% increase in salary. Also, several studies find that targeted monetary incentives can have an impact on teacher sorting (e.g. Clotfelter et al., 2008; Glazerman et al., 2013; Steele et al., 2010).

The extent to which the AEP program will be able to influence teacher decisions to work in disadvantaged schools will likely not be the same for all teachers. There are several factors that suggest that the award will be more effective for teachers who were already working in disadvantaged schools

[12] The program could also influence teachers' first job choice, but since one of the requirements to apply to the program is that the candidate is already teaching in the public sector, this will likely have a limited impact on the decisions of new teachers. We do not study this possibility in this paper.

at the time of the application. First, these teachers are less likely to be averse to working in this type of schools. Although on average teachers tend to avoid low-performing schools, many teachers appear not to consider student performance in their career choices (Boyd et al., 2005). Second, if there is a sunk cost for teachers to adjust to the usually harsher conditions of disadvantaged schools, teachers who were already in this type of schools would had already incurred this cost. Therefore, it would be less costly for them to work in disadvantaged schools relative to teachers who have not worked in this type of school previously. Third, loss aversion suggests that the reluctance of teachers at disadvantaged schools to lose the monetary incentive may be stronger than the interest of teachers at more advantaged schools to gain the same monetary incentive[13]. Asymmetric information can provide yet another explanation. It may be the case that teachers at more advantaged schools are not aware of the extra incentive they would receive if they taught at disadvantaged schools, whereas teachers at disadvantaged schools are clearly informed about it upon receiving it.

In this paper, unlike previous literature, we can test for heterogeneous effects on the relevant dimension: whether teachers were in a disadvantaged school or not at the time of application. Given all the potential factors that suggest that the additional monetary incentive to work in disadvantaged schools can have different effects for teachers who were already working in this type of schools, we carry out all our analyses separately for these two groups of teachers. If we find that the impact of the AEP program differs depending on the type of school where teachers were at the time of application, this would suggest that the factors we discussed can influence the efficacy of the equity component. Even though we will not able to identify which of the factors is more relevant, this finding is important because it sheds light on what dimensions matter when analyzing the efficacy of this type of program.

The efficacy of the equity component may depend not only on the characteristics of the teachers, but also on the characteristics of the award itself. To explore this, we exploit the fact that teachers received different amounts of the incentive based on their performance. For instance, one could think that the impact of winning the third level award (versus not winning it) on teaching in disadvantaged schools may be greater than winning the second level award (versus winning the lower third level award). Another strength of this paper is that we can test the effect of winning different levels of the award. There are several factors that explain why this could happen, including the non-pecuniary aspect of

[13] Loss aversion refers to the stronger preference for avoiding losses than for acquiring equivalent gains (e.g. Thaler and Sunstein, 2008).

the equity component, the principle of diminishing sensitivity, and whether the effectiveness of the award as a quality signal varies according to the level of the award[14]. As mentioned, we will not be able to identify which one is the more relevant factor, but our results will shed light on whether this dimension matters.

In sum, the impact of the program on teaching in disadvantaged schools can vary for several factors. First, there is a tension between teachers using the award as a signal of their quality to stay or move to high performing non-disadvantaged schools, and teachers being persuaded by the equity component of the program to stay on or to move to disadvantaged schools. The extent to which the equity component would be able to influence teacher decisions depends on several factors, including teachers' characteristics and the characteristics of the award itself. Regarding teachers' characteristics we will test for heterogeneous effects along the key dimension of whether teachers were at disadvantaged schools or not at the time of application. Regarding the award's characteristics, we will test for heterogeneous effects for winning in the second or third level (relative to winning it the third level and not winning respectively).

3. Data and empirical strategy

3.1. Database

We build a panel data set of teachers in the public sector in Chile from 2011-2017 merging different sources of administrative data. We use the teacher census, which contains information on teaching positions, degree and concentrations, functions, type of contract, number of contract hours, levels at which they teach, among other information. We merged this database with the AEP program database.

[14] The non-pecuniary aspect of the equity component refers to a "warm glow feeling" for being recognized for working in disadvantaged school. All winners are likely to enjoy this aspect similarly, so there would only be a difference in this regard between winners and not winners. Therefore, the impact of winning the third level award relative to not winning it could be greater than impact of winning the second level award relative to the third level one. The principle of diminishing sensitivity of prospect theory provides another reason. The additional equity amount that winners of the second level award relative to winners of the third level award is the same as the equity amount that the latter receive relative to non-winners: around $20,000. The principle of diminishing sensitivity predicts that the utility (disutility) of gaining (losing) the first $20,000 is greater than the utility (disutility) of gaining (losing) the second $20,000. Therefore, we expect that the impact of the first $20,000, that is, of winning the third level award (relative to not winning), would be greater. Another potential reason for this impact to be greater is that the effectiveness of the signal of teacher quality may differ by the award level. If teachers who win the second level award are more successful using the award as a signal to move to high-performing schools, then the equity component of the award would be less effective in retaining or attracting them to disadvantaged schools. In this case, the equity component will, again, be more effective for winners of the third level award relative to non-winners

The latter identifies teachers that applied each year to the program and as well as their score on each instrument: the portfolio and the written exam.

We also exploit a database that identifies low SES students to determine which schools are classified as disadvantaged. As mentioned above, disadvantaged schools were defined by the government as those in which 60% or more of the students enrolled were classified as low SES students. Moreover, we are also interested in examining whether receiving the award creates incentives for teachers to choose to teach at high-performing schools. To identify those top performing schools, we use the Chilean National Evaluation System of Teacher Performance (SNED, for its Spanish acronym). Consistent with this system, we define a school as high performing based on its student performance relative to its comparison group in SNED.[15]

3.2. Description of the sample

Our sample comprises of teachers who were working between 2012 and 2015 in the public system (municipal and private voucher sectors) and who applied to the AEP program. Only two percent of the total teachers who were eligible to apply to the AEP program applied during this period. We restrict the sample to primary and secondary school teachers since teachers in other education levels (pre-primary, adult education and special education) face very different labor markets. We also restrict the sample to those teachers who were at least four years away from retirement age at the time they applied because they are less likely to be influenced to transfer to another school.[16]

Table 1 presents some descriptive statistics on teacher characteristics and the characteristics of their schools to compare AEP eligible teachers who did not apply to the program (column (1)) to those

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[15] This is the same approach used by Berlinski and Ramos (2018) to identify top performing schools to evaluate the impact of the first version of the AEP program. SNED introduced a collective performance incentive for high-performing schools within their comparison group. The comparison group is determined by the school's geographic location, type (primary or secondary) and its students' socioeconomic level. The SNED performance index is a weighted average of six different sub-indexes, including student performance on standardized tests, which is the one we use. Given that teacher labor markets are usually constrained by location (Boyd et al., 2005; Jaramillo, 2013) and presumably also somewhat by type of school and socioeconomic status, we think that the relative definition of a high performing school (within a comparison group) is more informative that an absolute definition.

[16] Berlinski and Ramos (2018) also restrict the sample in this way. We also exclude teachers who did not follow the program assignment rules either because they cheated or because their scores did not match the corresponding category. This is a small percentage of the sample of applicants (8 percent).

who applied (column (2)).[17] In general, we find significant differences between these two groups. For example, teachers who applied to the program are more likely to be men, two years younger and with one less year of experience on average, eight percentage points less likely to be a primary school teacher (versus a secondary school teacher), and more likely to have a permanent contract. They are also more likely to come from a high-performing school. This makes sense as the literature suggests that teachers from these schools tend to be more talented and thus their greater application rates may be due to being more confident about their ability to win the award. Another striking difference between applicants and non-applicants is their mobility over two years. Applicants are less likely to leave the system in two years and are also less likely to transfer to another school.

In table 1 we also compare teachers who applied but did not win the award (column (4)) to those who won the award in any of the possible three levels (column (5)). We also find significant differences between these two groups. These differences are consistent with the unequal distribution of talented teachers we previously discussed. Awarded teachers are more likely to work at high-performing schools and we find that they are less likely to work in rural schools, municipal schools, and disadvantaged schools. Regarding their mobility, awarded teachers are less likely to leave the system in two years and less likely to transfer to another school.

In the last two columns of table 1 we compare all applicants of the AEP program (column (7)) to those that are included in our main sample column (8)). Given the methodology that we will use (see section 3.3 for more detail) and data limitations[18], our final sample for the main estimations is slightly greater than one quarter of the sample of all AEP applicants. This is the sample that we will use to estimate the impact of winning the AEP award in the third level versus not winning it. The results show that the teachers in our final sample are significantly different than the sample of all AEP applicants. For instance, they are more likely to be female, to be a primary school teacher and to work in a school that is rural, municipal or disadvantaged[19].

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[17] A small proportion of teachers (less than 10 percent) work at more than one school. For those teachers we show the characteristics of their main school, which we define as that one in which the teacher has the greater number of hours by contract. If more than one school shares that condition, we choose the main school randomly among schools.

[18] In our methodology we need to restrict the sample to those that obtained certain categories in the written test and portfolio instruments. That restriction reduces the sample to a third. Data limitations further reduces the remaining sample to 24%. The main data limitation is that there is around one quarter of missing values in the variable that identifies a school as disadvantaged. However, we investigate the problem of attrition in section 4.1 and conclude that it is unlikely that this potential problem is biasing our results.

