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Rule–based civil service: evidence from a nationwide teacher reform in Mexico

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This paper studies the effect of a civil service reform on the skills profile of new teachers in Mexico. The reform mandated the use of rule-based recruitment over discretionary hiring. Our results show that the reform led to hiring teachers with higher cognitive skills. We also show that an improvement in the bottom of the skills distribution of new hires drove this change. Two channels explain these effects. First, the reform decreased the prevalence of discretionary hires, who tended to be drawn from the bottom of the skills distribution. Second, the reform improved the screening efficiency of rule-based hiring, making cognitive skills more important determinants of hiring outcomes.

KEYWORDS

civil service, hiring methods, teacher hiring, teacher quality

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Servicio civil basado en reglas: evidencia de una reforma educativa a nivel nacional en México

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Este estudio analiza el efecto de una reforma al servicio civil de carrera en México en el perfil de habilidades de los nuevos docentes. La reforma estableció la obligatoriedad del uso de concursos de oposición para determinar el ingreso al servicio docente, proscribiendo un sistema caracterizado por un alto grado de discrecionalidad y opacidad. Los resultados muestran que la reforma condujo a la contratación de docentes con un mayor nivel de habilidades cognitivas, sobre todo porque redujo la proporción de contrataciones con niveles bajos de habilidades. Dos canales explican este efecto. En primer lugar, la reforma disminuyó la prevalencia de docentes contratados por medio del sistema discrecional, los cuales provenían desproporcionadamente de la parte inferior de la distribución de habilidades. En segundo lugar, la reforma mejoró la eficiencia del proceso de selección basado en los concursos de oposición, convirtiendo a las habilidades cognitivas en un determinante más importante de los resultados de selección.

KEYWORDS

servicio civil, métodos de selección, seleccción de docentes, calidad docente

1 | INTRODUCTION

An efficient bureaucracy is a cornerstone of state capacity and economic development. However, history shows that putting that cornerstone in place is often challenging (Grindle, 2012). For example, there is a consensus (going back to the Weberian definition of a professional bureaucracy) that the meritocratic recruitment of public officials is vital to a well-functioning bureaucracy. Yet, international indexes of bureaucratic quality indicate that many governments in low– and middle–income countries do not recruit public officials meritocratically (Besley et al., 2021). This pattern calls for a better understanding of the mechanisms used to recruit civil servants and the factors shaping their effectiveness.

Teachers are among the most important public sector employees. They are crucial factors in the quality of educational services and, therefore, critical to productivity and long-term growth. At the individual level, the positive impact of being assigned to a highly effective teacher persists into adult life (Rivkin et al., 2005; Chetty et al., 2014). Furthermore, teachers account for a significant part of public sector employment. In Mexico, around 24 percent of public sector employees are teachers, according to our calculations using data from the national labor force survey.

In this paper, we study the effect of a civil service reform on the skills profile of new teachers. We do so in the context of a nationwide education reform adopted in Mexico in 2014, which revamped the teachers' civil service. (We refer to this as the "SPD reform" in the rest of the paper.) Among other changes, the SPD reform mandated centrally managed, competitive examinations to determine hire and promotion decisions, proscribing a discretionary system in which local officials and teachers' union representatives took such decisions at the state level. The SPD reform scaled up a previous reform that introduced competitive examinations for teacher hiring in response to criticisms about opacity, corruption, and absence of merit in the discretionary system (Section 2).

We focus the analysis on the effects of the SPD reform on newly hired teachers' cognitive skills. Teacher quality is multidimensional, but several papers have shown that teachers with higher cognitive skills tend to be more effective —they add more value to student learning (Rockoff et al., 2011; Gronqvist and Vlachos, 2016; Hanushek et al., 2019; Neilson et al., 2019). Indeed, it would be surprising if teaching effectively did not require having at least basic levels of cognitive skills. Yet, using data from an international assessment of the adult population, Estrada and Lombardi (2020) show that many teachers in Latin America, including Mexico, have low levels of literacy and numeracy skills.

For the empirical analysis, we use personnel data to construct a dataset of primary and lower-secondary public school teachers hired in Mexico between 2012 and 2017. We link this data to results from the competitive examinations used to select new teachers during the same period. This way, we can identify teachers hired through the discretionary process before and after the SPD reform, plus successful and unsuccessful candidates taking the competitive examinations. Our measure of teachers' (and rule-based applicants') cognitive skills comes from their results in "ENLACE Media Superior" (hereafter, ENLACE), a census-based national standardized test applied at the end of secondary school (grade 12) between 2008 and 2013. We focus the analysis on recent university graduates who became (or applied to become) teachers in the public education system between 2012 and 2017 (Section 3).

Results show that teachers hired after the SPD reform have higher cognitive skills than teachers hired before the reform. The ENLACE score of new teachers increased between 2.7 to 3.8 percentile points after the SPD reform. An improvement in the bottom of the skills

distribution of newly hired teachers drives this change.

Because the SPD reform was implemented at the national level, the above effects are estimated using time variation. Yet, we provide evidence supporting their causal interpretation. Notably, our analysis rules out the main threat to identification: the possibility that the documented results are explained by secular trends or shocks that affect the pool of individuals from which teachers are selected.

We study several potential mechanisms to understand the forces behind these changes. First, the SPD reform increased the share of teachers hired via competitive examinations from 63.6 percent in 2012 to 76.8 percent in 2014 and 86.4 percent in 2016. However, it did not wholly eliminate discretionary hiring, highlighting the implementation challenges in contexts with weak state capacity. Second, the SPD reform increased the skills gap favoring rule-based over discretionary hires. A sharp increase in the skills of rule-based hires the year Mexico implemented the SPD reform and a progressive decline in the skills of the discretionary hires explain this enlargement of the skills gap.

Our results show that the improvement in the skills of rule-based hires is driven by an improvement in the screening of applicants, with only a modest contribution from the self-selection channel. Given the promise of making merit the key criterion of personnel decisions throughout the teaching career, the SPD reform could have attracted higher-skilled individuals into teaching. However, we find only small gains in rule-based applicants' skills. Second, the reform improved the screening efficiency of rule-based hiring, making cognitive skills stronger determinants of hiring outcomes. That is, the SPD reform made it more likely that those with higher skills would be hired. Before the SPD reform, a one-percentile-point increase in an applicant's ENLACE score was associated with an increase of 0.13 percentage points in the probability of being hired as a teacher. During the SPD regime, the corresponding increase was 0.43 percentage points.

This paper contributes to several literatures at the intersection of personnel, education, and public economics. We contribute, first, to the literature on personnel economics of the state and, more specifically, to a recent strand of papers that study the effect of rule-based and discretionary hiring on the profile of civil servants (Estrada, 2019; Neilson, Gallegos and Calle, 2019; Brassiolo, Estrada and Fajardo, 2020; Colonnelli, Prem and Teso, 2020; Dahis, Schiavon and Scot, 2020; Brassiolo, Estrada, Fajardo and Martinez-Correa, 2021; Munoz and Prem, 2021).[1] The paper also contributes to the literature on teacher hiring in developing countries (Estrada, 2019; Neilson, Gallegos and Calle, 2019; Araujo, Heineck and Cruz-Aguayo, 2020; Brutti and Torres, 2021). Our findings complement those by Estrada (2019), who—studying the period previous to the SPD reform—finds that teachers hired under the rule-based mechanism were significantly more effective at increasing student learning than discretionary hires. Relative to this paper, our contribution is to document the selection patterns (self-selection and screening) shaping the skills profile of rule-based hires.

