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Teacher mobility and merit pay: Evidence from a voluntary public award program☆

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ABSTRACT

This paper analyzes the effect on teacher mobility of a program that rewards excellence in teaching practices in Chile. Successful applicants receive a 6% annual wage increase for up to 10 years and an award that publicly recognizes their excellence. The paper uses a regression discontinuity design to identify the causal effect of the public merit award. The program does not alter transitions out of teaching. However, it increases the mobility of awardees within the school system. This is consistent with the program providing a credible public signal of teacher quality.

1. Introduction

An efficient and equitable public school system requires that classrooms be staffed with good teachers. However, relatively low teacher wages and rigid wage structures make it difficult for schools to attract and retain teachers; and flat wages across schools lead to teachers sorting on non-pecuniary aspects of employment (Rosen, 1986). In the United States, for example, good teachers tend to work in schools that serve more affluent students (Hanushek et al., 2004; Jackson, 2009). In Norway, good teachers prefer schools with a higher share of native students (Bonesrønning et al., 2005).

This paper provides quasi-experimental evidence of the causal impact on teacher mobility of a Chilean program that rewards pedagogical excellence. As in the United States and other Organization for Economic Development and Co-operation (OECD) countries, teachers in Chile are paid less than two-thirds of the earnings of similarly educated workers in other occupations and 8% leave the public school system every year.[1,2] Intending to reduce teacher turnover, the Chilean government introduced the Pedagogical Excellence Award (*Asignación a la Excelencia Pedagógica* – AEP). Successful applicants to the program receive a 6% yearly wage increase for up to 10 years and a public award from the Ministry of Education.[3]

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[1] In the United States, teachers earn 65% of what they could have earned in other career paths, and 7% of them leave the profession every year, according to statistics from the U.S. Department of Education (http://nces.ed.gov/pubs2014/2014077.pdf). This number is consistent with the proportion of teachers who leave at both city and state levels. See Staiger and Rockoff (2010) for evidence for Los Angeles and New York City; see Hanushek et al. (2004) and Hanushek et al. (2016) for Texas.

[2] Among OECD countries, school teachers make around 85% of the average earnings of tertiary-educated full-time workers (OECD, 2017).

[3] Increasing wages for all teachers or only for teachers with certain qualifications results in higher retention rates (Clotfelter et al., 2008; Falch, 2011; Ransom and Sims, 2010). Nonetheless, large wage increases across the board may be economically and politically unfeasible, as education ministries already spend around 60% of their budget on teachers' wages (OECD, 2017). More importantly, higher wages may not lead to better student outcomes because the wage increase is not related to teacher performance (De Ree et al., 2018). Tying wages to performance could potentially address the issue, yet unions worldwide oppose the introduction of performance measurement and compulsory standardized assessment (Lavy, 2009; Leigh, 2013; Jones, 2013). Thus, the remaining alternative is to make quality-based compensation policies voluntary.

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The ultimate success of the initiative, however, is not guaranteed. The program may reduce teachers' separation rates from the school system, but it may also create rents for successful teachers. Furthermore, it generates a public, verifiable signal of teacher quality. If teacher quality was previously unobservable to the market, the award may give good teachers a signal to use with prospective employers (Spence, 1973). In the case of Chile, students are highly segregated into schools by socioeconomic status (Mizala et al., 2007). Therefore, if the teachers who receive the award prefer schools with more affluent students, the program may foster an unequal distribution of good teachers.

Applications to the Pedagogical Excellence Award (AEP) are voluntary. To receive the award teachers must prove their expertise by preparing a teaching portfolio and taking a knowledge test.[4] The results of both assessments are combined in a final score and only those scoring above a certain threshold receive the award. This paper identifies the causal effect of the program using a sharp regression discontinuity design. We use administrative data for nine cohorts of applicants followed for five years. This unique dataset allows for tracking workers throughout the entire Chilean educational system. As a result, we can distinguish between exits from the profession and reallocations within the education sector.

Our estimates indicate that, locally, the incentive package does not alter transitions out of the school system in a five-year window. As a result, the 6% salary increase from the award does not appear to be a decisive factor for the roughly 15% of teachers near the threshold who would leave the system in the five years following their application to the program. We interpret this finding as suggestive evidence that at the margin at which the program selects teachers, their outside option is not strongly correlated with teaching efficacy.

Obtaining the award has a positive effect on the likelihood of switching to a new school, indicating that it provides teachers with a credible signal of unobservable quality that was previously unavailable in the market. Consistent with the notion that principals have private information about their employees and that information asymmetries increase with tenure (Bates, 2020), we find suggestive evidence that mobility increases for the most experienced of teachers after receiving the award. Perhaps surprisingly, we find no conclusive evidence that the award leads to a more unequal distribution of talented teachers across schools.

Our paper is closest to Bates (2020) who looks at the effect of releasing a public measure of teachers' value-added on teachers' mobility for two of the largest school districts in North Carolina. The introduction of a signal of teacher quality induced talented teachers to move to high performing schools. Therefore, the signal increased inequality in access to high-quality teaching. In North Carolina, the information on teacher quality was revealed for all teachers in the district. In contrast, Chile's Pedagogical Excellence Award only issues the signal for high quality teachers that succeed in their application.

Our study also relates to Goldhaber and Hansen (2009) who study the effects of the National Board of Professional Teaching Standards (NBPTS) certification program on teachers' career paths in North Carolina. As in the setting of our study, the state of North Carolina covers the full cost of the assessment and pays certified teachers a 12% salary increase. Certified teachers are more likely to leave North Carolina's public school system, with schools serving a higher share of minority students harder hit. Due to data limitations, it is not possible to know whether they leave the profession or move to school systems in other states or to private schools. More recent studies have looked at the effect of offering certified teachers bonuses if they stay or are hired in hard-to-staff schools (Glazerman and Seifullah, 2012; Springer et al., 2016; Swain et al., 2019; Feng and Sass, 2018; Cowan and Goldhaber, 2018). Unlike all these papers, a unique feature of our setting is that we can track the movement of teachers across the whole educational system.

Within the education literature, we complement the work on performance incentives for teachers (Duflo et al., 2012; Fryer, 2013; Goodman and Turner, 2013; Lavy, 2002, 2009; Glewwe et al., 2010; Muralidharan and Sundararaman, 2011; Figlio and Kenny, 2007; Springer et al., 2012; Barrera-Osorio and Raju, 2017; Behrman et al., 2015; Loyalka et al., 2019; Gilligan et al., 2018; Imberman and Lovenheim, 2015; Pugatch and Schroeder, 2018; Balch and Springer, 2015). Most of this literature focuses on how rewarding an output measure of performance affects teachers' productivity[5]. Fewer papers look at the effects of rewarding a measure of teachers' inputs (Clotfelter et al., 2006, 2007; Duflo et al., 2012; Goldhaber et al., 2007; Goldhaber and Anthony, 2007). The mobility and distributional consequences of these policies are rarely studied.

Section 2 of this paper provides some background on the Chilean education system and the design of the program. Section 3 describes the data used. Section 4 presents the identification strategy. Section 5 presents our results and Section 6 discusses the broader implications of the findings.

2. Background

Primary and secondary education in Chile is provided by three types of institutions: municipal schools, private-subsidized schools, and private schools. Municipal schools are non-profit institutions that offer instruction to students for free, receive a per-student subsidy from the Ministry of Education, and are administered by municipalities. Private schools are for-profit institutions that charge tuition fees, receive no subsidies from the government, and are administered as private corporations. Private-subsidized schools are run like private schools, receive the same per-student subsidy as municipal schools, and can also charge a tuition fee regulated by the government (Mizala and Urquiola, 2013; Mizala and Schneider, 2014). The bulk of the Chilean school system is made up of municipal and private-subsidized schools. In 2010, for instance, 93% of children enrolled in primary and secondary schools attended a municipal school (42%) or a private-subsidized school (51%). The municipal and private-subsidized schools are referred to in this paper as the voucher school system.

The contractual arrangements for teachers are different in the three types of providers. The employment of teachers in municipal schools follows a teacher statute negotiated by the national teachers' union. In the private sector, employment follows the standards established by the common labor law. Employment of teachers in private-subsidized schools retains some aspects of the municipal schools and the private schools (Mizala and Romaguera, 2005; Santiago et al., 2013). For example, the minimum wages, bonuses, and maximum working hours in private-subsidized schools are the same as in municipal schools. Yet, while private-subsidized schools can select, hire, and dismiss teachers, the Teachers' Statute limits the ability of municipal schools to fire teachers.

Wages in the private sector are uniformly higher. Younger teachers have higher wages in private-subsidized schools than in municipal schools, but wages increase faster in the municipal sector. The level of

[4] The design of the program and allocation rule is similar to that of the National Board of Professional Teaching Standards Program (NBPTS) (National Research Council, 2008). Cantrell et al. (2008) suggest that the NBPTS scores capture information that is helpful to identify high talented teachers.

[5] The evidence on the impact of incentive pay on student achievement is mixed. In developing countries, Lavy (2002, 2009) and Muralidharan and Sundararaman (2011) find that paying teachers according to how their students perform improves student achievement. However, using the same measure to assess students and teachers might lead to cheating and teaching to the test (Glewwe et al., 2010). Figlio and Kenny (2007) find that even small financial incentives have a positive effect on student achievement in the United States. Imberman and Lovenheim (2015) point out that the design of the incentive pay system determines to a great extent its effectiveness. The findings of Pugatch and Schroeder (2018) are mixed: incentive pay does not increase average student performance, but it has a positive impact at the top of the score distribution. On the other hand, Balch and Springer (2015), Goodman and Turner (2013), Fryer (2013), and Springer et al. (2012) find little or no short-term effects of incentive pay.