[19] We also use another sample of teachers to estimate the impact of winning the second level award versus winning the third level award. This sample differs from the sample of all AEP applicants in that it has fewer variables. They are more likely to be a permanent teacher and to work in a municipal school.

3.3. Empirical strategy

The assignment rule of the AEP award allows us to apply a sharp Regression Discontinuity (RD) design. The main advantage of this methodology is that it provides unbiased estimators. However, the results are local effects, that is, they are only valid for teachers who obtained scores close to the eligibility cut-off point. Thus, we cannot extrapolate the effect on teachers who are substantially above or below this point.

As mentioned previously, teachers receive the AEP award according to their performance on two different instruments: the written exam and the portfolio. The scores on both instruments are continuous variables that go from one to four. Depending on their scores on each instrument, teachers are assigned to a category from A to D in each instrument, A being the highest performance category and D the lowest performance category. The combination of their assigned categories on both instruments determines if the teacher receives the AEP award. Table 2 illustrates the rule of how the two categories are combined to assign teachers to four performance levels. The shaded colors in the table indicate the level of the award the teacher achieved. The table also shows the number of teachers in each possible combination of categories on both instruments for the four years that the program was in place. For instance, the table shows that 27 teachers obtained the category A on the portfolio and the category B on the written test and therefore achieved the first level award.

In the conventional univariate RD design, the treatment is determined by whether one "assignment" or "running" variable exceeds a known cut-off point or threshold (e.g. Lee and Lemieux, 2010). In our case we have a multidimensional RD since we have two running variables. There are different strategies to handle a multidimensional RD (Reardon and Robinson, 2012; Wong et al., 2013). Following previous studies (Cohodes and Goodman, 2014; Londoño-Velez et al, 2018) we carry out a frontier RD methodology, which consists of conditioning the sample on one of the running variables and then modeling the discontinuity along the remaining running variable using a univariate RD method. We have two options for this. We can restrict the sample to teachers who achieved a certain category on the written exam and compare teachers around one of the cut-off points according to their scores on the portfolio, which would then be the only running variable. Conversely, we can restrict the sample according to the teachers' category on the portfolio and use their score on the written exam as the running variable.

The frontier RD reduces the sample size significantly by restricting it based on the result of one of the running variables. We are mainly interested in estimating the impact of winning the third level award relative to not winning the award. We consider only two cases that provide a reasonable sample size for this estimation. The first case restricts the sample to teachers who obtained category C on the written test and compares teachers that achieved the third level award given their score in the portfolio and teachers that did not receive the award (sample size of 1,995 (see table 2)). Thus, for teachers in category C on the written test, we are comparing those that obtained category B in portfolio versus those that obtained categories C and D.[20] The second case restricts the sample to teachers who obtained C in the portfolio and compares teachers that received the third level award given their score on the written test with teachers that did not receive the award (sample size of 2,511 (see table 2)). As we will see below, only the first case passes the validity tests.

Sharp regression discontinuity design

The effect on each of outcome variables is estimated using the following model:

$$Y_{i,t+n} = \beta_0 + \tau D_{i,t} + f\left(Z_{i,t}\right) + \gamma_t + u_{i,t} \qquad (1)$$

Where $Y_{i,t+n}$ is one of the outcome variables (*n* years after the year the teacher applied to the AEP program), D_{it} is a treatment indicator of winning the AEP award, $f(Z_{it})$ is a control function that considers the distance between the teacher's score in the running variable and the threshold (we use two specifications for this function: linear and quadratic polynomials), γ_t are year fixed effects, and u_{it} is the error term. The subscript *i* refers to teachers and *t* refers to the year the teacher applied to the AEP program. The parameter of interest is τ. Under the basic underlying assumption that there is no manipulation of the running variable, this parameter captures the local impact of winning the award on the outcome of interest. We use the optimal bandwidth suggested by Calonico, Cattaneo, and Titiunik (2014).

We are interested in evaluating whether winning the AEP award influences the type of school teachers are working at one or two years after winning the award. As discussed above, if the amount of the equity component is large enough, winning the award may incentivize teachers to work in disadvantaged schools. If the amount is not large enough, teachers who win the award may use it as a signal of their quality to stay or move to high-performing schools. Also, teachers may try to teach in schools that are both disadvantaged and high performing. Therefore, our three outcome variables are

[20] We exclude teachers who achieved category A on the portfolio because the amount of money they received is twice as large as the amount received by those who achieved category B on the portfolio.

whether teachers are at each of these types of school one or two years after they applied to the AEP program. Our outcome variables are binary variables that take the value of 1 if the teacher who applied to the AEP program in time *t* is in a certain type of school in *t+n,* where *n* takes either the value of 1 or 2[21]. Specifically, the outcome variables are:

1. If the teacher is at a disadvantaged school in *t+n*.
2. If the teacher is at a high performing school in *t+n*.[22]
3. If the teacher is at a both disadvantaged and high performing school in *t+n.*

Since we know that the effects of winning the AEP award may vary depending on the type of school that the teacher was employed at when applying, we carry out the analysis for three samples of teachers: i) all teachers, ii) teachers who were at disadvantaged schools at the time of applying, and iii) teachers who were not at disadvantaged schools at the time of applying.

Validity of the RD

The basic underlying assumption to identify unbiased and consistent estimators using a sharp RD design is that there is no manipulation of the running variable. We cannot test this directly, but there are two main empirical tests that shed light on whether this assumption is likely to hold. One test of the validity of the RD design is the McCrary test which evaluates whether there is any kink in the density of the running variable around the cut-off point. Another test consists of evaluating whether "baseline covariates" (variables determined prior to the realization of the running variable) vary smoothly around the cut-off point (Lee and Lemieux, 2010).

We run the McCrary test for each of the potential running variables separately and for each of the cut-off points. Table 3 shows the p-value associated with this test in each case, and figure 1 shows the plots of the density functions. Panel A of the table and figure shows the results for the knowledge test

[21] If the teacher works in more than one school (less than 10% of the sample), we only consider her main school. We define the main school as the one in which the teacher has the greater number of hours by contract. If more than one school shares that condition, we choose the main school randomly among schools. If the teacher leaves the school system in *t+n* then the outcome variable takes the value of missing and the observation is not included in the estimation. That is, we exclude from the estimations the small percentage of teachers (around 4%) who leave the system in *t+n*. This is unlikely to bias our results since in general we find no effect of winning the award on retention and, moreover, we find that our main results are robust to including those teachers who left the system assuming that they had either a value of 0 or 1 for the outcome variable. We discuss this in more detail in section 4.1.

[22] As discussed above, we define this variable according to the student performance sub-index in SNED and relative to their comparison group. This variable takes the value of 1 if the relative performance is in the top 50%. The small percentage of teachers who are in the private non-voucher sector in *t+n* (around 1%) are excluded from the regressions that require computing whether the school was high performing in *t+n* as private non-voucher schools are not classified under SNED.

score as the running variable, using the entire sample of AEP applicants. We find discontinuities around each of the cut-off points and therefore rule out using this variable as the running variable[23]. Panel B of the table and figure shows results for the portfolio instrument, again using the entire sample of applicants. In this case we find that the density of the running variable is continuous around all the cut-off values. Moreover, since in our main estimations we will restrict the sample to those who achieved category C in the knowledge test, we also conduct the test for this restricted sample. Panel C of the table shows that results do not change. Panel D presents the results for our estimation sample and we find again that the density of the running variable is continuous around all the cut-off values. These results support using the portfolio instrument as the running variable. [24, 25]

The second approach to test the validity of the RD design is to examine whether baseline covariates vary smoothly around the threshold. To do this, we estimate the same specifications described for equation (1) but having as the outcome variable baseline covariates that capture teachers' characteristics and the characteristics of their schools at the time of application. Since these are predetermined variables, the treatment cannot influence them and therefore we should not find statistically significant differences around the cut-off point (other than by chance). Exploiting the panel nature of our dataset, we also include the lagged value of our outcome variables as additional baseline covariates: whether the teacher was at a disadvantaged school in *t-1*, whether she was at a high-performing school in *t-1* and whether she was at a disadvantaged and high-performing school in *t-1*. As Lee and Lemieux (2010) argue, since these lagged variables are expected to be highly correlated with our outcome variables, finding a discontinuity in the latter but not in the former would strongly support the validity of our RD design.

Table 4 shows the results for several baseline covariates for our main estimation sample. The first two columns of the table show the results for specifications using polynomials of order 1 and 2 respectively

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[23] It is surprising to find the result that suggests manipulation of the knowledge test scores given the considerable efforts of the Chilean Ministry of Education to make the evaluation of both instruments very rigorous and not prone to manipulation. We find similar results when we conduct the density test proposed by Cattaneo et al. (2017). It is likely that the manipulations occurred with the open-ended, rather than multiple choice, questions.

[24] Again, we find similar results when we carry out the density test of Cattaneo et al. (2017). A potential explanation for the contrasting results between both instruments is that the scores in the portfolio may be not affected by manipulation given the digitalization of the work samples which could improve the detection of manipulation. Also, evaluators disqualified teachers that copy on the portfolio, making this score potentially more subject to scrutiny and therefore harder to manipulate.