Our paper also connects to the literature on civil service reforms, which mainly focuses on the U.S. context (Rauch, 1995; Ujhelyi, 2014; Ornaghi, 2019; Moreira and Pérez, 2021). We contribute to this literature by studying a large civil service reform in a different setting. Finally, we contribute to the literature on decentralization, particularly to the studies that highlight that the weak capacity of some local governments can compromise the success of decentralization reforms. (See reviews in Bardhan (2002); Mookherjee (2015).) Our findings point out one factor that could contribute to such weakness: a less meritocratic selection of

[1] In related work, Xu (2018); Voth and Xu (2020) study the effect of using discretion in promotion decisions in the context of the British Empire.

bureaucrats.

2 | INSTITUTIONAL CONTEXT

In Mexico, state governments are responsible for the operation of preschool, primary, and lower secondary schools, whereas the federal government defines the national curriculum, monitors the system's performance, among other regulations, and finances a large share of the public education budget. Prior to 2008, state education ministries and the teachers' union were responsible for the selection and promotion of teachers.[2] In practice, the union had close to full control in the hiring and promotion decisions in many states through, for example, the appointment of state officials who were also union leaders and the inclusion of participation in union activities as a requirement for promotions (Santibanez, 2008). Personnel decisions were characterized by a high use of discretion and opacity. The system was widely criticized for lack of merit in decisions, including the practice of entitlement (which allowed teachers who were retiring to pass on their jobs to relatives) and the selling of teaching positions.

A 2008 reform named the "Alianza por la Calidad de la Educación" or ACE introduced the use of national competitive examinations to hire teachers for public schools. (See details about the ACE reform in Estrada (2019).) The ACE used test scores from national standardized examinations organized by the Federal authorities as the main criteria for hiring teachers. However, the use of competitive examinations in ACE was not mandatory. The decision of what share of vacancies would be filled by rule-based hiring was jointly taken by state authorities and the teachers' union, and the rest were assigned at the discretion of the teachers' union. Thus, the union was entitled to select a share of new hires in every state, and representatives from both state authorities and the union made promotion decisions. The ACE reform also did not introduce changes in other dimensions of the teaching career—it was limited to the selection of new teachers.

In 2013, the Mexican Congress enacted a major education reform that included revamping the teachers' civil service system. It expanded in scale and scope the policies implemented by ACE. However, there were some important differences between ACE and SPD. (Table 1 summarizes the main characteristics of rule-based hiring under both reforms.) The newly created teachers' civil service (named "Servicio Profesional Docente" or SPD) mandated the use of competitive examinations to determine the hiring and promotion of teachers in preschool , primary, and secondary education.[3] The SPD used standardized examinations to screen applicants. These assessments were designed specifically for this purpose and were the main criterion to make hiring offers. Like ACE before it, SPD faced fierce opposition from the teachers' union. Despite this and other implementation challenges, the federal Ministry of Education and the National Institute for the Evaluation of Education implemented in July of 2014 the first SPD examination for teacher selection, a process that took place every year until 2018.

In 2019, Mexico canceled the SPD reform because of a change in the political party in office, bringing this era of education reform to a close. See Figure A.1 for a summary timeline. A detailed description of the reform and the political context is available in Islas, Calef and Aparicio (2021).

[2]SNTE for its acronym in Spanish. See more about SNTE in Estrada (2019).
[3]The SPD reform did not cover either private schools or upper secondary schools operated by public universities.

3 | DATA

3.1 | Data Sources

We obtain information on primary and lower secondary school teachers hired from 2012 to 2017 from the following three databases:

- *Registro Nacional de Maestros*, RENAME: quarterly administrative dataset on school personnel (3rd quarter of 2011–4th quarter of 2012). Identifies teachers hired in 2012.
- *Censo de Escuelas, Maestros y Alumnos de Educación Básica*, CEMABE: census of schools, teachers and students carried out by the National Statistics Office, INEGI (September–December 2013). Identifies teachers hired in 2013.
- *Fondo de Aportaciones para la Nómina Educativa*, FONE: quarterly administrative dataset on school personnel (1st quarter of 2015 – 2nd quarter of 2018). Identifies teachers hired from 2014 to 2017.

The Federal Ministry of Education assembles the RENAME and FONE databases. They cover all public school teachers paid with federal funds, except those based in Mexico City schools. No official documents report the total number of teachers on the payrolls of state governments. However, according to our estimates, they accounted for around 13 percent to 15 percent of the teachers hired in 2013. Most teachers held positions funded by the federal government and are part of our analysis.

Information on the individuals who applied under the rule-based hiring process is based on micro-data from ACE for 2012–13 and SPD for 2014–17. There are no comparable records of "applicants" to the discretionary process. To the best of our knowledge, there is no documentation of the process or criteria used to select and promote teachers in the discretionary process.

The ENLACE exam is our measure of teachers' cognitive skills. ENLACE was a census-based standardized test applied to all students in their final year of upper secondary school (grade 12) between 2008 and 2013. The test assessed achievement in mathematics, literacy, and a rotating subject. The main purpose of the assessment was to provide feedback to stakeholders in the education system, and its results did not have consequences for students' graduation or admission into the next schooling level. Participation in ENLACE was optional, but more than 90 percent of all students sat for the test each year. de Hoyos, Estrada and Vargas (2021) find that ENLACE test scores are strong predictors of schooling and labor market trajectories and conclude that ENLACE effectively captured the cognitive skills it was designed to measure.

3.2 | Merging and Variables Included in the Final Dataset

Using the RENAME, CEMABE, and FONE databases, we construct a data set of new teachers inclusive of name, gender, birth date, type of teaching position, assigned school(s), and year of hire.[4] We identify as new teachers those individuals who do not appear in any record

[4] Across the different databases, we track individuals using their population ID (CURP for its acronym in Spanish) and taxpayer ID (RFC).

from previous school years—the datasets do not include information on hiring dates.[5]

We merge the results from the ACE and SPD entry examinations with the teachers' data, building a dataset that contains applicants' population ID, their results in the entry examination, and the type of teaching position they applied to.[6] The data does not include hiring offers or acceptances. Hence, we define rule-based hires as those who apply to the rule-based process, either the ACE or SPD examinations, and are part of the teacher payroll the following school year. Newly hired teachers who are on the payroll but did not participate in a rule-based process are considered discretionary hires.