Table 1
Teacher turnover.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

	2003–2016 Teachers		
	Active (t)	Not Active (t)	All
Same school ($t+1$)	0.809	0.000	0.625
New at school ($t+1$)	0.108	0.104	0.107
Out ($t+1$)	0.083	0.896	0.268

Notes: Universe of school teachers between 2003 and 2016. Transitions from t to $t+1$ observed at $t+1$. At every time t a teacher can stay at the same school, change from school, or move out of the school system. A teacher who is out of the system at t and returns to teaching at $t+1$ is considered as a change of school.

wages practically equalizes for the 41–50-year-old age group. After this age, municipal school teachers are paid a higher per hour wage rate than at private-subsidized schools (Bravo et al., 2008).

In 2015, the statutory salary of a typical primary or secondary school teacher in Chile was around US$28,000, less than two-thirds (61%) of what similarly educated workers in other occupations make (OECD, 2017). Besides, there is considerable teacher turnover. Table 1 looks at the transitions of the universe of 360,550 teachers who were not of retirement age during the 2003–2016 period. It shows that 81% of teachers employed at time t remain at the same school at $t+1$. In a given year, the remaining 19% of the contractual relationships between schools and teachers end: 11% of teachers change schools and 8% leave the voucher school system.[6,7] Among teachers who were not working at time t, either because of permanent or temporary (e.g. maternity leave) inactivity, 90% do not come back to work the following period. The remaining 10% goes back to teaching. Hence, teachers who left the school system are unlikely to return.[8]

In response to high levels of teacher turnover and the perception that many good teachers were leaving the profession, in 2002 the Chilean government introduced a voluntary award program to reward excellence in teaching practices, the AEP (Araya-Ramirez et al., 2012). The program was created to recognize voucher school system teachers for their subject knowledge, course curricular content, didactic skills, and classroom competence.

Any teacher working in a municipal or private-subsidized school for at least 20 h a week could apply for the program. To receive the award, applicants prepared a teaching portfolio and took a written test in an area of expertise of their choice. In the portfolio, teachers demonstrated their teaching practices. The assessment required a learning plan for the students, an evaluation strategy, a pedagogical reflection, and a recording of a class. In the written test, teachers were evaluated on the grounds of their chosen subject area and pedagogical knowledge. These assessments are similar to those of the NBPTS certification process, for which the existing evidence documents a positive correlation with teacher effectiveness (Cantrell et al., 2008; Clotfelter et al., 2006, 2007, 2010; Goldhaber and Anthony, 2007; Harris and Sass, 2009). The design and grading of the tests were undertaken by an independent third party contracted by the Ministry of Education. The open questions of the written test and the portfolio were marked by external experts following a subject specific rubric dictated by the Chilean Teaching Excellence Framework (*Marco para la Buena Enseñanza*) (Rodriguez et al., 2015).

The results of the two assessments were combined in a final score ranging from 100 to 400. For the AEP rounds taking place until 2011, the final score was a weighted average, with 70% of the weight given to the portfolio and 30% to the written test (Santiago et al., 2017). Teachers with a final score of at least 275 received the AEP award. To the best of our knowledge, there was no official document available for the applicants where the threshold was stated.[9] Moreover, given the multi-measure nature of the score, non-random manipulation around the 275-threshold was rather unfeasible (we test formally for manipulation of the score in Section 4).

AEP applicants scoring at least 275 received an incentive package consisting of two components. The first was a financial incentive equivalent to a 6% yearly wage increase for up to 10 years. The exact magnitude of the bonus varied at four certification tracks defined by levels of experience: 0–11 years, 12–21 years, 22–30 years, and 31 plus years. Within each of these levels, teachers could apply to the program at most twice. The financial incentives were paid by the government, irrespective of the school, as long as the teachers remained working at least 20 h per week in the voucher school system. The second component was an award from the Ministry of Education that recognized excellence in teaching. We think of the award as a signal of teacher quality that the teacher could use to signal her expertise throughout the entire education system. The awards were publicly announced in ceremonies with local authorities and media coverage, making them salient and giving visibility to the teachers' expertise.

After 2011, several components of the AEP program were restructured. The duration of the financial incentive was reduced from ten to four years. The amount of the payments and the certification tracts were adjusted by performance rather than by experience. Finally, the weights of the portfolio and the knowledge test were readjusted. We consider these changes a complete restructuring of the AEP and, effectively, the post-2011 AEP should be considered a different program (Rodriguez et al., 2015).

We concentrate our analysis on the 2003–2011 period. During these years, there were 14,562 applications. Although teachers could re-apply for the award, less than 12% did so. Further, only 11.89% of the first-time applicants that fail the assessments reapply for the program. Overall around 25% of applicants received the award. Fig. A1 presents the evolution of this rate. Interestingly, the rate varies over time: while 44% of the 2003 applicants received the award, less than 20% did so after 2007. It is worth noting that not all of the subject areas were available at every application wave: middle education subjects were introduced in 2004, pre-K in 2005, and special education and vocational education in 2008. As evidenced in Fig. A2, the AEP recipient rates also differ by subject area.

The entire process of the AEP took about 15 months. Fig. 1 presents a timeline of the process. The school year in Chile begins in March. The application for the program was done between April and May. The portfolio was prepared from July to October. The written examination took place in November. In April, all applicants received a report with their score and performance. The awards were granted during announcement ceremonies between April and July. Those who were successful received the first installment in July. Afterward, payments were made twice a year. The application materials were never returned.

Aside from the AEP, municipal school teachers could apply for an individual performance award known as the Variable Allocation for

[6] In addition to the 8% exit rate, about 0.5% of teachers retire every year. This figure is similar to the 8% exit rate used by Rothstein (2015) for the United States and the 6% exit rate for the Texas public school system documented by Hanushek and Rivkin (2016). Hanushek et al. (2016) find that, on average, 80% of the teachers in the Lone Star District in Texas during 1997 and 2001 stayed at the same school; 6% exited the Texas public school system; the remaining 14% changed either school or district. Similar numbers are found in Hanushek et al. (2004) and Hanushek and Rivkin (2010). Staiger and Rockoff (2010) adopt a similar 5% turnover rate for their simulations, based on the claim that this is the average proportion of experienced teachers who leave the Los Angeles and New York City districts each year. Based on data from the 1999–2000 Schools and Staffing Survey, Rothstein (2015) adopts an 8% annual exit rate.

[7] In Chile, there is a 2.8% monthly separation rate estimated for the entire economy between 2010 and 2015 (Naudon and Pérez, 2018). A rough comparison indicates that teacher turnover is below the annual separation rate for the entire economy.

[8] Overall, if we consider any teacher-year observation in the 2003–2016 period, there is a 62% chance that the teacher is in the same school as he or she was the previous year, an 11% chance of being in another school, and a 27% chance of being out of the school system. A teacher that was temporarily inactive and returns to the same school is effectively considered as being new at school.

[9] This cut-off point was identified by inspecting the data and was confirmed by the *Centro de Perfeccionamiento, Experimentación e Investigaciones Pedagógicas* (CPEIP) in internal correspondence.

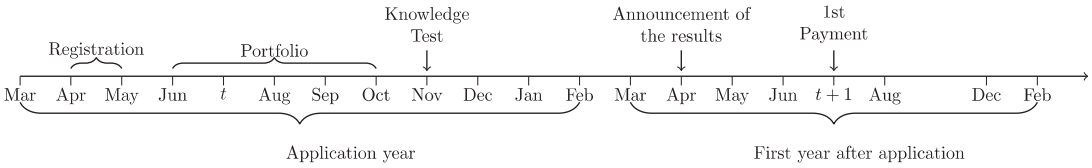

Fig. 1. Timeline.
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

Individual Performance (*Asignación Variable al Desempeño Individual* – AVDI). Teachers can receive both the AEP and the AVDI and can apply for them simultaneously, although less than 10% do so. For collective performance incentives, the government offers the National System for Performance Evaluation (*Sistema Nacional de Evaluación del Desempeño* – SNED) for all schools in the voucher system. In a given geographical region and within school types, SNED groups schools with similar student socioeconomic characteristics in clusters. Within these clusters, every two years, the schools are ranked according to six subindices that include student achievement on the national standardized tests known as the Education Quality Measurement System (*Sistema de Medición de la Calidad de la Educación* – SIMCE), the school's repetition and dropout rates, parental participation and perception of the school, and school working conditions.[10] All the teachers in the best ranked schools within each cluster receive an annual bonus equivalent to 50–70% of a teacher's monthly salary (Mizala and Urquiola, 2013). In 2017, both the AEP and the AVDI were replaced by a certification process associated with a new career structure: System for the Recognition of Teacher Professional Development (*Sistema de Reconocimiento del Desarrollo Profesional Docente*) (Santiago et al., 2017).

3. Data

We use administrative data for the universe of teachers in the school system published yearly by the Ministry of Education. The dataset is available from 2003 and contains information on basic demographics, educational qualifications, experience, and place and hours of work for all active teachers as of June 30 of each year. We match these records with the scores and award status of individual applicants to the AEP.