[25] We also conduct the McCrary test for the potential samples we can use to estimate the impact of winning the second level award versus winning the third level award and find similar results. That is, we conclude that we should use the portfolio instrument as the running variable in this case as well. Our estimation sample for this case would be those teachers who achieved category B in the knowledge test, and either category B or C in the portfolio.

for the sample of all teachers. We find that there are no significant discontinuities in any of the covariates. We also conduct continuity tests for our two subsamples of teachers: teachers who were at disadvantaged schools at the time of applying (columns 3-4), and those who were not at disadvantaged schools at the time of applying (columns 5-6). For the first subsample we find significant differences for two variables, namely, if the teacher works at more than one school and the number of contract hours. This is likely due to chance. For the second subsample of teachers, those who were not at disadvantaged schools at the time of applying, we do not find significant differences. These results support the validity of our RD design for all the subsamples. Moreover, following the suggestion in Lee and Lemieux (2010), we will explore the robustness of our results to the inclusion of all baseline covariates, including the respective lagged outcome variable. If the no-manipulation assumption holds, the inclusion of these covariates should not affect our estimates.

4. Results

4.1. Main results

In this section we present results for the impact of winning the AEP award in the third level relative to not winning the award. In Table 5 we will show the results for the impact on working at a disadvantaged school one and two years after winning the award. If the equity component of the award prevails over the potential use of the award as a quality signal to move to high performing schools, then we would expect to find a positive effect of winning the award on teaching in disadvantaged schools in the future. On the other hand, if the signaling of the award prevails over the equity component, we would expect a positive effect on working at a high performing school in the future. We will show these results in table 6. If both the equity component and the signaling play a role, we would expect a positive impact on working at both disadvantaged and high performing school. These results are shown in table 7.

Table 5 shows the impact of winning the third level award relative to not winning on the probability of working in a disadvantaged school in the future. It shows the results for our three main samples: all teachers, teachers in disadvantaged schools in *t*, and teachers in non-disadvantaged schools in *t*. Each of these samples have two columns of results, one for each specification of the control function (linear and quadratic polynomial). Moreover, the table is divided in two main panels according to the year the impact is measured: in *t+1* (panel A) and in *t+2* (panel B). Each of these panels are subdivided in two subpanels that includes the impact estimates controlling for two different sets of covariates. In the first subpanel we only include year fixed effects, and in the second subpanel on top of that we include all baseline covariates including the lagged outcome variable.

For the sample of all teachers we do not find a significant impact of winning the AEP award on the probability of working in a disadvantaged school one or two years after winning the award. However, as discussed in section 2.3, there are several reasons we could expect the equity component to be more effective for teachers who were already at a disadvantaged school at the time of application. Therefore, we next analyze the results for this subsample of teachers. We do not find significant effects for *t+1*, but we find significant positive effects for t+2: winning the third level AEP award increases the probability that these teachers continue working in a disadvantaged school in 25 to 29 p.p. two years after they won the award. This effect represents an increase of around 27% in the probability. This is our main result and it is illustrated in figure 2.[26]

For the subsample of teachers who were at non-disadvantaged schools in *t*, in general we find negative but not significant effects. However, for *t+2* we find that these negative effects are statistically different from the positive effects we found for the subsample of teachers who were at disadvantaged schools in *t*. These results suggest that the factors that explain the differences between these two samples, such as, unobserved preferences, sunk costs, loss aversion or asymmetric information, can play an important role in the effectiveness of the equity component on attracting or retaining teachers in disadvantaged schools. Also, the fact that the effects are negative for teachers who were at non-disadvantaged schools in *t*, suggests that they may be using the award as a signal to stay or move to preferred non-disadvantaged schools[27]. We explore this possibility further in table 6.

Table 6 shows the impact of winning the third level award relative to not winning it on the probability of teaching at a high performing school in the future. The structure of the table is the same as that of table 5. In this case, we neither find significant effects for the sample of all of the teachers nor for

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[26] We further evaluate whether this result can be explained by teachers who were already at a disadvantaged school at the time of application being less likely to change to a new school in *t+2* if they win the award. We do not find evidence in this regard, but we find suggestive evidence (not significant effects) that they are less likely to change to a new non-disadvantaged school and more likely to change to a new disadvantaged school. We hypothesize that the significant positive impact we find on working at a disadvantaged school in *t+2* would respond to a combination of effects: winning the award makes these teachers more likely to stay in their own disadvantaged school and also less (more) likely to transfer to non-disadvantaged (disadvantaged) schools in *t+2*. These results are available upon request.

[27] We also evaluate whether this result can be explained by the transfer decisions of these teachers. We find evidence that winning the award makes them more likely to transfer to a new non-disadvantaged school, probably "preferred" to their current school. This effect is statistically significant and may be part of the explanation for the negative impact (although statistically insignificant) we find on working at a disadvantaged school in *t+2* for these teachers.

those who were at disadvantaged schools in *t*. In contrast, we find that for those who were at non-disadvantaged schools in *t,* winners are between 27 and 41 p.p. more likely to be working in a high-performing school in *t+1* and *t+2*. As we discussed in section 2.3, the equity component may be less relevant for teachers who were at non-disadvantaged schools in *t* and therefore the appeal of using the award as a quality signal to move to preferred high-performing schools may be more attractive for these teachers. It is also possible that they are using the award to move to high-performing schools that are also disadvantaged so that they receive the additional compensation of the equity component. We explore that possibility in table 7 and find no evidence. We also do not find significant effects for the other samples of teachers for this outcome variable.

In the appendix we include several robustness checks of our results. First, we show that winning the award in the third level relative to not winning it neither has an effect on attrition (table A2) nor retention in the school system (table A3). The only exception is the impact on attrition and retention in *t+1* for the subsample of teachers in non-disadvantaged schools in *t*. However, we only find this for one of the specifications (when the order of polynomial in the control function is 1) and our main results are robust to both specifications. Additionally, we explore whether our main results are robust to including in the estimation sample those teachers who left the system assuming that they had either a value of 0 or 1 for the outcome variable. We confirm the robustness of our results in this case too (results available upon request). Finally, we show that our main results are also robust to alternative bandwidths (see tables A4 – A9).[28, 29]

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[28] We also evaluate whether our results are robust to using an alternative sample that consists of adding to our main sample those teachers who achieved category B in the knowledge test and either category C in the portfolio (and thus won the third level award) or category D in the portfolio (and thus did not win the award). We find that our main result is robust: we again find a positive impact of around 24 p.p. on the probability of teaching at a disadvantaged school in t+2 for the subsample of teachers who were in a disadvantaged school in *t*. However, we no longer find a significant positive impact of teaching at a high-performing school in *t+1* nor *t+2* for the subsample of teachers who were in a non-disadvantaged school in *t*. This may be a result of the added sample having different characteristics and therefore behaving differently than our main sample.

[29] Furthermore, we can conduct additional robustness tests that are specific to our context. In our case, the status of the school where the teacher was at baseline can change from one year to the next. For example, a school that was disadvantaged in t can stop being classified as disadvantaged in t+1 if its percentage of disadvantaged student population decreases enough in t+1. Similarly, a school that was high performing in t can stop being high performing in t+1. The fact that a teacher wins the award should not affect the probability that her baseline school changes its status in the future (independently where the awarded teacher is in the future). In general, we find that this is the case. However, there is one exception. We find that for teachers who were at non-disadvantaged schools in t, in one specification their baseline school is more likely to become high performing in t+2 if they win the award. This is problematic because it means that these teachers will be more likely to be at a high-performing school in t+2 even if winning the award does not influence their behavior. It is very unlikely that the classification of a school as disadvantaged is manipulated as a response of one teacher in the school winning the AEP award because this classification is used for other crucial policy purposes (such as for the Preferential Schooling Subsidy Law (SEP, for its acronym in Spanish)). Therefore, this

4.2. Additional results

In section 2.3 we discussed some reasons for thinking that the impact of winning the third level award (versus not winning it) may be different than the impact of winning the second level award (versus winning the third level award). These factors included the non-pecuniary aspect of the incentive, the principle of diminishing sensitivity and the effectiveness of the teacher quality signal.

In tables A10, A11 and A12 of the appendix we include tables analogous to tables 5, 6 and 7 but that present the impact of winning the second level award relative to winning the third level award. In general, we find that the estimates are not significantly different from those of tables 5, 6 and 7, suggesting that the factors mentioned previously are not that relevant to explain the impact of the program.

Even when the estimates are not statistically different, it is interesting to compare some of the results. One result that stands out is that in table A13 we find that teachers who were at a non-disadvantaged school in *t* are less likely to be at a disadvantaged school in *t+1*. The analogous result in table 5 was not statistically significant. This suggests that the equity component is less effective for teachers who won the second level award and instead they may be using the award as a signal to stay or move to a preferred non-disadvantaged school[30]. However, comparing tables 6 and A14, we find that both teachers who won the second and third level awards seem to be using them equally effectively to stay or move to preferred high-performing schools.

5. Conclusions

In this paper, we assess the impact of winning the AEP award on the type of school teachers in Chile choose to work in. The AEP program was in effect between 2012 and 2015 and consisted in providing monetary incentives to high-performing teachers. It also included an equity component, unique in

difference is likely to be due to chance. However, even if it is by chance, it can significantly hinder the interpretation of our results. Hence, as an additional robustness check, we run all our regressions controlling for a variable that indicates whether the baseline school of the teacher changed its classification in the respective future period. This is a strong test because we lose a relevant part of the variation. We find that our main result is robust to controlling for this: we again find a positive impact of around 20 p.p. on the probability of teaching at a disadvantaged school in *t+2* for the subsample of teachers who were in a disadvantaged school in *t*. For the effect on teaching at a high-performing school in *t+1* for the subsample of teachers who were in a non-disadvantaged school in *t*, we still find a significant effect (at 10%) but of smaller magnitude (14 – 17 p.p. instead of 38 – 41 p.p.) The analogous effect for *t+2* disappears with the inclusion of the control.