We transform the individual ENLACE test scores into year-specific percentiles of the overall distribution of the mean score in math and literacy. Among the 4.9 million students who sat for the test between 2008 and 2012, 95 percent have a complete population ID. We use the population ID to merge the ENLACE data with data from the merged teachers' and applicants' database described above. Due to data data limitations, we are not able to merge the information on the unsuccessful rule-based applicants in 2012 to their ENLACE scores. The final dataset includes information on all new hires, rule-based and discretionary, for primary and lower-secondary public schools between 2012 and 2017, while for rule-based applicants it covers the 2013-2017 period.[7]

3.3 | Samples Used in the Analysis

We identify a total of 181,590 individuals hired as primary and lower-secondary school teachers during the 2012–17 period. Because of their age, many of these individuals finished secondary school before ENLACE was administered for the first time in 2008. For the 2012 cohort of new teachers, the first in our analysis, we can only identify the ENLACE score of those hired four years after concluding secondary school.[8] Hence, our analysis is based on the sample of 24,914 individuals hired four years after finishing upper secondary. We refer to these individuals as "recent graduates."[9] Panel A of Table 2 shows descriptive statistics. Both all new teachers and recent university graduates are majority female, the new teachers are, on average, seven years older than the recent graduates, and the recent graduates are more likely to have been hired through a rule-based process (whether before or after the SPD reform). Their ENLACE scores are, on average, at the 67th percentile of the national distribution.

Panel B of Table 2 shows some descriptive statistics for the 468,846 individuals who applied to the rule-based process during the period 2013–17. The majority are female, on average 29 years old, and 14 percent succeeded in being hired. The 55,660 recent university graduates have an even higher proportion of females and are about seven years younger on average. Recent graduates tended to perform well on the standardized test used in the competitive examinations. Thirty-eight percent (66 percent) scored in the top quartile (half) of their entry

[5] Because CEMABE was designed to cover all public school teachers, it includes teachers paid with federal or state funds. To avoid counting state-funded teachers as federally funded teachers, we exclude all teachers in CEMABE who are based in schools that do not appear in either RENAME or FONE.

[6] Because test scores under SPD are only available in brackets corresponding to five performance categories, we construct a corresponding variable for the ACE test scores—reported as a continuous variable—that mimics the distribution of SPD applicants among these categories.

[7] The final dataset can be downloaded from xaber.org.mx along with a document explaining in detail how it was constructed.

[8] A teaching degree in Mexico typically requires four years of studies.

[9] We use the sample of teachers hired four or five years after finishing upper secondary for robustness checks (using 2013 as a baseline).

examination test, and 30 percent of them were hired. They have an average ENLACE score at the 61.5th percentile of the national distribution.

4 | EMPIRICAL STRATEGY

We are interested in identifying the effect of the SPD reform on the skills profile of new teachers and in shedding light on its underlying mechanisms. Because the SPD reform had a national reach and was implemented simultaneously across the country, we rely on time variation for our first set of results:

$$Y_{it} = \alpha + \sum_{\pi=2013}^{2017} \beta_\pi \cdot \mathbb{1}[\pi = t] + \Gamma X_{st} + \theta_s + \epsilon_{it} \tag{1}$$

Where Y_{it} is the ENLACE test score (in percentiles) of individual i hired at year t. $\mathbb{1}[\pi = t]$ is a vector of dummy variables that indicate the relative time (in years) with respect to 2012, the year prior to the enactment reform, and β_π are the coefficients of interest. X_{st} is a vector of labor market variables as controls and Γ is the associated vector of parameters. θ_s is a vector of state fixed effects and ϵ_{it} is an error term. We present heteroskedasticity-robust standard errors.

There was almost a one-year gap between the announcement and the implementation of the SPD reform, which could have led to anticipation effects. We deal with such a possibility by using 2012 (one year before the reform was announced and two years before it was implemented) as the baseline year.

To explore heterogeneous effects along the distribution of Y_{it}, we complement the main specification (equation 1) with a quantile regression model:

$$Q_\tau(Y_{it}) = \sum_{\pi=2013}^{2017} \beta_\pi(\tau) \cdot \mathbb{1}[\pi = t] + \Gamma(\tau) X_{st} + \theta_s + u_{it} \tag{2}$$

Where $Q_\tau(Y_{it})$ is the ENLACE test score of individual i hired at year t at the τ^{th} quantile and $\beta_\pi(\tau)$ and $\Gamma(\tau)$ are vectors of coefficients at the various quantiles.

In equations 1 and 2, the effect of the SPD reform is identified using time variation. Hence, it faces two important threats to identification. First, the effect of the reform might be confounded with a secular trend unrelated to the SPD reform on the ENLACE scores of new teachers. To mitigate this concern, we use a dynamic specification of treatment effects—instead of a simple before-and-after specification—which allows exploring in a desegregated way the evolution of the new teachers' profiles. Furthermore, by using the year-specific percentiles of ENLACE test scores as the outcome variable, we concentrate on changes in the relative position of newly hired teachers in the national distribution of cognitive skills, holding constant changes in overall test scores across years. We do not have information about long-term trends in the skills profile of the teaching force in Mexico, but a string of papers from other contexts has documented a secular decline—mostly in

developed countries (Nickell and Quintini, 2002; Corcoran et al., 2004; Fredriksson and Öckert, 2008), but also in Chile in Latin America (Neilson, Gallegos and Calle, 2019)—which in our specification would lead to an *underestimation* of the effects of the SPD reform on the skills profile of new teachers.

A second threat to identification is related to potential shocks that affect the selection process into teaching in a contemporaneous way to the SPD reform. We do not have any information about a contemporaneous policy or economic shock that could produce such a pattern. Nonetheless, we include in the estimation of equations (1) and (2) a set of covariates on economic conditions at the local (state) level that could affect occupational decisions in the labor market: the state's GDP per capita, unemployment rate, and the mean wages earned by tertiary-educated individuals working in non-teaching occupations

Furthermore, we can directly observe the skills profile of individuals who self-select (apply) into the rule-based process. As we rely on time variation, we cannot separate contemporaneous shocks to applicant quality from the potential effect of the SPD reform on the skills profile of rule-based applicants. This is not problematic though, as in Section 6, we find that the implementation of the SPD reform was followed by only a modest change in the skills profile of rule-based applicants, which—no matter the source—cannot explain the improvement in the skills profile of new teachers that we present in the next section.

5 | MAIN RESULTS

We find a clear improvement in the skills profile of teachers hired after the SPD reform. Figure 1a shows point estimates for the changes with respect to 2012 in the average ENLACE scores of the teachers hired every year—coming from the estimation of equation 1.[10] The point estimates for the changes in the post-reform years vary from 2.7 to 3.8 percentiles of the ENLACE test score distribution and are all statistically significant at the 95 percent level. For context, teachers hired in 2012—our baseline year—had average ENLACE scores in the 65th percentile. We do not find clear evidence of an anticipation effect. The coefficient for 2013 has a small magnitude (-1.0 percentiles) and is not statistically significant.