We are interested in understanding whether teachers who get the award sort on academic performance or students' socio-economic status. We draw information on schools' academic performance[11] and student socio-economic status (SES) from the SNED data set. The SES variable comes in five categories: low, middle-low, middle, middle-high and high. To improve our empirical analysis, we further construct a continuous measure of SES using the share of disadvantaged students in each school.[12] Unfortunately, this data is only available from 2008; thus, we assign each school to the average share of disadvantaged students in the 2008–2016 period.

To build our estimation sample, we start with 14,562 teachers who applied for the AEP between 2003 and 2011, and we concentrate on the 12,797 first-time applicants.[13] Among that group, 12,503 have complete administrative records. Finally, we eliminate teachers who at the time of application were working in schools for which there was no student socioeconomic status information. This gives us a sample of 12,162 applicants (Table A1).

The first column of Table 2 presents descriptive statistics for all the 1,227,513 teacher-year observations of teachers working at least 20 h a week in the voucher school system during the 2003–2011 period. The second column presents analogous information for those teachers who applied for the AEP program at the time of their application. Next, the table presents the beta coefficients of an ordinary least squares (OLS) regression of the decision to apply for the AEP on teacher and school characteristics. Columns four and five present the same descriptive statistics at different points of the distribution of the AEP score. Column six presents the estimated coefficients of an OLS regression of the AEP score on teacher characteristics at the time of application.

The average Chilean teacher was a 42-year-old woman with a degree in education and 19 years of teaching experience working 38 h a week.[14] Sixty-two percent of teachers were primary school teachers and 17% worked as middle school teachers. Forty-three percent of teachers worked at schools considered by SNED as middle, middle-high or high socioeconomic status ("High SES schools").

Relative to the average voucher school system teacher, at the time of their application for the award, the AEP applicants are slightly younger, more likely to have a degree in education, and more likely to work at more than one school. AEP applicants are also more likely to be previously AVDI certified and to be working at high socioeconomic status schools and at schools currently awarded with SNED.

The fourth and fifth columns of Table 2 present average teacher characteristics around the discontinuity threshold (275). As can be seen from the sample size, a large mass of AEP applicants (94%) score between 200 and 349 points. Teachers scoring between 200 and 274 and between 275 and 349 are relative similar in terms of gender, number of contracted hours, number of schools where teachers work, and percentage of teachers working in SNED-awarded schools, private-subsidized schools, Santiago metropolitan region schools, and rural schools. The score, however, is negatively correlated with age, and positively correlated with having a degree in education, being a primary or middle school teacher, receiving the AVDI certification, and working at more affluent schools. This is confirmed in column six in Table 2. Ceteris paribus, in the AEP score, a degree in education is associated with three additional points; being a primary or middle school teacher is associated with five additional points; teaching at a high socioeconomic status school is associated with another five additional points; and being previously AVDI certified is associated with almost 20 additional points.[15]

4. Empirical strategy

Receiving the AEP incentive package is a deterministic function of the applicant's aggregate score. Yet, as shown in column six of Table 2, this measure of teacher performance is associated with other potential determinants of teacher behavior. Therefore, if we want to study the

[10] Further description of the content of the SNED subindexes can be found in Mizala and Urquiola (2013).

[11] Chilean data allow for matching AEP applicants to schools. Yet, the link to students' outcomes is complicated by two main factors. First, the SIMCE national standardized tests are only available for students in the 4th, 8th, and 10th grades. Second, while up to 4th grade students are assigned a general primary teacher for most subjects; afterward they have a different teacher for each subject and in secondary school, they self-select into courses. Since at the school level there are only a few AEP applicants per school, an analysis of the effects of AEP on individual student learning would suffer from intra-school sorting and would be underpowered. Therefore, we do not pursue that analysis in the paper.

[12] A disadvantaged or priority student (*alumnos prioritarios*) is any student who is subscribed to the social protection system in Chile, is in the most vulnerable third according to her socio-economic status in the social register of households, or is classified in Section A of the national health fund.

[13] We eliminate 2002 AEP applicants because of a lack of administrative data.

[14] Around 12% of the teachers work in more than one school. For these teachers, we select as the main school the institution at which they work the largest share of hours.

[15] The knowledge test is a common component of the AEP and AVDI certification process.

Table 2
Descriptive statistics.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

	2003–2011 Teachers	AEP applicants at *t*	Application decision	AEP applicants at *t*		Score
				200−274	275−349	
	(1)	(2)	(3)	(4)	(5)	(6)
Male	0.298	0.275	−0.016***	0.271	0.279	1.018
			(0.002)			(0.697)
Age	42.106	39.128	−0.001***	39.363	37.835	−0.900***
	[10.923]	[9.003]	(0.000)	[9.111]	[8.482]	(0.060)
Years of experience	18.673	15.178	0.007***	15.258	14.477	1.233***
	[12.373]	[9.549]	(0.000)	[9.695]	[8.881]	(0.134)
Degree in education	0.932	0.970	0.034***	0.966	0.982	2.994*
			(0.002)			(1.738)
Primary school teacher	0.615	0.563	0.005***	0.548	0.592	4.702***
			(0.002)			(0.778)
Middle school teacher	0.170	0.224	0.012***	0.218	0.245	4.847***
			(0.003)			(0.924)
Total hours	38.047	38.386	0.001***	38.311	38.666	0.042
			(0.000)			(0.044)
Working at more than one school	0.118	0.147	0.006***	0.145	0.154	−0.459
			(0.002)			(0.957)
Previously AVDI certified	0.019	0.040	0.194***	0.035	0.061	19.532***
			(0.006)			(1.252)
High SES school	0.432	0.499	0.009***	0.481	0.566	4.972***
			(0.002)			(0.750)
SNED awarded school	0.301	0.355	0.018***	0.348	0.381	2.660***
			(0.002)			(0.655)
Private-subsidized school	0.440	0.490	−0.001	0.490	0.503	−0.148
			(0.002)			(0.775)
Santiago metropolitan region	0.325	0.302	−0.022***	0.298	0.314	−0.415
			(0.002)			(0.699)
Rural school	0.149	0.125	−0.011***	0.123	0.123	−1.071
			(0.002)			(1.018)
N	1,227,513	12,162	1,227,513	8252	3190	12,162

Notes: Columns (1) and (2), and (4) and (5) present the mean of the descriptive variable for the referred sample of teachers, with the standard deviation in squared brackets. Column three presents the estimated coefficients of an ordinary least squares (OLS) regression of the application decision on the descriptive variables and the years of experience squared at the teacher-year unit of observation. Column (6) presents the estimated coefficients of an OLS regression of the score on the descriptive variables, the years of experience squared, and a battery of application wave fixed effects against the score. Robust standard errors are presented in parentheses. AVDI stands for Asignación Variable al Desempeño Individual (Variable Allocation for Individual Performance). High SES is a dummy that takes the value of 1 if the teacher is working at middle, middle-high or high socioeconomic status schools. SNED stands for Sistema Nacional de Evaluación del Desempeño (National System for Performance Evaluation).
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

causal impact of the program on the retention of talented teachers and their allocation across the school system, a naive comparison of the outcomes of awardees versus non-awardees will provide biased and inconsistent estimates of these effects.

We tackle the issue of causality using a sharp regression-discontinuity design (RDD). In it, we exploit the discontinuity in the allocation of the award around the 275 threshold. Fig. 2 presents the share of AEP recipients at each score bin level at the time of the first AEP application. In the year of the first application, the allocation rule of the AEP depicts a sharp RDD. As time goes by, the relationship between AEP recipients and the score at the first application depicts a fuzzy RDD as previously non-certified applicants pass the test. Table A2 presents the corresponding coefficients of this first-stage regression. We highlight that among the 9021 applicants in our sample that fail the test, 1082 applied twice for the program (11.99%), 65 applied three times (0.72%), and six applied four times (0.07%).[16] More importantly, none of the applicants who received the AEP incentive package scored below 275.

In the absence of manipulation around this cut-off, teachers who scored 275 should be similar to those who scored 274.[17] Therefore, if

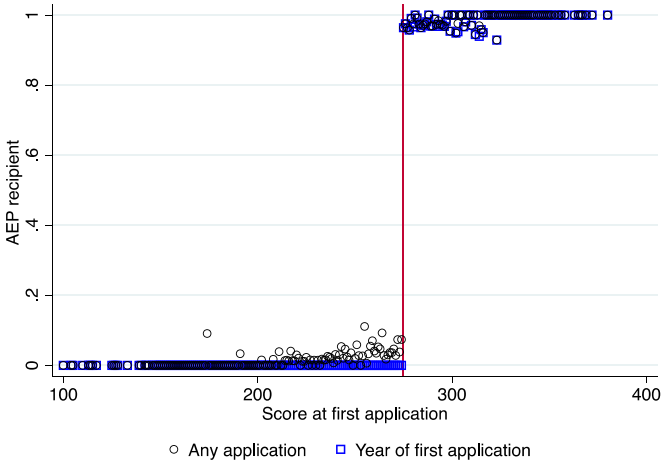

Fig. 2. Pedagogical Excellence Award program recipient rate against the application score. Notes: Recipient rate at time after the first program application and at any other time (ever recipient) against the score on the first application. Table A2 presents the corresponding first-stage regressions. AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award).
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

[16] A similar pattern happens in the full sample. Among the entire set of 14,562 applications, 12,797 are first time applications. Among the sample of 9550 teachers that failed their first application, 1124 applied for a second time (11.77%), 67 applied for a third-time (0.70%), and six applied for the fourth time (0.06%).

[17] See Hahn et al. (2001) and Lee (2008) for an interpretation of the regression discontinuity approach as a local randomization.

we observe any systematic difference in behavior around the threshold after the incentive package is granted, we can attribute it to the program.