[30] This may also explain why results for *t+2* in table A13 for teachers who were at disadvantaged schools in *t*, unlike those results in table 5, are not statistically significant.

Latin America and other contexts, that offered high-performing teachers an additional monetary incentive to work in disadvantaged schools. The main goal of that component was to compensate for other working conditions that usually dissuade teachers from working in these schools. Given the role that effective teachers play in students' academic success, especially for low-income and low-performing students (e.g. Cruz-Aguayo and Schady, 2018), these types of policies are key for narrowing the persistent socioeconomic achievement gaps in the region.

We find that the effectiveness of the AEP program to attract or retain high performing teachers in disadvantaged schools depends largely on where the teacher was working at the time they applied to the program. We find that, for teachers who were already working in disadvantaged schools at the time they applied for the AEP program, winning the third level award increased their probability to continue working in a disadvantaged school by 22 to 29 p.p. two years after they won the award. This effect represents an increase of around 27%. However, the equity component was not enough to attract talented teachers from non-disadvantaged schools to disadvantaged schools. Moreover, these teachers were more likely to stay or move to high performing schools, presumably using the award as a signal of their quality to teach at their preferred schools.

Our results suggest that designing and implementing policies to attract talented teachers to disadvantaged schools is a challenging task. We discussed several reasons why monetary incentives to teach at disadvantaged schools could be more effective for teachers who are already teaching at this type of school: unobserved preferences, sunk costs, loss aversion, and asymmetric information. The fact that asymmetric information may be a relevant factor points to potential cost-effective ways to achieve the goal of reducing teacher sorting. Policymakers should inform teachers of the extra incentive to teach at a disadvantaged school. Survey evidence in Chile suggests that teachers are often not informed about national policies that impact their schools (Elacqua et al. 2015a). Policymakers could organize targeted information campaigns when they promote similar programs among teachers. It is also important that teachers can easily identify which schools are classified as disadvantaged. However, this should be done very carefully to avoid provoking a stigma against disadvantaged schools.

Furthermore, the government could improve the design of the incentive to better meet the goal of reducing teacher sorting. Instead of having an additional incentive for talented teachers working at disadvantaged schools, the total amount of the incentive may only apply for those teachers. Alternatively, talented teachers working at non-disadvantaged schools may receive the incentive during the first year after winning the award but to keep it for the next years they may be required to transfer to a disadvantaged school. If they are loss averse, they would be more likely to transfer. Further research on various types of incentive programs is needed to assess how to make these programs more effective at reducing teacher sorting.

Another cost-effective strategy for policymakers is to use behavioral insights to make teachers' intrinsic motivations to work in more challenging environments more salient close to the time they make their decision where they will work the following year. Recent research suggests that when choosing where to work, teachers focus more on extrinsic motivations, such as location, safety, and working conditions (Rosa, 2017). These practical considerations likely crowd out the intrinsic satisfaction of working with more disadvantaged students. Recent work in Rio de Janeiro finds that priming social identity and reminding teachers of social motivations can impact their behavior and job choices (Elacqua et al., 2019). Changing the perspective of what teaching involves at these schools can be crucial to make disadvantaged schools more attractive. Another strategy would be to promote activities where talented teachers who had a positive experience working at disadvantaged schools could share their experience with their peers at more advantaged schools.

Nonetheless, policies that increase the attractiveness per-se of working in disadvantaged schools are also crucial to reduce teacher sorting and these policies usually require significant resources and therefore a strong political consensus. In view of the very low participation rate in the AEP program (around 2%), the reach of this program was quite limited. Based on our results, incentives for talented teachers to work in disadvantaged schools may be incorporated in teacher hiring and in their career path. These incentives can be monetary and non-monetary such as faster promotions for teachers who work in disadvantaged schools. Peru has incorporated this type of non-monetary incentive for teachers who work at rural schools, but they are not restricted to talented teachers and therefore they end up going to novice and low performing teachers. Chile has recently incorporated monetary incentives for high performing teachers to work in disadvantaged schools in its teacher career path. This equity incentive is only available for teachers that reach a specific level in the career path and choose to work at a disadvantaged school. Besides providing monetary and non-monetary incentives, it is also crucial to improve the working conditions in disadvantaged schools. These schools are in a greater need of better infrastructure, educational inputs, technical and pedagogical support, and high-quality leadership. Teachers that work in the most disadvantaged and isolated schools also often need transportation and housing.

Overall, this paper improves our understanding of policies that aim to attract and retain high-performing teachers in disadvantaged schools. We find that monetary incentives can be an effective tool to achieve this objective for some teachers. However, it also highlights that this type of incentive might not be enough to attract a high proportion of talented teachers to disadvantaged schools. Therefore, in order to reduce the inequities caused by the most talented teachers sorting into the most advantaged and highest performing schools, several considerations should be considered regarding aspects of the implementation of this type of program and the design of the incentives. Moreover, policies that apply this type of incentives to general teacher hiring and career path promotions are also likely necessary to reduce teacher sorting.

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Tables

Table 1: Descriptive statistics for teachers in the public sector

	AEP eligible teachers			AEP applicants			AEP applicants and our main sample		
	Non-AEP applicants	AEP applicants	p-value of difference	Non-awarded teachers	Awarded teachers	p-value of difference	All AEP applicants	Our main sample	p-value of difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(6)
Teacher characteristics									
Woman = 1	72%	69%	0.000	70%	69%	0.593	69%	73%	0.002
Age	36.34	34.47	0.000	35.68	34.04	0.000	34.47	35.17	0.003
Teacher experience	9.34	8.36	0.000	8.59	8.29	0.151	8.36	8.16	0.307
Works at more than one school	7%	8%	0.004	9%	8%	0.497	8%	7%	0.022
Primary school teacher	84%	76%	0.000	78%	76%	0.066	76%	86%	0.000
Permanent teacher	47%	51%	0.000	48%	52%	0.003	51%	45%	0.000
Contract hours	36.55	37.03	0.000	36.52	37.2	0.000	37.03	36.99	0.836
Teacher's main school characteristics									
Rural school	15%	12%	0.000	18%	10%	0.000	12%	20%	0.000
In Santiago metropolitan region	32%	33%	0.060	30%	35%	0.001	33%	27%	0.000
Municipal school	45%	38%	0.000	41%	37%	0.004	38%	53%	0.000
Disadvantaged school	51%	51%	0.833	57%	49%	0.000	51%	54%	0.066
Percentage of priority students at school	0.60	0.60	0.318	0.62	0.59	0.000	0.60	0.61	0.040
High-performing school (relative)	57%	62%	0.000	57%	63%	0.000	62%	57%	0.001
Teacher's mobility									
Teacher leaves the system in two years	8%	4%	0.000	4%	3%	0.100	4%	3%	0.928
Teacher is at a new school in two years	23%	19%	0.000	21%	18%	0.008	19%	20%	0.462
Observations	377,240	5,990		1,546	4,444		5,990	1,518	

Notes: The sample pools teachers who worked in the public sector for years 2012-2015. In all cases the sample includes teachers of primary and secondary schools, who were at least four years away from retirement age, and for AEP applicants we further restrict to teachers who followed the program assignment rules.

Table 2: AEP assignment rule

Score in portfolio	Score in knowledge test			
	Category A (Score: 3.39 - 4.00)	**Category B** (Score: 2.76 – 3.38)	**Category C** (Score: 1.89 - 2.75)	**Category D** (Score: 1.00 - 1.88)
Category A (Score: 3.01 - 4.00)	11	27	11	1
Category B (Score: 2.52 – 3.00)	444	1,459	797	51
Category C (Score: 2.00 - 2.51)	364	1,331	1,058	122
Category D (Score: 1.00 - 1.99)	25	122	140	27

Notes: The shades of the cells indicate the level of the award: the darkest shade corresponds to the first level award (highest amount), the medium shade corresponds to the second level award, and the lightest shade corresponds to the third level award (lowest amount). The white cells correspond to not winning the award. The numbers in the cells corresponds to the number of teachers in each combination of categories.