An improvement in the bottom of the skills distribution explains most of the improvement that the SPD reform produced in the skills profile of new teachers. The SPD reform was accompanied by a sharp improvement in the skills of teachers at the 0.1 quantile. We estimate equation 2 to study whether the change in the profile of teachers hired after the reform varied across the skills distribution. Figure 1b reports the corresponding point estimates for changes with respect to 2012 to test scores for teachers in the 0.1 and the 0.9 quantiles. The point estimates for the changes in the post-reform years vary from 4.6 to 6.2 percentiles of the ENLACE score and are all statistically significant at the 95 percent level. To evaluate the magnitude of these point estimates, consider that in 2012 new teachers in the 0.1 quantile had ENLACE test scores at the 24th percentile of the national test distribution. The corresponding point estimates for changes to teacher test scores in the 0.9 quantile are are small in magnitude (around 1 percentile) and not statistically significant. This lack of an effect may be because the test scores of incoming teachers at the 0.9 quantile were already high in 2012 (equivalent to the 94th percentile of the overall ENLACE distribution), so there

[10] Figure A.2a in the Appendix presents the raw yearly means, and Table A.1 in the Appendix reports the point estimates plotted in Figure 1a. It also presents results from estimations without the controls for the state-level labor market conditions and using yearly changes in these variables instead of levels. Results are consistent across specifications.

was little room to improve.[11]

Due to data limitations, we focus our analysis on recent graduates—teachers hired four years after finishing secondary school. Figure A.4 in the Appendix shows that our results are robust to the inclusion of individuals hired five years after finishing secondary school, using 2013 as the baseline year. Unfortunately, we cannot go beyond this extension.

6 | MECHANISMS

Our results suggest that the rule-based personnel policies implemented with the reform had a positive effect on the skills profiles of new teachers. We turn now to evidence that could support a causal relationship and shed light on the mechanisms linking the SPD reform with the improvement in teachers' skills.

6.1 | The Prevalence of Rule-based Hiring

We study first the extent to which the SPD reform effectively increased the prevalence of rule-based hiring in the public education system. Figure 2 reports the share of new teachers hired under the rule-based method. We make three observations. First, rule-based hiring was the most common way to select teachers even before the SPD reform, with 63.6 percent of the teachers hired through a competitive examination in 2012 as a result of the ACE reform. Second, the SPD reform significantly increased the prevalence of rule-based hiring—by 14 percentage points in its first year of implementation and 23 percentage points two years later. (See point estimates in Figure A.5 in the Appendix.) Third, the use of discretionary hiring—albeit to a lesser extent—persisted after the SPD reform.[12]

6.2 | The Skills Gap Between Rule-based and Discretionary Hires

The skills gap between rule-based and discretionary hires widened after the SPD reform. Figure 3a plots yearly means of ENLACE scores by hiring method. Three things stand out. First, rule-based hires have, on average, higher ENLACE scores than discretionary hires starting from the baseline year. Rule-based hires in 2012 have, on average, a 3.4 percentile higher ENLACE score than discretionary hires. The gap increased to 6.7 in 2013 and to 14.5 in 2014—the first year in which the reform was implemented. Second, there seems to be a discontinuity in the skills profile of rule-based hires when the reform is implemented. Third, the skills profile of discretionary hires follows a downward trend. The ENLACE scores of this group decreased on average by 3.2 percentiles per year from 2012 to 2016, and regression estimates for the skills gap between rule-based and discretionary hires by year of hiring (Figure 3b) confirm the widening skills gap between these two groups of teachers.

The widening skills gap between rule-based hires and discretionary hires is mainly explained by a downward trend in the skills of discretionary hires and a marked improvement in

[11] A similar—though less stark—pattern is found from comparing the 0.25 and 0.75 quantiles—see figures A.2b and A.3 in the Appendix.

[12] We might have overestimated the proportion of rule-based hires among total hires. Because we do not observe job offers, we define rule-based hires as individuals who apply to the rule-based process and are hired as new teachers. Our definition might encompass individuals who, despite having participated in a competitive examination, were hired through a discretionary process.

the skills of rule-based hires between 2013 and 2014. (The point estimate for the difference between these two years is 4.4 percentiles, with p-value of 0.01.)

The marked improvement in the skills of rule-based hires between 2012 and 2014 is startling. Figures 3c and 3d present raw yearly percentiles and quantile regression estimates for the skills gap between rule-based and discretionary hires. The gap at the 0.1 quantile increased from 5 percentiles in 2012 to 20 percentiles in 2014. In contrast, the corresponding gap at the 0.9 quantile was 2 percentiles in 2012 and 3 percentiles in 2014.[13]

Combined with the increased prevalence of rule-based hiring, the widening skills gap between rule-based and discretionary hires and—particularly—its large increase in the year the SPD reform was implemented support the hypothesis that this reform is responsible for the documented improvement in the skills profile of new teachers. The sharp improvement in the skills profile of rule-based hires—but not discretionary hires—in 2014 is evidence against the concern that the improvement in the skills profile of new teachers was the result of a secular trend in the profile of individuals who self-select into the teaching profession (which would affect both rule-based and discretionary hires), a matter which we investigate further below.

6.3 | Self-selection and Screening in Rule-based Hiring

Two channels could explain the documented change in the skills gap between rule-based and discretionary hires: changes in self-selection (in the pool of individuals from which new teachers are drawn) and screening. We study the importance of both mechanisms in the rule-based process; we cannot do the same for the discretionary process because we only observe individuals who were hired, not the full pool from which they are selected.

| Self-selection

The SPD reform had at most only a modest effect on the skills profile of the pool of individuals who decided to apply to rule-based hiring. Figure 4a shows point estimates for the change with respect to 2013 in the ENLACE score of rule-based applicants. Between 2013 and 2014, there is a small drop in the average ENLACE score of rule-based applicants (point estimate is -1.4 percentiles, with p-value of 0.00). From 2015 on, there are no statistically significant changes with respect to 2013.

At the bottom of the skills distribution, there was a modest improvement in the profile of individuals who self-selected into the rule-based process. Figure 4b plots the corresponding quantile regression estimates. For the 0.1 quantile, there is no observed change between 2013 and 2014, and then there is a significant increase of around 1.5 percentiles from 2015 on. For the 0.9 quantile, there are significant decreases of around 1 percentile in 2014 and 2017 with respect to 2013, and no observed change in 2015 and 2016 with respect to 2013.[14] To interpret the magnitude of these point estimates, consider that with respect to 2013, the average ENLACE score of rule-based hires in the post-SPD years improved by around 3.4–4

[13] See OLS and quantile regression estimates for the yearly change in the skills gap with respect to 2012 in Figures A.6a and A.6b in the Appendix; and raw yearly percentiles and quantile regression estimates for the 0.25 and 0.75 quantiles in Figures A.7a and A.7b in the Appendix.

[14] We obtain a similar picture if, instead of focusing only on individuals who finished secondary school four years before applying to a teaching position, we include in the sample those who finished four or five years prior, as shown in Figure A.8 in the Appendix.

percentiles and by 5–7 percentiles at the 0.1 quantile of the rule-based hires' distribution (Figure A.9 in the Appendix). This further weakens the concern that the main results could be explained by a secular trend or shock—independent of the reform—to the skills profile of individuals who self-select to teaching.

| Screening

The SPD reform improved the efficiency of rule-based hiring, making cognitive skills more important determinants of hiring outcomes. Figure 5 reports local means of the probability of being hired among rule-based applicants by percentile of the ENLACE score for the periods before and after the SPD reform. As expected, the relationship between the probability of being hired and the ENLACE score changed significantly with the implementation of the SPD reform, making skills a stronger predictor of hiring. (Figure A.10 in the Appendix reports similar results by year to show that this change is not the result of a secular trend.) While ACE was in effect, a one-percentile-point increase in the ENLACE score was associated with an increase of 0.13 percentage points in the probability of being hired (controlling for state fixed effects, see Table A.3 in the Appendix), whereas during the SPD regime the corresponding increase was of 0.43 percentage points. Although an applicant with an ENLACE score at the 10th percentile had the same (unconditional) probability of being hired in both the ACE and SPD examinations (of 10.9 percent), an applicant with an ENLACE score at the 90th percentile had a 20.9 percent chance of being hired during the ACE examination and a 43.5 percent chance of being hired during the SPD one.