We implement the regression discontinuity design using the following estimating equation:

$$y_{is\tau} = \alpha + \beta D_{is\tau} + \gamma f(x_{is\tau} - 275) + \delta D_{is\tau} f(x_{is\tau} - 275) + \lambda_\tau + \mu_s + \varepsilon_{is\tau}, \quad (1)$$

for all $x_{is\tau} \in (275 - h, 275 + h)$. That is to say, the outcome variable $y_{is\tau}$ (a measure of mobility or transition out of the school system) for a teacher i who applied for an AEP certification in subject s at wave τ is a function of a constant α; a dummy $D_{is\tau}$ which takes the value of 1 if the teacher scored at least 275 and 0 otherwise; a suitable polynomial function of the score centered on the discontinuity cut-off, $f(x_{is\tau} - 275)$, varying at both sides of the cut-off; and a set of wave fixed effects (λ_τ) and subject area fixed effects (μ_s).

We estimate Eq. (1) using a local non-parametric approach with a triangular kernel and a first-order polynomial of the score in the optimal bandwidth (h) of Calonico et al. (2014b). We present the bias-corrected coefficients and the robust corrected standard errors, clustered at the school of application as prescribed in Calonico et al. (2014a). For each outcome variable, we use the variable-specific optimal bandwidth as prescribed in Calonico et al. (2014b).

We are interested in the parameter β. Under suitable assumptions, β provides a local measure of the causal impact of obtaining the AEP incentive package on teachers' mobility. The basic identifying assumption is that there is no systematic manipulation of the running variable around the threshold. There are at least two strategies to explore the plausibility of this assumption (Lee and Lemieux, 2010). First, there should be no kinks in the density of the score around the discontinuity. Second, predetermined factors ought to vary smoothly around the 275 cut-off.

Fig. 3 plots the histogram of the final score for cells of size 1, in a bandwidth of 15 score points around the 275 cut-off. There is no visual evidence of kinks in the density of the score around the 275 threshold. In Table A3, we formally test the no discontinuity hypothesis and present the p-values of the Calonico et al. (2014a) test and the Frandsen (2017) test for variables with discrete support. There is not a single application wave for which the tests indicate a discontinuity of the density. Furthermore, pooling all applications waves together, we cannot reject the null hypothesis of no discontinuity.

Fig. 4 provides evidence on the continuity of predetermined covariates around the 275 threshold. To do so, we first estimate Eq. (1) using as the outcome variable several characteristics of the teachers and their corresponding schools at the time of application, and then we plot the p-values of the estimated coefficients for the threshold dummy. As the random pattern in Fig. 4 indicates, none of our predetermined covariates exhibit a systematic pattern of correlation around the threshold. In Table A4, we present the corresponding coefficients and also the estimates from specifications without controls, controlling for application wave and certification subject. All in all, the estimated coefficients are small and not statistically significant.

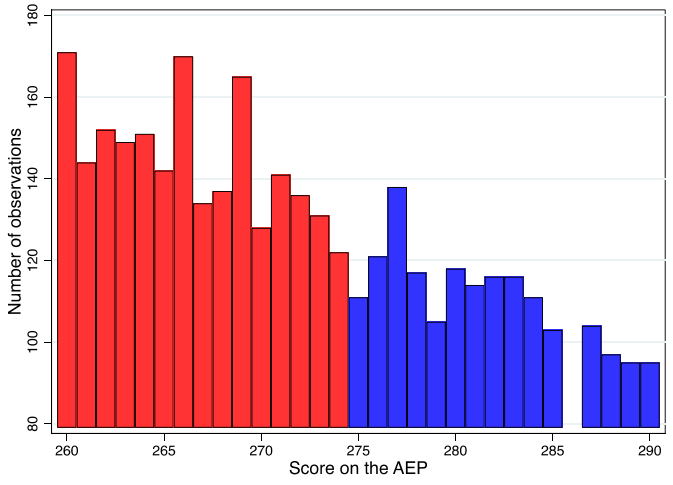

Fig. 3. Distribution of the score. Notes: Score bins of size 1 in a 15 bandwidth around the 275 cut-off.
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

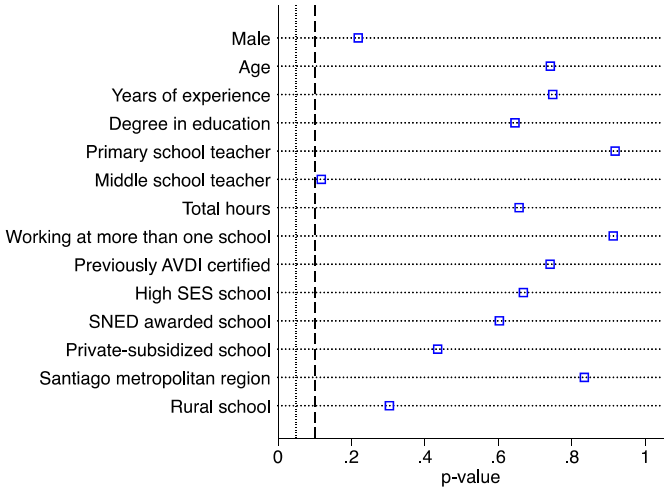

Fig. 4. Balance of the covariates. Notes: The squares represent the p-value for the estimated β coefficient of the threshold dummy in Eq. (1) with the teacher characteristic at the time of application as the outcome variable, including application wave and certification subject fixed effects (see column (4) in Table A4). Errors clustered at the school of application level. The dotted vertical line depicts the 5% statistical significance threshold. The dashed vertical line depicts the 10% statistical significance threshold. AVDI stands for Asignación Variable al Desempeño Individual (Variable Allocation for Individual Performance). High SES is a dummy that takes the value of 1 if the teacher is working at middle, middle-high or high socioeconomic status schools. SNED stands for Sistema Nacional de Evaluación del Desempeño (National System for Performance Evaluation).
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

As an additional test of the validity of the design, we use the predetermined covariates to predict our main outcomes of interest (mobility and transitions out of the school system). To do so, we estimate a logit model of whether or not the teacher moved out of the voucher school system at any point during the two years following application for the AEP, using as explanatory variables the predetermined characteristics in Fig. 4. We repeat the analogous exercise for between-school mobility using as the left-hand-side variable a dummy that takes the value of 1 if the teacher moved to a new school at any point during the two years following the application to the program, and 0 otherwise. With these two models, we predict the probability of being out of the school system and the probability of moving to a new school. In Figs. A3 and A4, we plot the mean values of the predicted probabilities at each score cell bins of size 2 and in Table A5 we present the corresponding estimates. Neither the predicted transitions out of the voucher system nor the predicted mobility are discontinuous around the 275 threshold.

5. Main results

In terms of personnel policy, the main goal of the Pedagogical Excellence Award is to identify good teachers, prevent them from leaving the system, and allocate them where they are most needed (Araya-Ramirez et al., 2012). For this purpose, the program provides the incentive package described in Section 2. Clearly, the package improves the wage standard of the voucher school system and could provide a public signal of teacher quality. Nonetheless, whether or not it can achieve its stated goals is an empirical question.

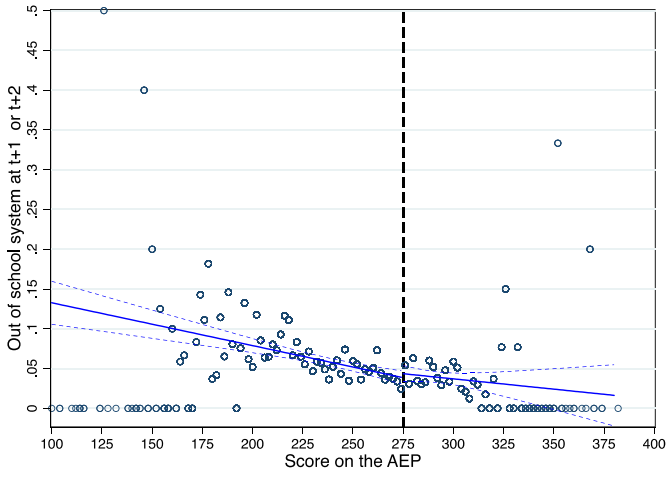

Fig. 5. Effect of Pedagogical Excellence Award program on teachers' transitions out of the school system. Notes: The circles represent the average of the outcome variable at score bins of size 2. The solid line represents a linear fit of the average outcome variable at each score cell on the score, with the corresponding 95% confidence intervals (dotted lines). The outcome variable is dummy that takes the value of one if the teacher is out of the school system at any point during the two years following the application to the AEP. AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award).
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

To see it more clearly, consider a setting in which teaching pays a fixed wage and teachers have a noisy signal of their ability (Rothstein, 2015). Schools only observe the overall distribution of teacher ability. Principals learn of the teachers' ability as teachers accumulate experience (Lefgren and Jacob, 2008; Staiger and Rockoff, 2010; Rockoff et al., 2012). Teachers move across schools looking for better amenities (Rosen, 1986), but mobility is tempered by their inability to credibly signal their quality.