Table 3: McCrary tests

Around threshold between categories:	A and B (1)	B and C (2)	C and D (3)
Panel A: Score in knowledge test			
p-value	0.000	0.000	0.006
Panel B: Score in portfolio			
p-value	0.135	0.952	0.166
Panel C: Score in portfolio restricted to category C in knowledge test			
p-value	0.861	0.680	0.176
Panel D: As panel C further restricted to main estimation sample			
p-value	0.240	0.428	0.567

Table 4: Continuity tests

Impact of winning third level award (relative to not winning) on baseline covariates

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variables: Teacher characteristics in t						
Woman = 1	-0.07	-0.09	-0.22	-0.26	0.18	0.02
	(0.10)	(0.12)	(0.16)	(0.17)	(0.12)	(0.17)
Age	0.11	0.10	1.56	0.51	-1.16	-1.60
	(1.85)	(2.02)	(2.26)	(3.46)	(2.31)	(2.49)
Teacher experience	-0.06	-0.03	0.70	0.02	-0.26	-0.75
	(1.43)	(1.71)	(2.25)	(2.84)	(2.05)	(2.14)
Works at more than one school	0.02	-0.03	0.06**	-0.06	-0.04	-0.08
	(0.05)	(0.06)	(0.03)	(0.04)	(0.06)	(0.05)
Primary school teacher	-0.12	-0.16	-0.10	-0.16	-0.23	-0.29
	(0.09)	(0.12)	(0.10)	(0.12)	(0.16)	(0.20)
Permanent teacher	-0.03	-0.01	-0.17	-0.10	0.17	0.30
	(0.11)	(0.12)	(0.14)	(0.15)	(0.17)	(0.22)
Contract hours	-1.07	-1.24	-3.60*	-4.52**	0.01	2.86
	(1.42)	(1.64)	(1.87)	(2.11)	(1.86)	(2.45)
Outcome variables: School characteristics in t						
Rural	-0.07	0.04	-0.02	0.01	-0.05	0.00
	(0.08)	(0.10)	(0.15)	(0.17)	(0.05)	(0.05)
In Santiago metropolitan area	-0.08	-0.16	-0.10	-0.10	-0.14	-0.14
	(0.09)	(0.12)	(0.13)	(0.13)	(0.18)	(0.23)
Municipal school	-0.05	-0.05	0.07	0.14	-0.26	-0.29
	(0.11)	(0.12)	(0.13)	(0.16)	(0.20)	(0.23)
Disadvantaged school	0.03	0.12				
	(0.11)	(0.14)				
Percentage of priority students at school	-0.01	0.04	0.00	0.02	-0.02	-0.01
	(0.03)	(0.05)	(0.03)	(0.04)	(0.04)	(0.04)
High performing school	0.05	0.04	-0.00	-0.04	0.15	0.13
	(0.11)	(0.13)	(0.13)	(0.19)	(0.17)	(0.18)
Outcome variables: School of the teacher in t-1						
Disadvantaged school in t - 1	0.12	0.14	0.17	0.24	-0.04	-0.12
	(0.12)	(0.13)	(0.12)	(0.16)	(0.10)	(0.13)
High performing school in t - 1	-0.04	-0.05	-0.03	-0.02	-0.00	0.01
	(0.11)	(0.13)	(0.14)	(0.19)	(0.15)	(0.19)
Disadv. and high performing school in t - 1	0.05	0.06	0.13	0.16	-0.10	-0.12
	(0.10)	(0.11)	(0.13)	(0.18)	(0.07)	(0.10)
Order of polynomial in control function:	1	2	1	2	1	2

Table 5: Impact of winning third level award (relative to not winning) on teaching at a disadvantaged school in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.02	0.03	0.03	0.01	-0.10	-0.09
	(0.11)	(0.13)	(0.10)	(0.12)	(0.10)	(0.14)
Mean dep. vble. for WA III = 0	0.59	0.57	0.86	0.87	0.19	0.19
Effective obs.	560	672	270	381	257	266
Observations	1,444	1,444	790	790	654	654
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	-0.05	-0.04	0.04	0.03	-0.07	-0.05
	(0.07)	(0.08)	(0.08)	(0.10)	(0.10)	(0.11)
Mean dep. vble. for WA III = 0	0.59	0.57	0.85	0.86	0.20	0.18
Effective obs.	488	693	295	355	242	303
Observations	1,348	1,348	742	742	606	606
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.05	0.14	0.25***	0.29**	-0.18	-0.17
	(0.09)	(0.13)	(0.10)	(0.14)	(0.12)	(0.14)
Mean dep. vble. for WA III = 0	0.59	0.60	0.77	0.77	0.34	0.33
Effective obs.	617	562	356	356	276	358
Observations	1,410	1,410	776	776	634	634
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.05	0.08	0.22**	0.20	-0.09	-0.08
	(0.07)	(0.10)	(0.10)	(0.13)	(0.11)	(0.12)
Mean dep. vble. for WA III = 0	0.59	0.59	0.75	0.78	0.37	0.32
Effective obs.	685	648	294	380	236	297
Observations	1,314	1,314	729	729	585	585
Order of polynomial in control function:	1	2	1	2	1	2

Table 6: Impact of winning third level award (relative to not winning) on teaching at a high-performing school in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.14	0.15	0.04	0.02	0.27*	0.37*
	(0.11)	(0.12)	(0.16)	(0.18)	(0.16)	(0.20)
Mean dep. vble. for WA III = 0	0.57	0.57	0.52	0.54	0.60	0.61
Effective obs.	607	868	259	383	232	292
Observations	1,463	1,463	793	793	670	670
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.18*	0.19	0.12	0.09	0.38**	0.41**
	(0.10)	(0.12)	(0.14)	(0.17)	(0.17)	(0.19)
Mean dep. vble. for WA III = 0	0.57	0.57	0.54	0.55	0.64	0.60
Effective obs.	630	772	345	446	166	264
Observations	1,425	1,425	769	769	656	656
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.07	0.11	-0.03	-0.07	0.32*	0.37*
	(0.11)	(0.13)	(0.14)	(0.16)	(0.18)	(0.21)
Mean dep. vble. for WA III = 0	0.58	0.59	0.58	0.58	0.60	0.60
Effective obs.	571	686	318	422	187	286
Observations	1,450	1,450	786	786	664	664
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.13	0.20	0.02	0.09	0.33**	0.31
	(0.11)	(0.13)	(0.14)	(0.19)	(0.17)	(0.19)
Mean dep. vble. for WA III = 0	0.57	0.58	0.56	0.58	0.61	0.59
Effective obs.	522	664	279	323	171	291
Observations	1,405	1,405	757	757	648	648
Order of polynomial in control function:	1	2	1	2	1	2

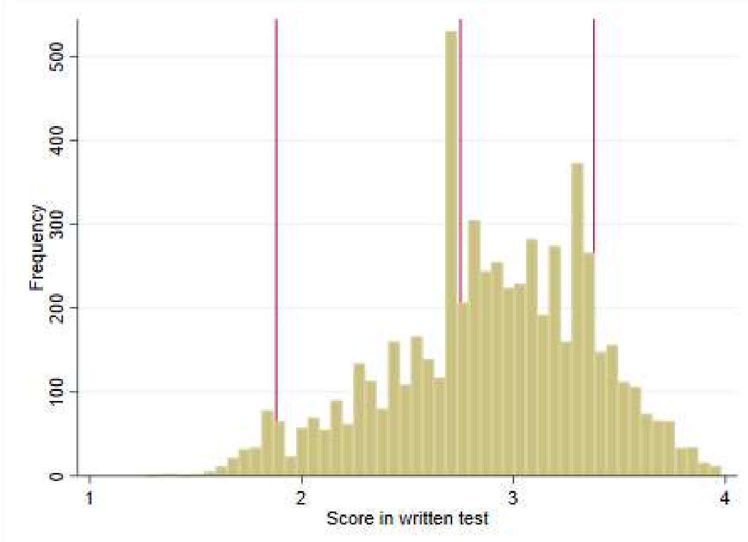
Table 7: Impact of winning third level award (relative to not winning)
on teaching at a disadvantaged and high-performing school in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.03	0.03	0.10	0.05	-0.05	-0.02
	(0.11)	(0.12)	(0.16)	(0.18)	(0.11)	(0.12)
Mean dep. vble. for WA III = 0	0.32	0.32	0.43	0.46	0.15	0.13
Effective obs.	559	827	255	389	199	301
Observations	1,436	1,436	785	785	651	651
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.06	0.02	0.09	0.01	-0.02	0.01
	(0.08)	(0.10)	(0.13)	(0.18)	(0.10)	(0.11)
Mean dep. vble. for WA III = 0	0.32	0.32	0.45	0.46	0.15	0.12
Effective obs.	670	788	351	367	196	335
Observations	1,335	1,335	734	734	601	601
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.00	0.05	0.11	0.12	-0.16	-0.18
	(0.10)	(0.13)	(0.13)	(0.18)	(0.11)	(0.13)
Mean dep. vble. for WA III = 0	0.34	0.34	0.44	0.45	0.20	0.20
Effective obs.	643	645	353	369	259	271
Observations	1,407	1,407	774	774	633	633
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.03	0.01	0.09	0.17	-0.09	-0.08
	(0.08)	(0.11)	(0.14)	(0.20)	(0.10)	(0.11)
Mean dep. vble. for WA III = 0	0.34	0.33	0.43	0.43	0.19	0.18
Effective obs.	646	715	290	292	249	311
Observations	1,302	1,302	721	721	581	581
Order of polynomial in control function:	1	2	1	2	1	2