The SPD regime was more successful than its rule-based predecessor, ACE, in making hiring outcomes more sensitive to applicants' cognitive skills. Both regimes used standardized tests to screen applicants. However, the institutions responsible and the length and contents of the tests differed. Figure 6 plots local means of the probability of scoring in the top quartile (half) of the SPD (ACE) entry examination by the applicant's ENLACE score, and Table A.4 in the Appendix presents the corresponding regression estimates—controlling for state and type of teaching position fixed effects. In line with the previous results, the SPD examination strengthened the relationship between screening and cognitive skills. For example, an ACE applicant with an ENLACE score at the 50th percentile had an (unconditional) probability of scoring at the top quartile (half) of the entry examination distribution of 9.8 percent (23.6 percent), whereas an SPD applicant with the same ENLACE score had a probability of 21.3 percent (58.0 percent) of scoring at the top quartile (half) of the entry examination.

7 | CONCLUSIONS

This paper shows that the implementation of the SPD reform improved the skills profile of new teachers. This progress was mainly driven by changes in the bottom of the skills distribution of newly hired teachers. Two main channels explain this result. First, the reform decreased the prevalence of discretionary hires, which were drawn disproportionately from the bottom of the skills distribution. Second, the reform improved the screening efficiency of rule-based hiring, making cognitive skills a more important determinant of hiring outcomes.

The SPD reform decreased, but did not eradicate, the use of discretionary hiring. This finding had not been documented before in this context, but it echoes evidence from a similar teacher reform in Colombia (Brutti and Torres, 2021). The incomplete reach of these

reforms speaks to the challenges of implementing civil service reforms in contexts where institutions might be weak and incentives for non-compliance strong.

The skills profile of discretionary hires was already worse than those of rule-based hires and worsened after the SPD reform. This evidence is consistent with the idea that the abuse of discretion in hiring can lead to the selection of lower-skilled individuals because they are the ones who have fewer labor market options and therefore benefit the most from non-meritocratic access to a job (Estrada, 2019).

The SPD reform was based on the promise of making merit the key criterion of personnel decisions through the teaching career, in contrast to the accusations often made to the discretionary regime. One could expect that such a change in personnel policy made teaching a more attractive career for higher-skilled individuals, a possibility reinforced by the fact that the reform eliminated application restrictions among university graduates from fields different from the ones exclusively related to teaching ("escuelas normales" as they are known in Mexico). We only find a modest improvement in the skills profile of rule-based applicants. However, we cannot discount the hypothesis that the self-selection effect would have grown in importance in the medium- to long-term (because our post-reform period of analysis only comprises four years).

Several countries in Latin America have implemented teacher reforms to make rule-based hiring mandatory. The list includes Brazil, Chile, Colombia, Ecuador, Mexico, and Peru. The results presented in this paper highlight two important dimensions to evaluate the effect of such reforms on teacher quality. One is its overall efficiency vs. the alternative regime. The other is the technical efficiency of the assessment used to screen teachers.

The results presented in this paper show how a rule-based civil service system can improve the skills profile of incoming public officials. However, the ambitious reform under analysis faced a political backlash that led to its cancellation. This demonstrates that the political implementation and the generation of a broad coalition of support among public servants and other stakeholders is as important as the technical content of personnel policies for the long-run success of civil service reforms.

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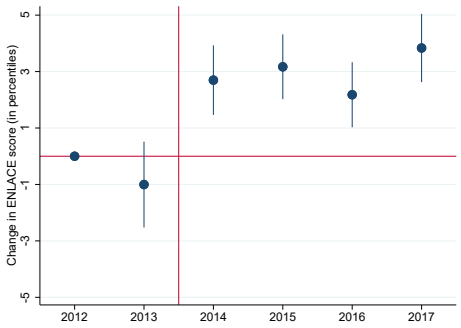
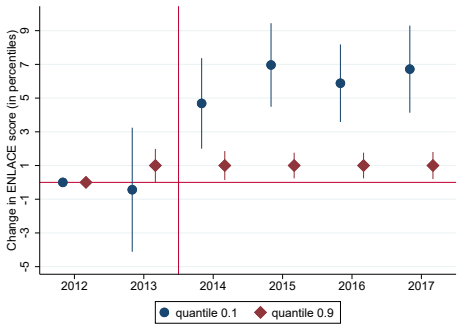
FIGURES

FIGURE 1 **New teachers: Change in ENLACE scores with respect to 2012**

(a) OLS estimates (2012: mean = 64.9)

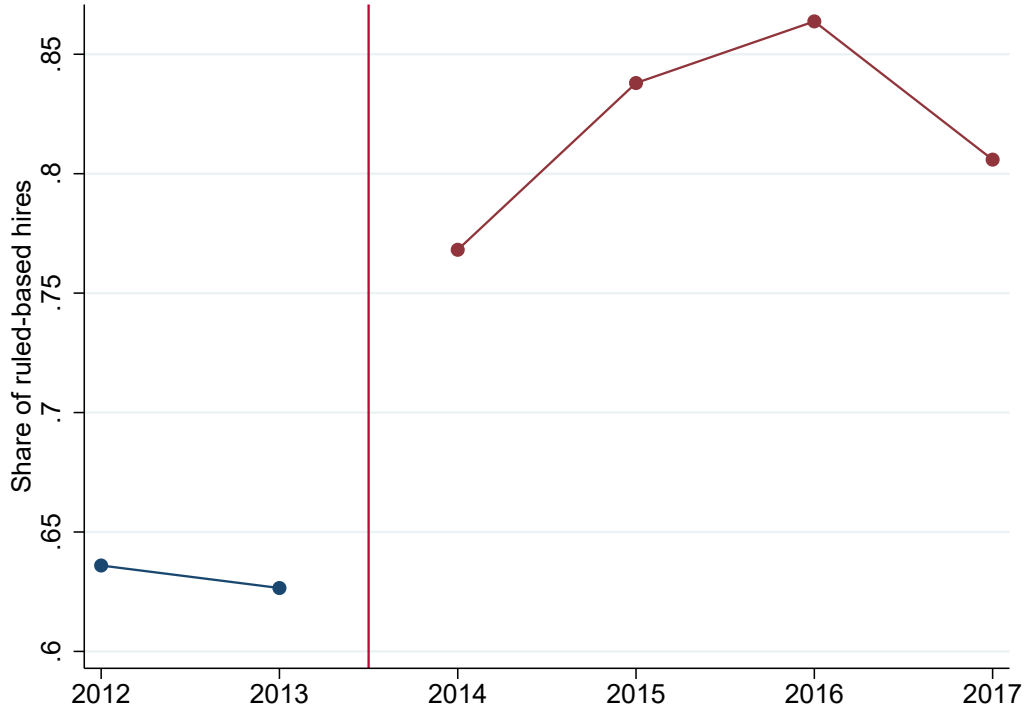


(b) Quantile regression estimates (2012: p10 = 24.3, p90 = 94.1)