What happens if the government sponsors a program that rewards talented teachers and enables them to signal their quality, like in Chile? The signal is only issued once the teacher passes the assessment and talented teachers can obtain the signal at a lower cost.[18] Net of these costs, the AEP reward increases the value of teaching and makes it more attractive in relation to the outside option. Yet, because the assessment is not compulsory, the extent to which the financial reward affects the decision to stay in teaching depends on who self-selects for it. As a result, the policy may or may not increase retention rates of talented teachers.[19]

Once the teacher opts to remain in the profession, she also decides whether to stay at the same school or move elsewhere. If she passed the assessment, she has a new credible signal of her quality available for the entire education system. Yet, the additional information it conveys may differ between her current school and the rest of the schools. Bates (2020) argues that after the release of public information on teacher quality there will be two forces at play. On the one hand, because there is more information available about teacher quality for those with more experience the effect of the newly available information is lower for them. On the other hand, if the current principal has more information about teacher quality than the rest of the school system, a model of asymmetric learning predicts that the new public information will have a stronger impact on teachers with longer tenure. These results hold *all else equal*. Therefore, the overall gradient on experience (we have no information on tenure) is an open question as experience and tenure are highly correlated.

We begin our analysis by looking at the effect of receiving an AEP award on teachers' transition out of the school system. Fig. 5 summarizes the relationship between the AEP score and whether or not a teacher spends a period out of the school system in the two years following application for the program. The circles represent the unadjusted mean of the outcome variable within score cell bins of size 2, the vertical dashed line represents the 275 cut-off, and the solid horizontal line represents a linear fit of the average outcome variable at each score cell on the score, with the corresponding 95% confidence intervals (dotted lines). There is no visual evidence of breaks in the probability of exiting the teaching career around the cut-off.

In Fig. 6, we perform the analogous exercise for teachers' mobility within the school system in the two years following application for the AEP. In contrast to Fig. 5, Fig. 6 suggests that teachers receiving the AEP award are more likely to move to a new school.

Table 3 addresses these questions more formally and presents the results of estimating Eq. (1) for teachers' transitions out of the voucher school system, to a private school, or to a new school (in the voucher or private school system). We use two different measures to capture the time dimension of the mobility patterns: (1) a dummy equal to one if a teacher moved at any point during the first two years after applying for the program, and (2) a dummy equal to one if the teacher moved at any point during the five years after applying for the program. Since AEP status is announced in April of the year following the examination and employment status is designated in June, the first two years represent around 14 months following the announcement of the results. All our specifications include application wave and certification subject fixed effects. For further reassurance and to gain precision, columns two and four in Table 3 also control for a battery of teacher characteristics at the time of application.

Starting with transitions out of the school system, we find no evidence that teachers just passing the AEP test are less likely to quit

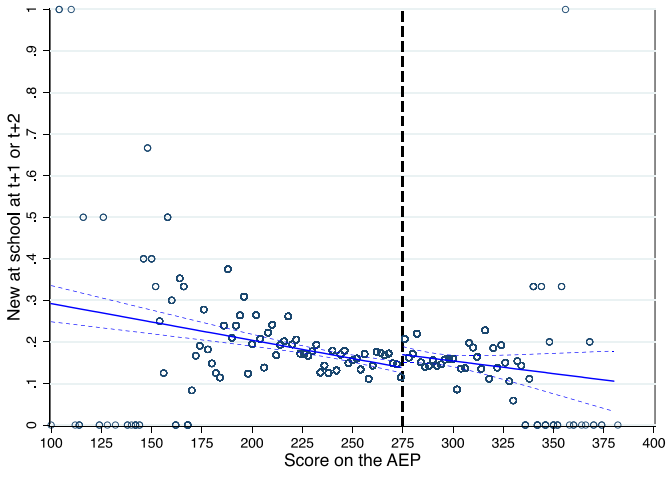

Fig. 6. Effect of the Pedagogical Excellence Award program on teachers' mobility within the school system. Notes: The circles represent the average of the outcome variable at score bins of size 2. The solid line represents a linear fit of the average outcome variable at each score cell on the score, with the corresponding 95% confidence intervals (dotted lines). The outcome variable is a dummy that takes the value of one if the teacher is new at the school at any point during the two years following the application to the AEP. AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award).
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

[18] There are two underlying assumptions. First that the award is a credible signal of quality. Second, that teacher quality remains unaffected by the AEP. On our first assumption, Cantrell et al. (2008) suggest that a similar assessment to the AEP is helpful to identify highly talented teachers. On our second assumption, the evidence is mixed. While Clotfelter et al. (2006, 2007) and Goldhaber and Anthony (2007) document that the NBPTS program does not increase teacher effectiveness, Clotfelter et al. (2010) suggest that it does. Taylor and Tyler (2012) suggest that the mere fact of undergoing an evaluation process improves teacher effectiveness. Dee and Wyckoff (2015) also document how incentive pay based on inputs developed in such evaluations can have long-lasting effects by increasing the attrition of low-quality workers and by incentivizing effort and developing skills among the remaining workers.

[19] An alternative but also plausible scenario where the financial incentives may not affect quit behavior is one in which, at the margin of selection, teachers are socially motivated and have a low valuation for jobs outside the teaching sector. See Ashraf et al. (2018) for a setting in which the more able workers are also the more socially motivated ones.

Table 3
Effect of the Pedagogical Excellence Award program on teacher retention and mobility.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

Outcome variable	$t+1$ to $t+2$		$t+1$ to $t+5$	
	(1)	(2)	(3)	(4)
Out of the school system	0.015	0.015	0.011	0.013
	(0.013)	(0.013)	(0.025)	(0.024)
p-Value	0.266	0.254	0.642	0.592
Bandwidth	21	22	23	23
N	4953	5349	5691	5349
Mean of control	0.045	0.045	0.147	0.147
Private school	0.005	0.003	0.003	−0.000
	(0.008)	(0.007)	(0.010)	(0.010)
p-value	0.474	0.642	0.807	0.995
Bandwidth	18	19	22	24
N	4627	4865	5349	5691
Mean of control group	0.015	0.015	0.030	0.029
New at school	0.058**	0.062**	0.065*	0.070*
	(0.028)	(0.028)	(0.035)	(0.036)
p-Value	0.036	0.026	0.064	0.050
Bandwidth	19	18	19	16
N	4865	4382	4627	3913
Mean of control group	0.155	0.153	0.310	0.318
Controls	No	Yes	No	Yes

Notes: Local non-parametric regression-discontinuity design specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score. Robust corrected standard errors clustered at the school of application level in parentheses. All specifications include application wave and certification subject fixed effects. Controls include gender, age, experience, education title, middle school teacher, primary school teacher, hours worked, a dummy of working at more than one school, and a dummy of previous Asignación Variable al Desempeño Individual (Variable Allocation for Individual Performance) certification at the time of application.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

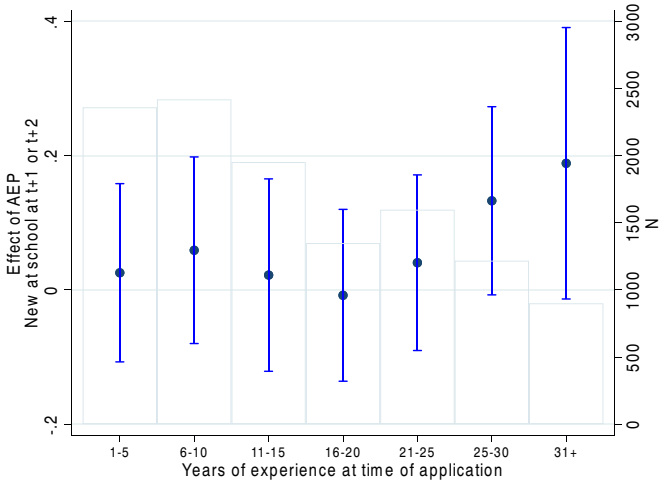

Fig. 7. Effects of the Pedagogical Excellence Award program on teacher mobility by experience. Notes: The left-hand-side y-axis presents the estimated β coefficient of the threshold dummy in Eq. (1) using a local non-parametric regression-discontinuity design specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score, in each of the age categories separately. The brackets represent the 95% confidence intervals from robust corrected standard errors clustered at the school of application level. None of the specifications include application wave or certification subject fixed effects, or controls. The right-hand-side y-axis presents the number of observations at each age category. AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award).
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

teaching than those just failing the test (first set of rows in Table 3, "Out of the school system"). Across all our specifications, the impact of receiving the incentive package is small and non-statistically significant. Thus, locally, getting an AEP does not affect transitions out of the school system. The education literature suggests a wage separation elasticity ranging from −1 to −3.5 (Dolton and Van Der Klaauw, 1995, 1999; Clotfelter et al., 2008; Falch, 2011). Our point estimate is positive but not statistically significant, with an implied zero elasticity. We believe this result is not necessarily at odds with the existing evidence, as our local average treatment effect may be based on teachers who are more committed to remaining in the profession.

Next, we explore whether teachers used the AEP to signal quality and transit to private schools. Although such a change would imply that the awardee is no longer eligible for the 6% wage increase associated with the program, the wage differential between the voucher school system and the private education sector may compensate for such a loss. The second set of rows in Table 3 ("Private school") rejects this hypothesis. We find no evidence that receiving the AEP award increased teachers' propensity to move to private schools, either in the two- or five-year window.

If the AEP award provides a credible signal of teachers' talent previously unavailable to the market, it should boost mobility across the school system as suggested by Fig. 6. In the third set of rows of Table 3 ("New at school"), we show that awardees are 6 percentage points more likely to move to a new school in the first two years after receiving the award. Fifteen percent of AEP applicants who scored between 257 and 274 (optimal bandwidth of 18) changed schools at least once during this time interval. Therefore, the estimated impact of obtaining the award implies a 40% boost to mobility. Since the effect on the longer five-year span indicator is similar to the short-term one, the evidence suggests that most transitions occur soon after obtaining the award. Notice that, as obtaining the award does not affect mobility to private schools, the induced mobility must be within the voucher school system.