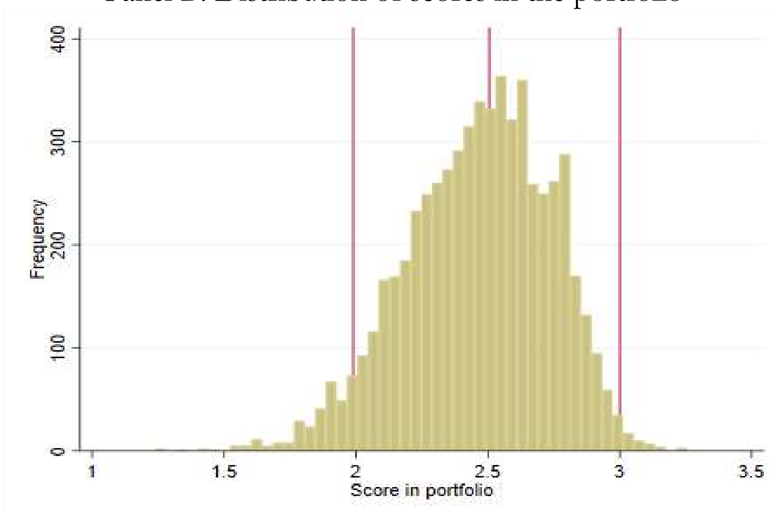
Figures

Figure 1: Distribution of scores in both AEP instruments

Panel A: Distribution of scores in the knowledge test



Panel B: Distribution of scores in the portfolio

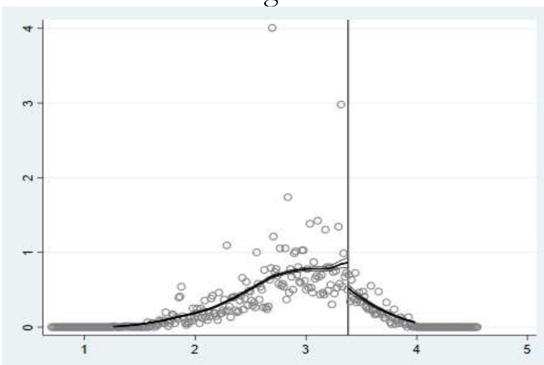


Notes: The three vertical lines in each panel indicate the threshold scores between categories A and B, B and C, and C and D respectively.

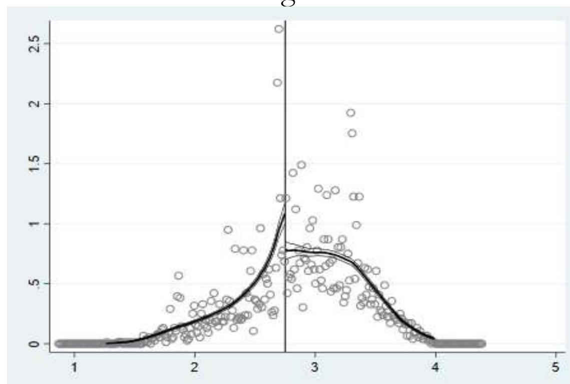
Figure 2: McCrary test plots

Panel A: Score in knowledge test as running variable

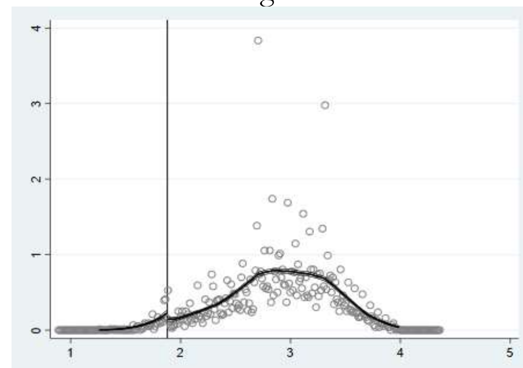
Between categories A and B



Between categories B and C

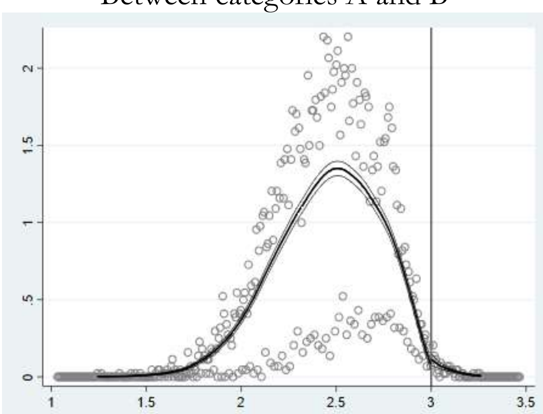


Between categories C and D

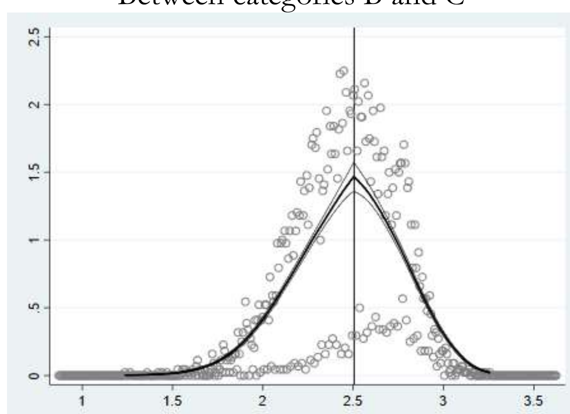


Panel B: Score in portfolio as running variable

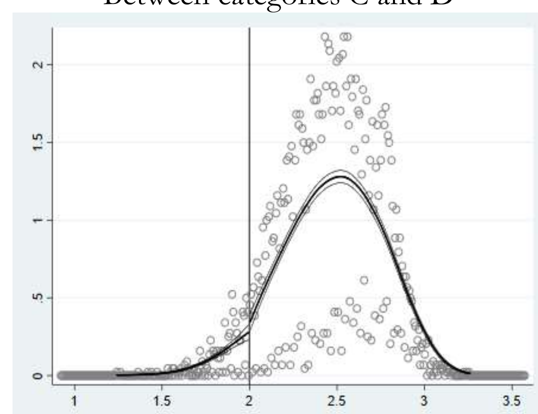
Between categories A and B



Between categories B and C



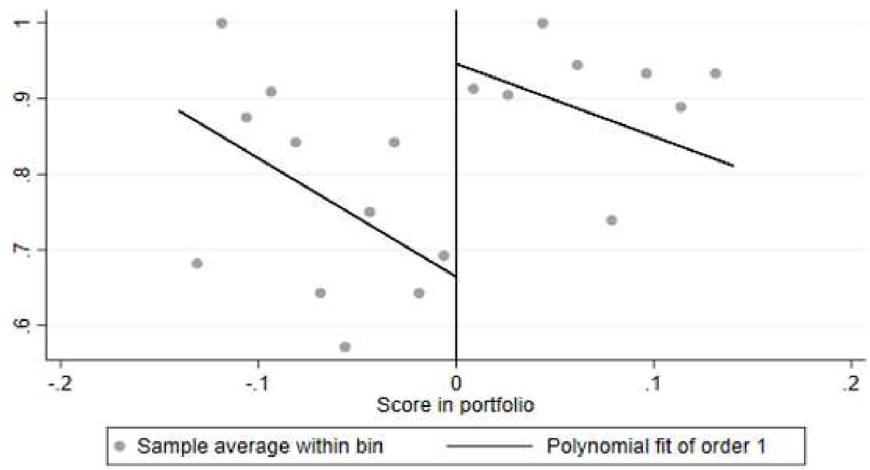
Between categories C and D



Notes: The results of these tests are shown in panels A and B of table 3.

Figure 3: Predicted probability of teaching at a disadvantaged school in *t+2*

(Sample: Teachers at disadvantaged schools in *t*)



Appendix

Table A1: Continuity tests

Impact of winning second level award (relative to winning third level award) on baseline covariates

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variables: Teacher characteristics in t						
Woman = 1	0.08	0.08	0.06	0.07	0.17	0.17
	(0.08)	(0.08)	(0.10)	(0.12)	(0.12)	(0.14)
Age	-0.77	-2.05	-0.43	-1.11	-3.20	-3.36
	(1.19)	(1.72)	(1.82)	(2.21)	(2.68)	(2.99)
Teacher experience	0.98	0.50	1.51	1.57	-0.52	-0.67
	(1.11)	(1.55)	(1.57)	(1.74)	(2.52)	(2.87)
Works at more than one school	-0.09*	-0.09	-0.10	-0.09	-0.11	-0.13
	(0.05)	(0.06)	(0.07)	(0.08)	(0.08)	(0.10)
Primary school teacher	0.06	0.08	0.13	0.17	-0.17	-0.17
	(0.08)	(0.09)	(0.10)	(0.11)	(0.13)	(0.16)
Permanent teacher	0.15	0.13	0.05	0.07	0.10	0.06
	(0.09)	(0.11)	(0.11)	(0.13)	(0.16)	(0.17)
Contract hours	0.55	0.73	3.47*	3.87*	-0.27	-0.60
	(1.02)	(1.36)	(1.86)	(2.04)	(1.74)	(1.78)
Outcome variables: School characteristics in t						
Rural	0.06	0.07	0.12	0.16	-0.01	-0.08
	(0.06)	(0.07)	(0.10)	(0.12)	(0.05)	(0.06)
In Santiago metropolitan area	-0.13	-0.14	-0.20*	-0.22	-0.07	-0.11
	(0.08)	(0.09)	(0.12)	(0.14)	(0.13)	(0.16)
Municipal school	-0.08	-0.08	-0.07	-0.11	-0.01	-0.01
	(0.09)	(0.09)	(0.11)	(0.14)	(0.14)	(0.15)
Disadvantaged school	0.06	0.05				
	(0.09)	(0.10)				
Percentage of priority students at school	0.05	0.05	0.05**	0.05	0.01	-0.00
	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.04)
High performing school	0.12	0.18*	0.21	0.31*	0.13	0.22
	(0.08)	(0.11)	(0.13)	(0.16)	(0.11)	(0.15)
Outcome variables: School of the teacher in t-1						
Disadvantaged school in t - 1	0.10	0.09	0.11	0.08	0.05	0.03
	(0.08)	(0.11)	(0.11)	(0.14)	(0.05)	(0.05)
High performing school in t - 1	0.03	0.02	0.12	0.17	-0.05	-0.15
	(0.09)	(0.10)	(0.12)	(0.15)	(0.11)	(0.17)
Disadv. and high performing school in t - 1	0.12	0.14	0.18	0.20	0.02	-0.01
	(0.08)	(0.11)	(0.12)	(0.16)	(0.04)	(0.05)
Order of polynomial in control function:	1	2	1	2	1	2