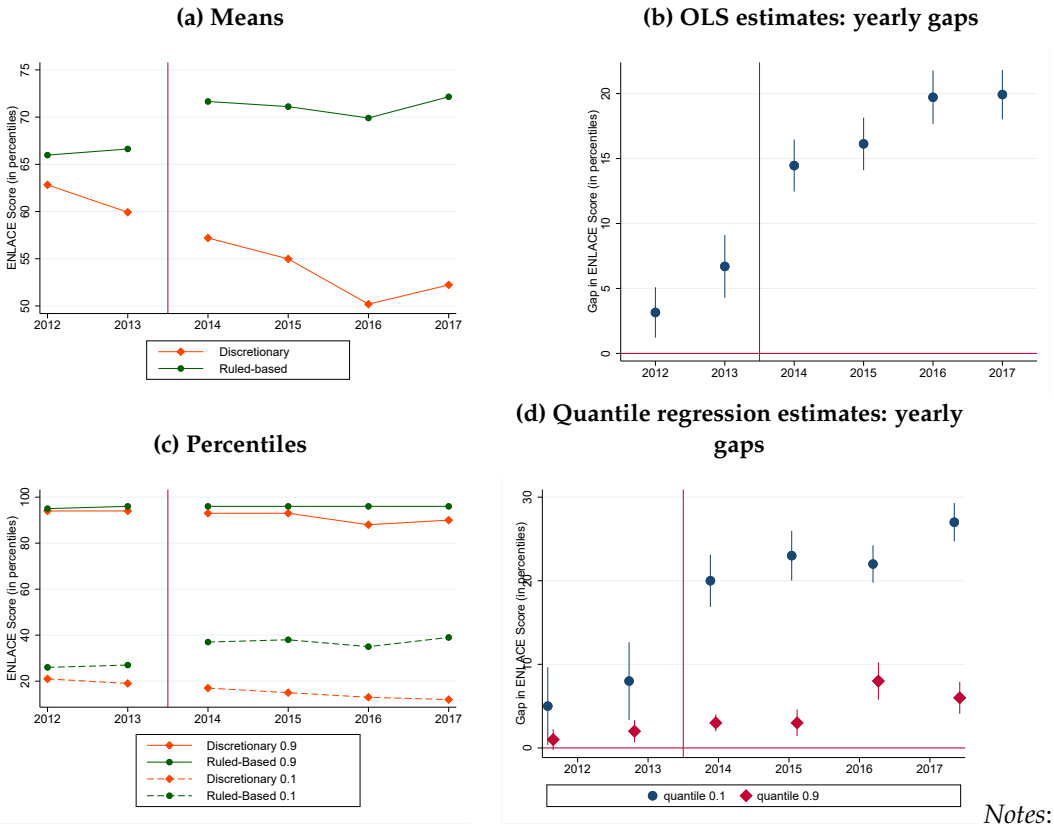
Notes: Panel (a) shows the difference in percentiles of the ENLACE score of newly hired teachers with respect to 2012, corresponding to the β_π estimates of equation (1). Panel (b) shows the difference in percentiles of the ENLACE score of newly hired teachers for quantile 0.1 in blue and quantile 0.9 in red with respect to 2012, corresponding to the $\beta_\pi(0.1)$ and $\beta_\pi(0.9)$ estimates of equation (2). Regressions include state fixed effects, state job market controls, and robust standard errors. Confidence intervals at the 95 percent level are shown in bars.

FIGURE 2 **New teachers: Share of rule-based hires**



Notes: The figure shows the share of rule-based newly hired teachers for each of the sample years. As explained in Section 3.1, we define rule-based hires as individuals who apply to the rule-based process (ACE or SPD) and are hired as teachers the following school year.

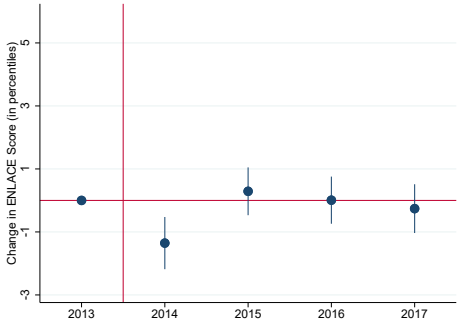
FIGURE 3 **New teachers: ENLACE scores of rule-based vs. discretionary hires**



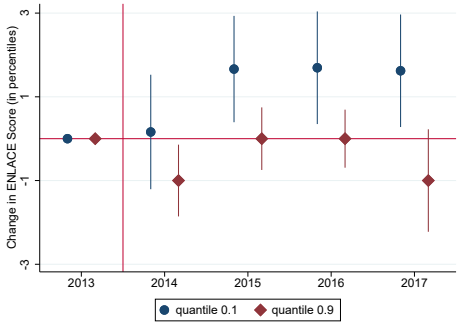
Notes: Panel (a) shows the ENLACE score in percentile means for new rule-based and discretionary hires for each year in the sample. Panel (b) shows the estimates of the annual gaps in ENLACE scores in percentiles between new rule-based and discretionary hires; regressions include state fixed effects and robust standard errors. Panel (c) shows the ENLACE score in percentiles at quantiles 0.1 and 0.9 for new rule-based and discretionary hires for each year in the sample. Panel (d) shows estimates of the annual gaps in ENLACE score in percentiles at quantiles 0.1 and 0.9 between new rule-based and discretionary hires; regressions include state fixed effects and robust standard errors. For Panels (b) and (d), confidence intervals at the 95 percent level are shown in bars.

FIGURE 4 **Rule-based applicants: Change in ENLACE scores with respect to 2013**

(a) OLS estimates (2013: mean = 59.0)