We carry out several sensitivity analyses to address the robustness of the within-sector mobility results. First, Fig. A5 addresses the issue of alternative bandwidths. As expected, the smaller the window around the threshold, the larger the magnitude of the coefficient but the lower the precision. As we include observations further away from the 275 threshold, the coefficients stabilize around the 6 percentage points, while the precision increases to attain statistically significant results at the conventional 5% level, even in the 50 point windows around the 275 cut-off. Second, Fig. A6 verifies that there are no jumps in the probability of moving to a new school at other points of the AEP score distribution. Finally, in Table A6 we test whether the AEP affected mobility in the year prior to the program and find no evidence of such effects.[20]

Fig. 7 presents the effect of AEP on mobility in bins of accumulated experience at the time of application for the program. On the left-hand-side y-axis we present the estimated β coefficients (and the 95% confidence interval) from Eq. (1) for different experience groups: 1 to 5 years, 6 to 10, 11 to 15, 16 to 20, 25 to 30, and 31 plus. Consistent with a model of asymmetric employer learning and with the findings in Bates (2020), Fig. 7 suggests that mobility increases for the most experienced of teachers (last two age brackets) after receiving the award.[21] This is, of course, not the strongest possible test of information asymmetry. A better option would be to separate teachers based on how long they have worked with their current school principal (see Rockoff et al., 2012). Unfortunately, such information is not available.

A potential concern with the design of this merit-based award is that successful teachers may gravitate towards schools serving better performing or higher socioeconomic status students. To analyze this issue, we use as outcomes the school average test performance and the share of disadvantaged students of the applicants' current school. In the top set of rows of Table 4, we show that marginally getting an

[20] Table A6 is done in the subset of teachers that applied for the program between 2004 and 2011. We would have liked to do this exercise for the two and five years before the application, but the administrative data are only available since 2003. As a result, every additional year prior to the application to the program further reduces the sample. The retrospective strategy for the out of the school system outcome is not feasible as 90% of teachers who leave the school system do not come back.
[21] For the last two brackets the p-values are 0.063 and 0.052, respectively.

Table 4
Effect of the Pedagogical Excellence Award program on the characteristics of school of destination.
Source: Own calculations based on data from the Ministry of Education (Chile).

Outcome variable	$t+2$		$t+5$	
	(1)	(2)	(3)	(4)
School achievement	0.104	0.099	0.057	0.049
	(0.078)	(0.072)	(0.069)	(0.071)
p-Value	0.179	0.171	0.409	0.493
BW	24	26	31	27
N	5515	5897	6908	6231
Mean of control	0.554	0.557	0.563	0.557
Share of disadvantaged students in school	−0.031**	−0.034**	−0.016	−0.019
	(0.013)	(0.014)	(0.013)	(0.013)
p-Value	0.020	0.013	0.204	0.147
BW	22	20	26	21
N	4629	4222	5259	4574
Mean of control	0.407	0.407	0.405	0.404
Baseline controls	No	Yes	No	Yes

Notes: School achievement is the average school achievement (as reported by the SNED) between 2003 and 2016. Share of disadvantaged students in school the average share of disadvantaged students at the school between 2008 and 2016. Local non-parametric RDD specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score. Robust corrected standard errors clustered at the school of application level in parenthesis. All specifications include application wave and certification subject fixed effects. Controls include gender, age, experience, education title, middle school teacher, primary school teacher, hours worked, a dummy of working at more than one school, and a dummy of previous Asignación Variable al Desempeño Individual (Variable Allocation for Individual Performance) certification at the time of application.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

AEP award does not make teachers more likely to work at schools with higher student achievement. In contrast, the bottom set of rows of Table 4 (columns (1) and (2)) show that two years after obtaining the award applicants are more likely to work in schools with less disadvantaged students. The induced 3 percentage points change is not enough to allow a teacher to transit from a low socioeconomic status school to high socioeconomic status school as, while 64% of the students in low socioeconomic status schools are disadvantaged, only 29% of the students attending high socioeconomic status schools are so. Moreover, five years after application to the program the impact is smaller and non-statistically significant.

We further explore whether talented teachers are moving to schools where students have higher socio-economic status by exploiting yearly information on school socioeconomic status. As described in Section 3, SNED sorts schools in the voucher system into five categories based on the socio-economic status of the students they serve: low, middle-low, middle, middle-high, and high. We compute the total number of talented teachers active each year and the share in each school category, where a teacher is considered as talented if she ever received the AEP award during the 2003–2011 period. We present this information in Fig. 8. The share of talented teachers in low SES schools hovers around 20% for the entire period. If anything, there seems to be an increasing share of talented teachers in schools serving low SES students towards the end of our data. All in all, this reinforces the idea that schools serving high SES students have not attracted more talented teachers over time.

6. Discussion

In this paper we study a program that provides a financial bonus and public recognition to teachers in Chilean public schools who pass a series of voluntary assessments. Using a sharp regression discontinuity design, we estimate that obtaining this Pedagogical Excellence Award does not alter transitions out of the school system but does increase mobility between schools. Perhaps surprisingly, considering the high segregation of the Chilean school system by students' socioeconomic status, affluent schools did not systematically attract more AEP awardees.

Our findings speak to a large literature in personnel economics studying how to recruit, retain, and motivate public sector employees (see Finan et al., 2015, for a survey). More specifically, our findings relate to a set of papers that address the issue of how to compensate public sector workers in developing countries (Ashraf et al., 2014; Ashraf et al., 2018; Dal Bó et al., 2013; De Ree et al., 2018). Within this literature, we raise an important point. At the margin at which voluntary participation programs select workers, the outside option might not be correlated with their expertise as civil servants. As a result, providing financial

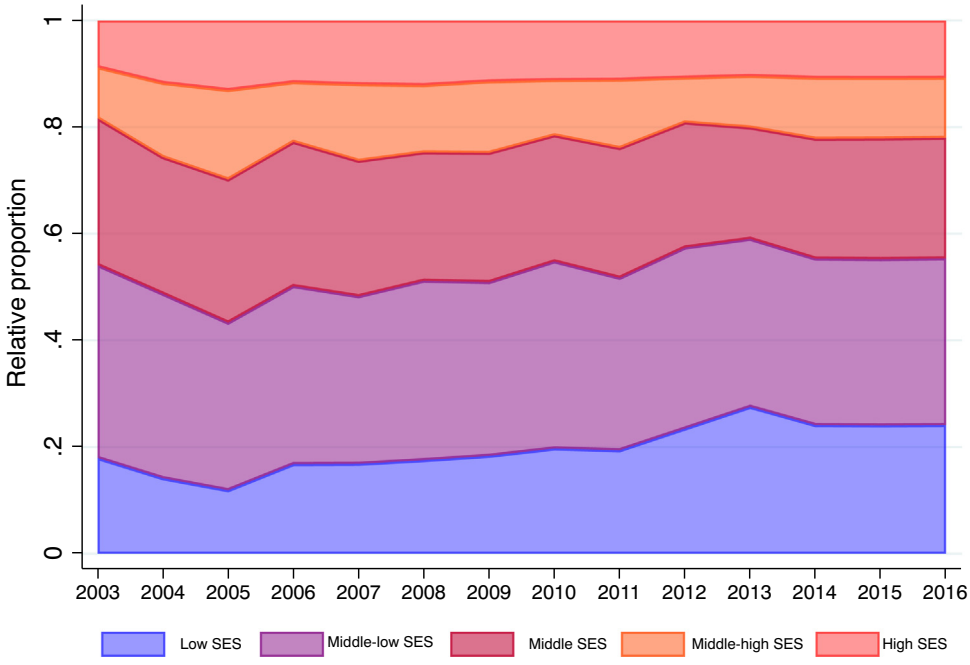

Fig. 8. Concentration of Pedagogical Excellence Award program ever-certified teachers by school socioeconomic status, over time. Notes: Share of AEP ever certified teachers in each type of SES school by year between. SES stands for socioeconomic status.
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

incentives via voluntary enrollment and quality standards might not contribute to increasing retention rates among motivated workers (Besley and Ghatak, 2005). If pro-social motivation positively correlates with talent (Ashraf et al., 2018), giving motivated agents better means to achieve their goals might prove a powerful incentive to stay on the job. For example, in the teaching sector, this can be accomplished by investing in complementary inputs such as school resources.

We also highlight the potential distributional effects of revealing information about worker quality. In markets where there is asymmetric learning between employers and where sorting across establishments is driven by workplace amenities, the revelation of information about worker ability may exacerbate inequality, as both employers and employees react to that available information. Importantly, our findings suggest that any compensatory measure designed to ameliorate these transitions (e.g., higher wages in hard-to-staff establishments, travel subsidies, or housing subsidies) should rise steeply with experience. We believe this is a crucial issue for the public sector, where amenities are determined by societal needs rather than by profit-maximization. Further research is required on these aspects of the personnel economics of the public sector.