Table A2: Impact of winning third level award (relative to not winning) on attrition in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.05	-0.02	0.00	-0.01	-0.12*	-0.10
	(0.05)	(0.07)	(0.08)	(0.10)	(0.07)	(0.07)
Mean dep. vble. for WA III = 0	0.07	0.06	0.04	0.04	0.10	0.10
Effective obs.	693	638	282	388	243	310
Observations	1,518	1,518	817	817	701	701
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	-0.05	-0.02	0.01	0.02	-0.14**	-0.12
	(0.05)	(0.07)	(0.08)	(0.10)	(0.07)	(0.08)
Mean dep. vble. for WA III = 0	0.06	0.06	0.04	0.04	0.10	0.10
Effective obs.	659	659	266	388	276	314
Observations	1,410	1,410	765	765	645	645
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.00	0.01	0.00	0.01	-0.01	0.04
	(0.04)	(0.06)	(0.06)	(0.07)	(0.08)	(0.12)
Mean dep. vble. for WA III = 0	0.08	0.08	0.05	0.05	0.12	0.10
Effective obs.	715	712	282	361	242	285
Observations	1,518	1,518	817	817	701	701
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.00	0.03	0.00	0.01	-0.04	-0.03
	(0.05)	(0.06)	(0.06)	(0.07)	(0.08)	(0.11)
Mean dep. vble. for WA III = 0	0.08	0.08	0.04	0.05	0.12	0.11
Effective obs.	599	660	265	401	245	314
Observations	1,410	1,410	765	765	645	645
Order of polynomial in control function:	1	2	1	2	1	2

Table A3: Impact of winning third level award (relative to not winning) on retention in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.02	-0.02	-0.05	-0.08	0.11**	0.09
	(0.04)	(0.06)	(0.07)	(0.09)	(0.06)	(0.07)
Mean dep. vble. for WA III = 0	0.97	0.98	0.98	0.98	0.96	0.96
Effective obs.	600	601	290	362	274	305
Observations	1,518	1,518	817	817	701	701
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.01	-0.01	-0.07	-0.09	0.10*	0.08
	(0.05)	(0.06)	(0.07)	(0.08)	(0.06)	(0.07)
Mean dep. vble. for WA III = 0	0.98	0.97	0.99	0.98	0.96	0.96
Effective obs.	554	640	253	374	285	305
Observations	1,410	1,410	765	765	645	645
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.02	-0.04	-0.03	-0.03	0.00	-0.01
	(0.03)	(0.04)	(0.04)	(0.05)	(0.02)	(0.03)
Mean dep. vble. for WA III = 0	0.97	0.96	0.96	0.96	0.97	0.96
Effective obs.	448	658	306	463	233	241
Observations	1,518	1,518	817	817	701	701
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	-0.03	-0.04	-0.05	-0.06	-0.00	0.00
	(0.03)	(0.04)	(0.05)	(0.06)	(0.02)	(0.03)
Mean dep. vble. for WA III = 0	0.97	0.96	0.97	0.96	0.96	0.96
Effective obs.	413	652	250	387	241	245
Observations	1,410	1,410	765	765	645	645
Order of polynomial in control function:	1	2	1	2	1	2

Table A4: Impact of winning third level award (relative to not winning) on teaching at a disadvantaged school in t+1 and t+2

Using greater bandwidth

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.04	-0.04	0.08	0.05	-0.15*	-0.08
	(0.09)	(0.11)	(0.08)	(0.09)	(0.09)	(0.12)
Mean dep. vble. for WA III = 0	0.57	0.56	0.87	0.85	0.19	0.18
Effective obs.	764	966	383	526	384	398
Observations	1,444	1,444	790	790	654	654
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	-0.01	-0.02	0.11*	0.06	-0.11	-0.09
	(0.06)	(0.07)	(0.06)	(0.09)	(0.09)	(0.10)
Mean dep. vble. for WA III = 0	0.57	0.56	0.86	0.86	0.19	0.19
Effective obs.	675	1,017	410	473	354	464
Observations	1,348	1,348	742	742	606	606
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.04	0.08	0.23***	0.27**	-0.21**	-0.22*
	(0.08)	(0.11)	(0.08)	(0.12)	(0.10)	(0.12)
Mean dep. vble. for WA III = 0	0.58	0.58	0.78	0.78	0.32	0.29
Effective obs.	867	788	471	472	404	510
Observations	1,410	1,410	776	776	634	634
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.06	0.06	0.23***	0.23**	-0.12	-0.13
	(0.06)	(0.08)	(0.08)	(0.11)	(0.10)	(0.11)
Mean dep. vble. for WA III = 0	0.58	0.58	0.78	0.79	0.33	0.31
Effective obs.	984	943	409	519	335	455
Observations	1,314	1,314	729	729	585	585
Order of polynomial in control function:	1	2	1	2	1	2

Table A5: Impact of winning third level award (relative to not winning) on teaching at a disadvantaged school in t+1 and t+2

Using smaller bandwidth

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.00	0.03	0.02	0.04	-0.09	-0.09
	(0.12)	(0.15)	(0.11)	(0.13)	(0.11)	(0.15)
Mean dep. vble. for WA III = 0	0.58	0.59	0.85	0.85	0.22	0.21
Effective obs.	454	563	225	322	218	225
Observations	1,444	1,444	790	790	654	654
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	-0.04	-0.03	0.01	0.05	-0.06	-0.05
	(0.08)	(0.09)	(0.08)	(0.12)	(0.11)	(0.12)
Mean dep. vble. for WA III = 0	0.59	0.58	0.85	0.84	0.21	0.19
Effective obs.	391	599	244	292	200	255
Observations	1,348	1,348	742	742	606	606
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.09	0.17	0.28**	0.24	-0.19	-0.19
	(0.11)	(0.15)	(0.11)	(0.16)	(0.13)	(0.15)
Mean dep. vble. for WA III = 0	0.60	0.60	0.75	0.75	0.37	0.33
Effective obs.	509	452	290	291	222	286
Observations	1,410	1,410	776	776	634	634
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.07	0.08	0.20*	0.21	-0.12	-0.11
	(0.08)	(0.11)	(0.12)	(0.15)	(0.12)	(0.13)
Mean dep. vble. for WA III = 0	0.59	0.60	0.75	0.76	0.38	0.34
Effective obs.	594	549	243	318	194	251
Observations	1,314	1,314	729	729	585	585
Order of polynomial in control function:	1	2	1	2	1	2

Table A6: Impact of winning third level award (relative to not winning) on teaching at a high-performing school in t+1 and t+2

Using greater bandwidth

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.15*	0.15	0.10	0.06	0.18	0.25
	(0.09)	(0.10)	(0.13)	(0.15)	(0.14)	(0.17)
Mean dep. vble. for WA III = 0	0.57	0.58	0.54	0.55	0.61	0.62
Effective obs.	837	1,184	372	528	328	446
Observations	1,463	1,463	793	793	670	670
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.19**	0.18*	0.19*	0.17	0.21	0.25
	(0.08)	(0.10)	(0.11)	(0.13)	(0.14)	(0.16)
Mean dep. vble. for WA III = 0	0.57	0.59	0.55	0.56	0.61	0.61
Effective obs.	876	1,106	461	615	235	382
Observations	1,425	1,425	769	769	656	656
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.08	0.08	0.07	0.02	0.14	0.20
	(0.09)	(0.11)	(0.11)	(0.13)	(0.15)	(0.18)
Mean dep. vble. for WA III = 0	0.58	0.59	0.58	0.58	0.59	0.59
Effective obs.	776	1,003	422	592	272	418
Observations	1,450	1,450	786	786	664	664
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.13	0.13	0.10	0.03	0.11	0.15
	(0.09)	(0.11)	(0.11)	(0.15)	(0.14)	(0.16)
Mean dep. vble. for WA III = 0	0.59	0.58	0.58	0.58	0.58	0.59
Effective obs.	735	936	394	444	250	427
Observations	1,405	1,405	757	757	648	648
Order of polynomial in control function:	1	2	1	2	1	2

Table A7: Impact of winning third level award (relative to not winning) on teaching at a high-performing school in t+1 and t+2