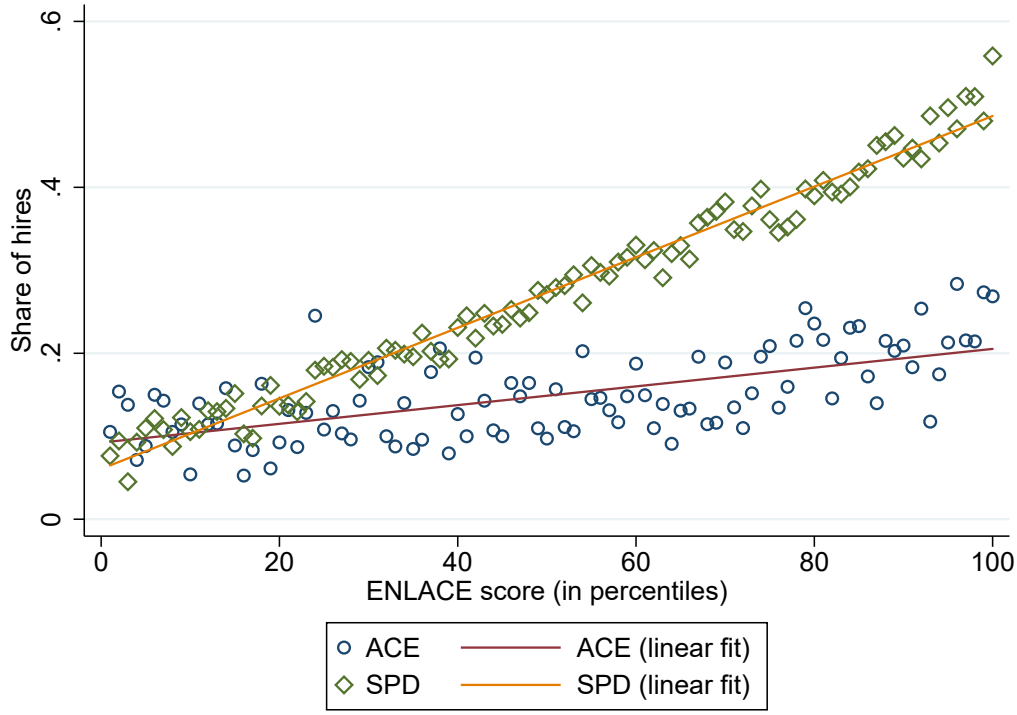


(b) Quantile regression estimates (2013: p10 = 19.6, p90 = 92.5)



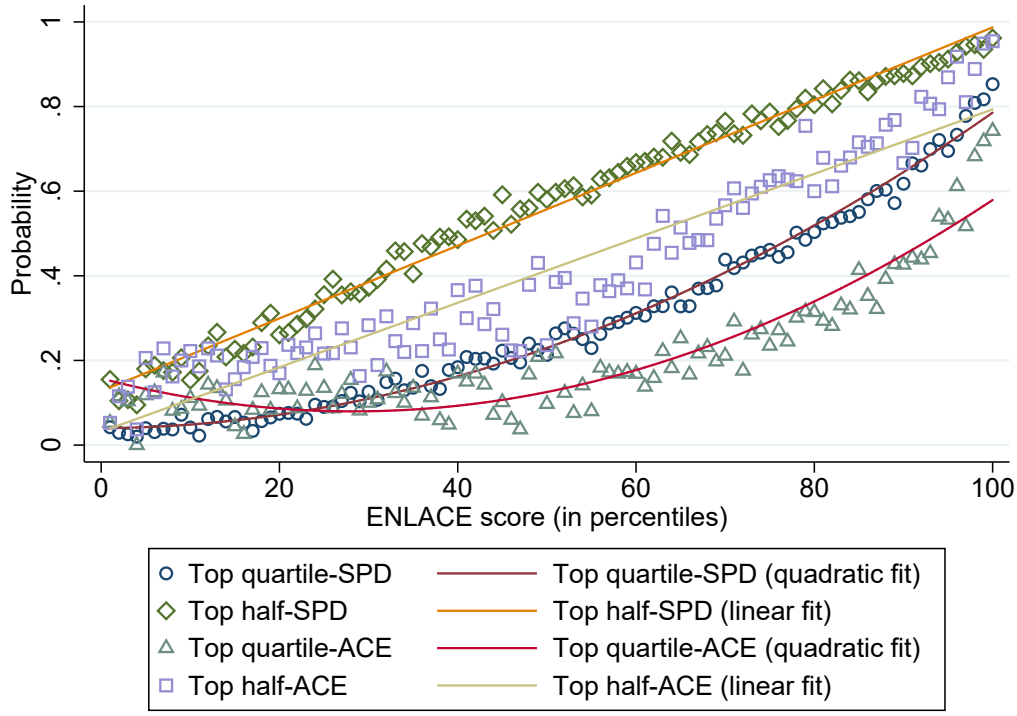
Notes: Panel (a) shows the difference in percentiles of the ENLACE score of rule-based applicants with respect to 2013, corresponding to the β_π estimates of equation (1). Panel (b) shows the difference in percentiles of the ENLACE score of rule-based applicants for quantile 0.1 in blue and quantile 0.9 in red with respect to 2013 corresponding to the $\beta_\pi(0.1)$ and $\beta_\pi(0.9)$ estimates of equation (2). Regressions include state fixed effects and robust standard errors. Bars show confidence intervals at the 95 percent level.

FIGURE 5 **Rule-based applicants: Probability of being hired by ENLACE score**



Notes: The figure shows probability of being hired by each percentile in ENLACE score for ACE and SPD rule-based applicants. A linear fit is included for each system.

FIGURE 6 **Rule-based applicants: Probability of obtaining a high entry examination score by ENLACE score**



Notes: The figure shows the probability of scoring in the top 25 percent and top 53 percent of the ACE and SPD entrance exams for each of percentiles in ENLACE score. For the probability of scoring in the top 53 percent in any of the systems a linear fit was included, in the other hand, for the probability of scoring in the top 25 percent in any of the systems a quadratic fit was included.

TABLES

TABLE 1 **Teacher hiring reforms: ACE and SPD characteristics**

Characteristics		ACE	SPD
Institutions in charge of competitive examinations	Regulations and oversight	National Committee with representatives from the Federal Ministry of Education and teachers' union (Comisión Nacional Rectora).	National Institute for the Evaluation of Education and Federal Ministry of Education.
	Implementation	State committees with representatives from state Ministry of Education and teachers' union (Comités Estatales de Seguimiento).	Federal and state ministries of education.
Exam's content(*)		**1.** Course content; **2.** Teaching skills; **3.** Intellectual skills; **4.** Regulations, ethics and school management.	**1.** Course content; **2.** Teaching skills; **3.** Intellectual skills; **4.** Regulations, ethics and school management.
Exam's length (number of questions)		80	175-240(**)
Hiring criteria		Weighted average of test score in standardised entry exam and (optionally, if chosen by the State Ministry of Education) bachelor's GPA.	Test score in standardised entry exam.
Assignment of teachers to schools		Responsibility of state committees with representatives from state Ministry of Education and teachers' union.	Applicants can choose among available vacancies in order of their ranking established for hiring decisions.
Eligibility criteria		Bachelor degree from authorised public and private teacher training institutions. Specialization varies according to the position.	Bachelor degree from any higher education institution. Specialization varies according to the position.

Notes: (*) In both cases, exams were specific for each type of position (primary teacher, secondary math teacher, etc). ACE comprised only one exam, while SPD was divided into two exams (only in the case of teachers applying to fill in a vacancy for indigenous languages took a third exam). (**) According to the 2014–15 Exam Study Guide, the total number of questions amounted to 175. Subsequent guides indicated a total of 240 questions.