Appendix A

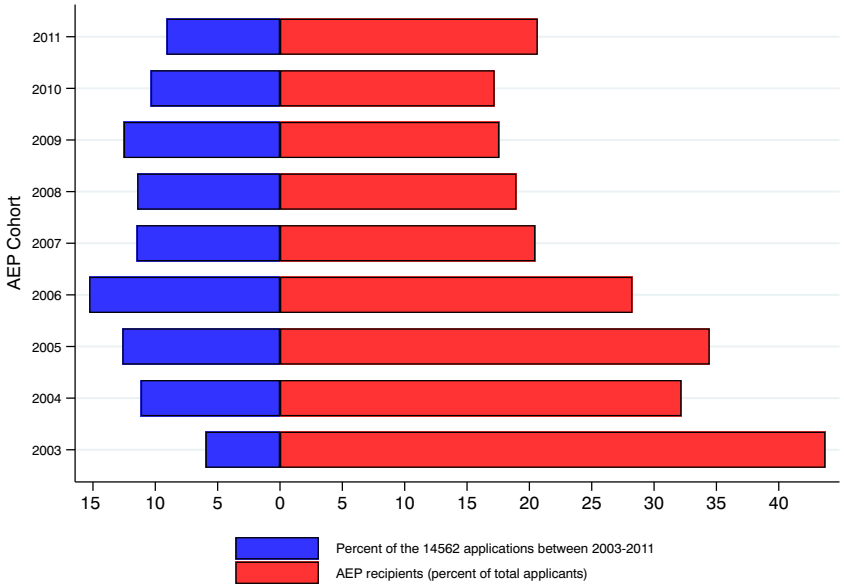

Fig. A1. Pedagogical Excellence Award recipient rate by application wave. *Notes*: AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award). *Source*: Prepared by the authors' based on data from the Ministry of Education (Chile).

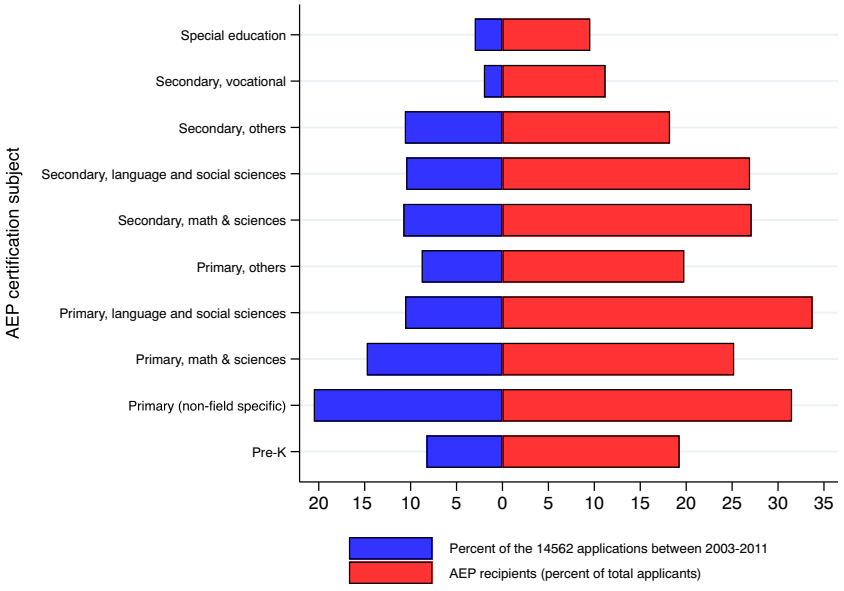

Fig. A2. Pedagogical Excellence Award recipient rate by certification subject. *Notes*: AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award). *Source*: Prepared by the authors' based on data from the Ministry of Education (Chile).

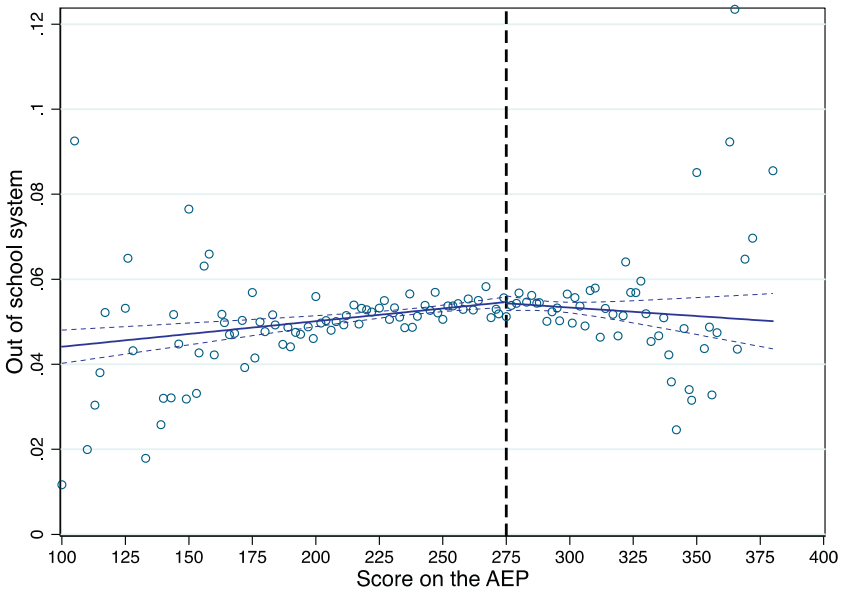

Fig. A3. Predicted teachers' transitions out of the school system. *Notes*: The circles represent the average of the outcome variable at score bins of size 2. The solid line represents a linear fit of the average outcome variable at each score cell on the score, with the corresponding 95% confidence intervals (dotted lines). The outcome variable is the predicted probability of being out of the school system at any point during the two years following application to Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award), using a logit model with predetermined covariates as regressors.
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

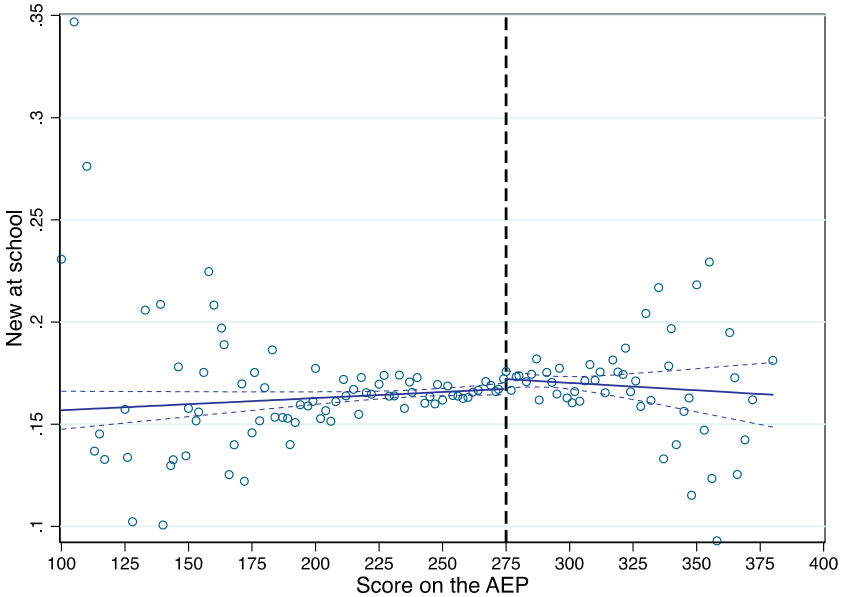

Fig. A4. Predicted teachers' mobility within the school system. *Notes*: The circles represent the average of the outcome variable at score bins of size 2. The solid line represents a linear fit of the average outcome variable at each score cell on the score, with the corresponding 95% confidence intervals (dotted lines). The outcome variable is the predicted probability of being new at the school at any point during the two years following application to Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award), using a logit model with predetermined covariates as regressors.
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

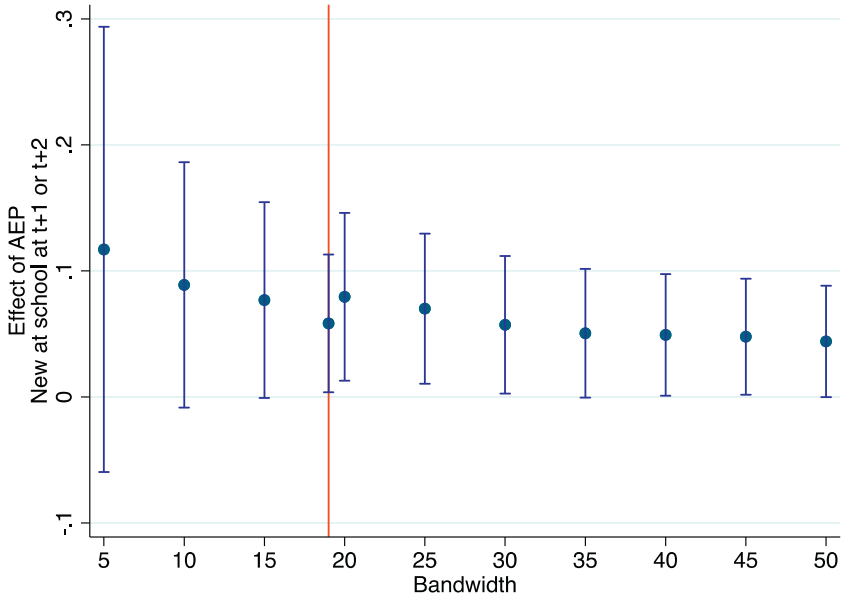

Fig. A5. Effect of the Pedagogical Excellence Award on mobility within the school system, alternative bandwidths. *Notes*: Each point represents the estimated β coefficient from a local non-parametric regression-discontinuity design specification in the bandwidth depicted in the x-axis, with a triangular kernel, and a linear polynomial of the score. The brackets represent the 95% confidence intervals from robust corrected standard errors clustered at the school of application level. All of the specifications include application wave and certification subject fixed effects. The solid vertical line (in red) denotes the Calonico et al. (2014b) optimal bandwidth. AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award).
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