Using smaller bandwidth

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.16	0.16	0.05	0.06	0.36**	0.45**
	(0.12)	(0.13)	(0.18)	(0.21)	(0.18)	(0.22)
Mean dep. vble. for WA III = 0	0.56	0.57	0.52	0.54	0.63	0.61
Effective obs.	489	702	225	322	186	247
Observations	1,463	1,463	793	793	670	670
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.18*	0.25*	0.09	0.09	0.41**	0.49**
	(0.11)	(0.13)	(0.16)	(0.19)	(0.17)	(0.21)
Mean dep. vble. for WA III = 0	0.56	0.57	0.53	0.54	0.63	0.61
Effective obs.	524	657	269	382	138	225
Observations	1,425	1,425	769	769	656	656
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.12	0.18	-0.05	-0.05	0.43**	0.47**
	(0.12)	(0.15)	(0.15)	(0.18)	(0.20)	(0.24)
Mean dep. vble. for WA III = 0	0.58	0.59	0.56	0.58	0.60	0.57
Effective obs.	462	577	256	361	153	232
Observations	1,450	1,450	786	786	664	664
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.21*	0.29**	0.05	0.13	0.43**	0.43**
	(0.12)	(0.14)	(0.15)	(0.21)	(0.17)	(0.21)
Mean dep. vble. for WA III = 0	0.58	0.57	0.56	0.56	0.60	0.58
Effective obs.	427	529	242	258	143	243
Observations	1,405	1,405	757	757	648	648
Order of polynomial in control function:	1	2	1	2	1	2

Table A8: Impact of winning third level award (relative to not winning) on teaching at a disadvantaged and high-performing school in t+1 and t+2

Using greater bandwidth

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.05	0.05	0.15	0.14	-0.07	-0.07
	(0.09)	(0.10)	(0.13)	(0.14)	(0.09)	(0.10)
Mean dep. vble. for WA III = 0	0.32	0.32	0.46	0.47	0.12	0.13
Effective obs.	788	1,156	367	560	282	462
Observations	1,436	1,436	785	785	651	651
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.08	0.06	0.20*	0.10	-0.05	-0.07
	(0.07)	(0.09)	(0.11)	(0.15)	(0.09)	(0.09)
Mean dep. vble. for WA III = 0	0.32	0.32	0.46	0.47	0.13	0.13
Effective obs.	985	1,099	469	503	276	496
Observations	1,335	1,335	734	734	601	601
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.03	-0.00	0.17	0.09	-0.19**	-0.15
	(0.08)	(0.11)	(0.11)	(0.15)	(0.10)	(0.12)
Mean dep. vble. for WA III = 0	0.33	0.33	0.45	0.44	0.18	0.18
Effective obs.	905	915	468	506	388	398
Observations	1,407	1,407	774	774	633	633
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.05	0.02	0.16	0.10	-0.12	-0.11
	(0.07)	(0.09)	(0.11)	(0.16)	(0.09)	(0.10)
Mean dep. vble. for WA III = 0	0.33	0.33	0.45	0.45	0.18	0.17
Effective obs.	941	1,027	405	416	359	465
Observations	1,302	1,302	721	721	581	581
Order of polynomial in control function:	1	2	1	2	1	2

Table A9: Impact of winning third level award (relative to not winning) on teaching at a disadvantaged and high-performing school in t+1 and t+2

Using smaller bandwidth

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.05	0.06	0.15	0.13	-0.01	-0.02
	(0.12)	(0.13)	(0.18)	(0.20)	(0.12)	(0.13)
Mean dep. vble. for WA III = 0	0.31	0.32	0.44	0.45	0.15	0.13
Effective obs.	453	685	223	342	161	253
Observations	1,436	1,436	785	785	651	651
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.02	0.00	-0.00	0.12	0.01	0.01
	(0.09)	(0.11)	(0.15)	(0.21)	(0.11)	(0.11)
Mean dep. vble. for WA III = 0	0.33	0.32	0.44	0.44	0.17	0.13
Effective obs.	565	648	273	292	148	276
Observations	1,335	1,335	734	734	601	601
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.01	0.10	0.09	0.18	-0.17	-0.15
	(0.11)	(0.15)	(0.15)	(0.21)	(0.12)	(0.14)
Mean dep. vble. for WA III = 0	0.34	0.34	0.44	0.43	0.21	0.21
Effective obs.	513	544	276	292	217	220
Observations	1,407	1,407	774	774	633	633
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.01	0.02	0.11	0.17	-0.12	-0.13
	(0.09)	(0.12)	(0.15)	(0.22)	(0.10)	(0.12)
Mean dep. vble. for WA III = 0	0.34	0.34	0.43	0.44	0.22	0.20
Effective obs.	547	608	241	253	208	252
Observations	1,302	1,302	721	721	581	581
Order of polynomial in control function:	1	2	1	2	1	2

Table A10: Impact of winning second level award (relative to winning third level award) on teaching at a disadvantaged school in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	-0.06	-0.08	0.01	-0.00	-0.25**	-0.30**
	(0.10)	(0.12)	(0.08)	(0.10)	(0.10)	(0.12)
Mean dep. vble. for WA III = 0	0.47	0.47	0.82	0.84	0.15	0.13
Effective obs.	624	809	322	418	261	389
Observations	1,867	1,867	918	918	949	949
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	-0.13**	-0.16**	-0.01	-0.09	-0.20**	-0.26**
	(0.07)	(0.08)	(0.07)	(0.10)	(0.09)	(0.11)
Mean dep. vble. for WA III = 0	0.47	0.48	0.84	0.84	0.15	0.13
Effective obs.	572	846	418	418	259	406
Observations	1,683	1,683	830	830	853	853
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.20*	0.18	0.22**	0.19	0.04	0.05
	(0.10)	(0.12)	(0.10)	(0.12)	(0.12)	(0.13)
Mean dep. vble. for WA III = 0	0.46	0.46	0.73	0.76	0.19	0.18
Effective obs.	659	874	383	456	349	579
Observations	1,827	1,827	908	908	919	919
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.07	0.06	0.10	0.11	0.06	0.05
	(0.07)	(0.08)	(0.08)	(0.09)	(0.12)	(0.13)
Mean dep. vble. for WA III = 0	0.46	0.48	0.74	0.77	0.20	0.19
Effective obs.	715	994	393	586	328	479
Observations	1,644	1,644	816	816	828	828
Order of polynomial in control function:	1	2	1	2	1	2

Table A11: Impact of winning second level award (relative to winning third level award) on teaching at a high performing school in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.19**	0.24**	0.07	0.31*	0.30**	0.28*
	(0.10)	(0.12)	(0.12)	(0.16)	(0.12)	(0.15)
Mean dep. vble. for WA III = 0	0.60	0.63	0.67	0.67	0.59	0.59
Effective obs.	533	700	374	351	319	400
Observations	1,895	1,895	926	926	969	969
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.20**	0.20*	-0.08	0.14	0.35***	0.36***
	(0.10)	(0.12)	(0.10)	(0.15)	(0.11)	(0.14)
Mean dep. vble. for WA III = 0	0.58	0.63	0.64	0.67	0.52	0.58
Effective obs.	481	744	404	375	248	348
Observations	1,823	1,823	892	892	931	931
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.13	0.19*	0.08	0.23	0.20	0.20
	(0.09)	(0.11)	(0.12)	(0.16)	(0.12)	(0.14)
Mean dep. vble. for WA III = 0	0.65	0.62	0.62	0.61	0.64	0.63
Effective obs.	645	851	391	419	334	495
Observations	1,874	1,874	923	923	951	951
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.11	0.16	0.08	0.14	0.20	0.25*
	(0.09)	(0.11)	(0.11)	(0.14)	(0.13)	(0.15)
Mean dep. vble. for WA III = 0	0.64	0.62	0.64	0.63	0.61	0.63
Effective obs.	583	857	375	463	264	412
Observations	1,797	1,797	885	885	912	912
Order of polynomial in control function:	1	2	1	2	1	2

Table A12: Impact of winning second level award (relative to winning third level award) on teaching at a disadvantaged and high performing school in t+1 and t+2

Sample:	All teachers		Teachers at disadvantaged schools in t		Teachers at non-disadvantaged schools in t	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact in t+1						
Panel A1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.02	0.07	0.06	0.24	-0.05	-0.15
	(0.09)	(0.12)	(0.12)	(0.17)	(0.08)	(0.10)
Mean dep. vble. for WA III = 0	0.30	0.29	0.55	0.56	0.06	0.06
Effective obs.	769	887	383	369	359	409
Observations	1,856	1,856	911	911	945	945
Panel A2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	-0.05	0.01	-0.07	0.09	-0.03	-0.12
	(0.06)	(0.10)	(0.10)	(0.15)	(0.07)	(0.09)
Mean dep. vble. for WA III = 0	0.30	0.29	0.55	0.54	0.06	0.06
Effective obs.	956	841	456	396	361	409
Observations	1,661	1,661	819	819	842	842
Panel B: Impact in t+2						
Panel B1: Controlling only for year fixed effects						
Winning AEP III (WA III) = 1	0.17*	0.21*	0.18	0.24*	0.08	0.11
	(0.10)	(0.11)	(0.12)	(0.14)	(0.10)	(0.14)
Mean dep. vble. for WA III = 0	0.28	0.26	0.45	0.45	0.10	0.10
Effective obs.	609	832	339	454	399	472
Observations	1,824	1,824	907	907	917	917
Panel B2: Controlling also for baseline covariates						
Winning AEP III (WA III) = 1	0.10	0.14	0.05	0.18	0.12	0.13
	(0.09)	(0.11)	(0.11)	(0.15)	(0.11)	(0.13)
Mean dep. vble. for WA III = 0	0.28	0.26	0.44	0.44	0.11	0.10
Effective obs.	622	791	410	431	349	459
Observations	1,625	1,625	807	807	818	818
Order of polynomial in control function:	1	2	1	2	1	2