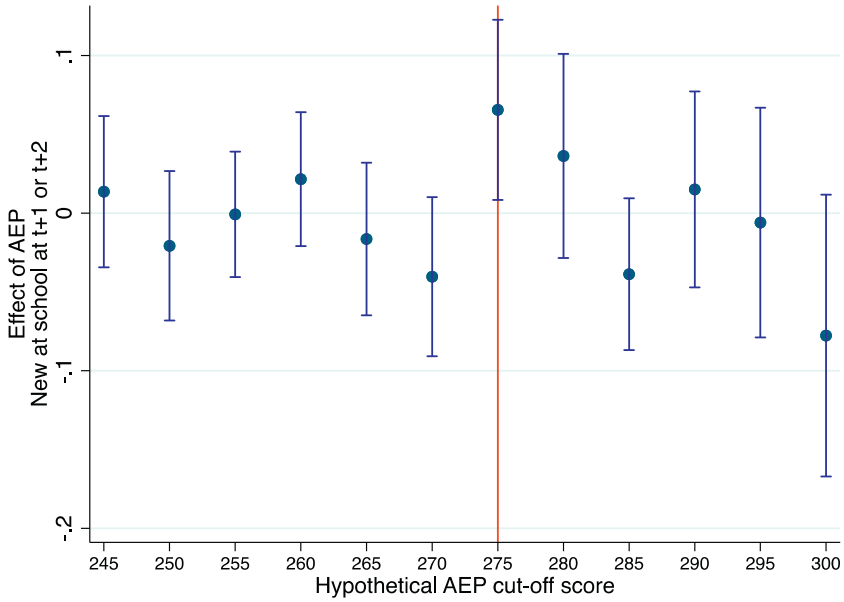

Fig. A6. Effect of the Pedagogical Excellence Award on mobility within the school system on alternative cut-offs. *Notes*: Each point represents the estimated β coefficient from a local non-parametric regression-discontinuity design specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score, assuming the score on the x-axis as the cut-off. The brackets represent the 95% confidence intervals from robust corrected standard errors clustered at the school of application level. All of the specifications include application wave and certification subject fixed effects. The solid vertical line (in red) denotes the true certification cut-off. AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award).
Source: Prepared by the authors' based on data from the Ministry of Education (Chile).

Table A1
Estimation sample.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

Criteria	Sample size
AEP applicants 2003–2011	14,562
First time applicants	12,797
With complete administrative record	12,503
At schools with socio-economic status records	12,162

Notes: 2002 applicants to the program are eliminated due to lack of administrative data. AEP stands for Asignación a la Excelencia Pedagógica (Pedagogical Excellence Award).

Table A2
Pedagogical Excellence Award allocation rule.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

	First application	Ever certified
β	0.968***	0.919***
	(0.009)	(0.014)
p-Value	0.000	0.000
Bandwidth	20	24
N	4865	5691
Mean	0.258	0.278

Notes: The running variable is the score at the first time of application. Local non-parametric regression-discontinuity design specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score. Robust corrected standard errors clustered at the school of application level in parentheses.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Table A3
Test for continuity of the density of the score.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

	All	2003	2004	2005	2006	2007	2008	2009	2010	2011
Calonico et al. (2014b)	0.889	0.210	0.444	0.225	0.779	0.454	0.915	0.998	0.575	0.946
Frandsen (2017)	0.465	0.192	0.354	0.637	0.832	0.786	0.646	0.941	0.932	0.786

Notes: The Calonico et al. (2014b) test selects the optimal bandwidth independently for each wave.

Table A4
Balance of pre-determined covariates.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

Predetermined covariate	(1)	(2)	(3)	(4)
Male	0.031	0.036	0.044	0.044
	(0.036)	(0.036)	(0.035)	(0.036)
p-Value	0.383	0.322	0.217	0.218
Bandwidth	16	16	15	14
N	4143	3913	3647	3647
Age	0.117	0.251	0.094	0.229
	(0.711)	(0.721)	(0.684)	(0.694)
p-Value	0.869	0.728	0.890	0.741
Bandwidth	16	14	18	15
N	4143	3647	4382	3913
Years of experience	−0.372	−0.210	−0.415	−0.226
	(0.709)	(0.722)	(0.684)	(0.702)
p-Value	0.600	0.771	0.544	0.748
Bandwidth	18	16	20	17
N	4627	4143	4865	4143
Degree in education	0.009	0.007	0.006	0.004
	(0.009)	(0.009)	(0.009)	(0.009)
p-Value	0.321	0.471	0.504	0.645
Bandwidth	30	29	28	24
N	6820	6643	6470	5691
Primary school teacher	−0.046	−0.018	−0.002	0.002
	(0.039)	(0.039)	(0.022)	(0.022)
p-Value	0.237	0.635	0.923	0.918
Bandwidth	18	17	24	24
N	4627	4382	5773	5773
Middle school teacher	0.053	0.054	0.038	0.038
	(0.027)	(0.029)	(0.025)	(0.025)
p-Value	0.052	0.066	0.126	0.118
Bandwidth	27	23	16	17
N	6470	5691	4143	4143
Total hours	−0.313	−0.244	−0.360	−0.303
	(0.724)	(0.712)	(0.688)	(0.681)
p-Value	0.665	0.732	0.601	0.656

(continued on next page)

Table A4 (*continued*)

Predetermined covariate	(1)	(2)	(3)	(4)
Bandwidth	13	13	13	13
N	3159	3408	3159	3408
Working at more than one school	0.000	0.002	0.003	0.003
	(0.030)	(0.030)	(0.029)	(0.028)
p-Value	0.996	0.955	0.925	0.913
Bandwidth	15	15	15	16
N	3647	3913	3913	3913
Previously AVDI certified	0.007	0.008	0.006	0.005
	(0.018)	(0.017)	(0.017)	(0.016)
p-Value	0.703	0.648	0.727	0.741
Bandwidth	17	20	19	22
N	4382	4865	4627	5349
High SES school	0.023	0.023	0.021	0.018
	(0.041)	(0.041)	(0.041)	(0.041)
p-Value	0.584	0.570	0.602	0.668
Bandwidth	17	16	16	16
N	4143	4143	4143	3913
SNED awarded school	0.008	0.015	0.012	0.017
	(0.032)	(0.032)	(0.032)	(0.033)
p-Value	0.797	0.644	0.709	0.603
Bandwidth	28	27	28	26
N	6470	6291	6643	6291
Private-subsidized school	0.032	0.035	0.033	0.032
	(0.041)	(0.041)	(0.040)	(0.041)
p-Value	0.431	0.399	0.410	0.435
Bandwidth	18	17	19	17
N	4627	4143	4627	4143
Santiago metropolitan region	0.008	0.009	0.007	0.008
	(0.038)	(0.038)	(0.038)	(0.038)
p-Value	0.827	0.808	0.849	0.834
Bandwidth	16	15	16	16
N	3913	3913	3913	3913
Rural school	0.030	0.030	0.027	0.027
	(0.027)	(0.027)	(0.026)	(0.026)
p-Value	0.276	0.273	0.307	0.303
Bandwidth	16	17	18	18
N	4143	4143	4382	4382
Application wave fixed effect	No	Yes	No	Yes
Certification subject fixed effect	No	No	Yes	Yes

Note: Data for teachers applying to AEP waves 2003–2011, at the time of application. Local non-parametric regression-discontinuity design specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score. Robust corrected standard errors clustered at the school of application level in parenthesis. All specifications include application wave and certification subject fixed effects. Controls include gender, age, experience, education title, middle school teacher, primary school teacher, hours worked, a dummy of working at more than one school and a dummy of previous Asignación Variable al Desempeño Individual (AVDI) (Variable Allocation for Individual Performance) certification at the time of application. High SES is a dummy that takes the value of 1 if the teacher is working at middle, middle-high or high socioeconomic status schools. SNED stands for Sistema Nacional de Evaluación del Desempeño (National System for Performance Evaluation).
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Table A5
Continuity of predicted outcome variables.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

Predicted outcome variable	$t+1$ to $t+2$	$t+1$ to $t+5$
	(1)	(2)
Out of the school system	0.002	0.000
	(0.002)	(0.005)
P-Value	0.351	0.939
Bandwidth	23	20
N	5691	4953
Mean	0.053	0.157
New at school	0.001	0.001
	(0.007)	(0.009)
p-Value	0.896	0.898
Bandwidth	15	17
N	3647	4143
Mean	0.167	0.332

Notes: Local non-parametric regression specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score. Robust corrected standard errors clustered at the school of application level in parentheses. All specifications include application wave and certification subject fixed effects.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Table A6
Placebo test: effect of the Pedagogical Excellence Award on teacher mobility prior to the program.
Source: Authors' calculations based on data from the Ministry of Education (Chile).

Outcome variable	$t-1$ to t	
	(1)	(2)
New at school	0.046	0.037
	(0.039)	(0.037)
p-value	0.237	0.318
Bandwidth	14	14
N	2851	2851
Mean	0.219	
Controls	No	Yes

Notes: Subsample of AEP applicants between 2004 and 2011. Local non-parametric regression-discontinuity design specification in the Calonico et al. (2014b) optimal bandwidth, with a triangular kernel and a linear polynomial of the score. Robust corrected standard errors clustered at the school of application level in parentheses. All specifications include application wave and certification subject fixed effects.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

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