TABLE 2 **New teachers and rule-based applicants: Descriptive statistics**

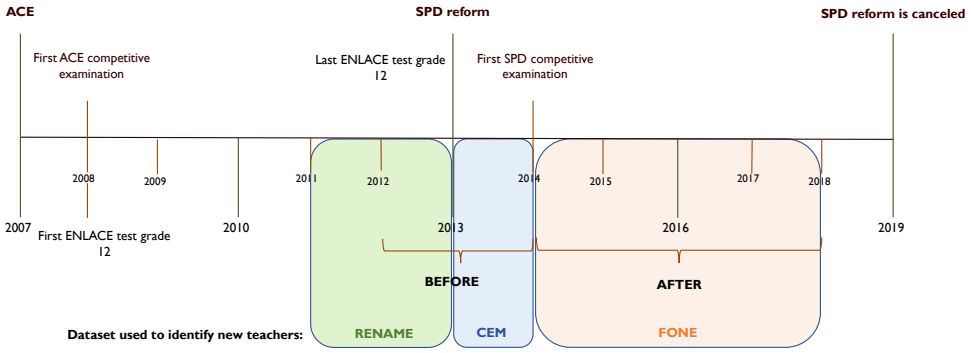
		Panel A - New Teachers 2012-2017		
		All	Recent graduates (4 years)	Recent graduates (4 & 5 years)
		(1)	(2)	(3)
Female	Mean	0.649	0.691	0.686
	SD	0.477	0.462	0.464
Age	Mean	29.529	22.283	22.664
	SD	8.864	0.749	0.918
ENLACE Score (in percentiles)	Mean		67.342	64.508
	SD		25.012	25.634
Rule-based hire	Mean	0.457	0.784	0.732
	SD	0.498	0.411	0.443
	Observations	181,590	24,914	39,615
		Panel B - Rule-based applicants 2013-2017		
		All	Recent graduates (4 years)	Recent graduates (4 & 5 years)
		(1)	(2)	(3)
Female	Mean	0.692	0.764	0.752
	SD	0.461	0.424	0.432
Age	Mean	29.147	22.294	22.611
	SD	7.138	0.766	0.927
ENLACE score (in percentiles)	Mean		61.547	59.594
	SD		26.570	26.834
Top-quartile score in entry examination	Mean	0.241	0.377	0.346
	SD	0.415	0.484	0.476
Top-half score in entry examination	Mean	0.505	0.659	0.625
	SD	0.498	0.474	0.484
Rule-based hire	Mean	0.136	0.300	0.282
	SD	0.343	0.458	0.445
	Observations	468,846	55,660	79,530

Notes: Panel A shows summary statistics for new teachers in the period 2012–17. Column (1) shows statistics for all new teachers, including those we cannot merge with ENLACE. Column (2) shows statistics for recent graduates who entered the system 4 years after graduating from secondary school. Column (3) shows statistics for recent graduates who entered the system 4 or 5 years after graduating from secondary school. Panel B shows summary statistics for rule-based applicants for the period 2013–17. Column (1) shows statistics for all rule-based applicants, including those we cannot merge with ENLACE. Column (2) shows statistics for recent graduates who approached the rule-based system 4 years after graduating from secondary school. Column (3) shows statistics for recent graduates who approached the rule-based system 4 or 5 years after graduating from secondary school.

APPENDIX. ADDITIONAL FIGURES AND TABLES

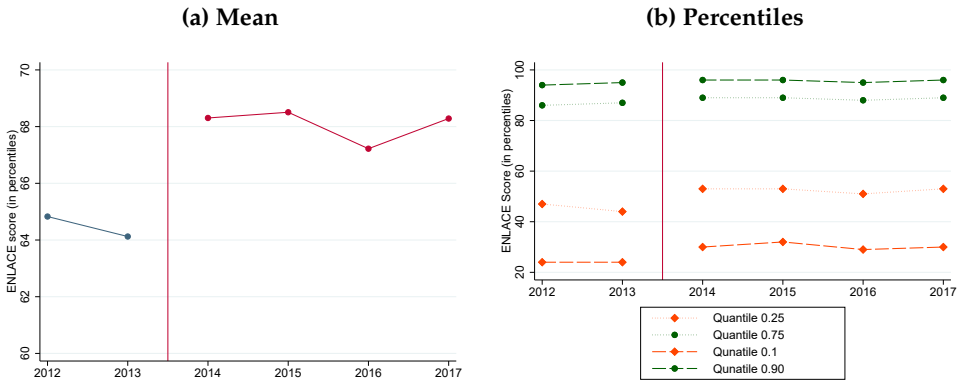
I Figures

FIGURE A.1 **Timeline and data sources**



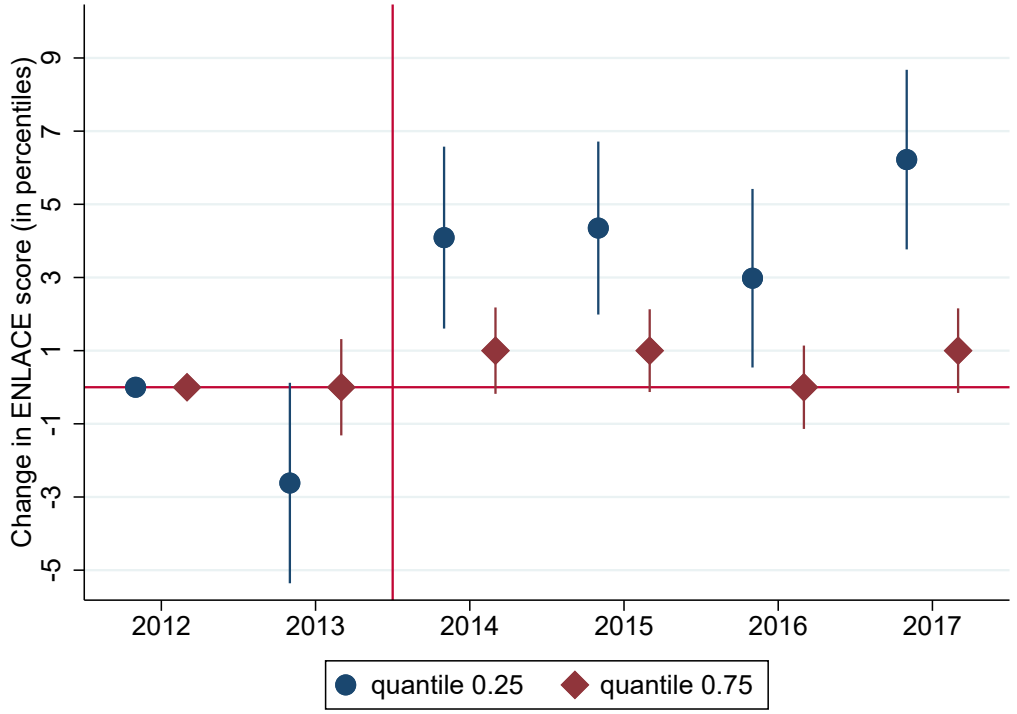
Notes: This timeline illustrates the significant changes in teacher personnel policies that the Mexican education system experienced over 2007–19. The figure also shows the data sources used to identify the newly hired teachers (RENAME, CEM, and FONE), the competitive examinations (ACE and SPD), and the ENLACE 12th grade scores.

FIGURE A.2 **New teachers: ENLACE score**



Notes: Panel (a) shows the mean percentile ENLACE scores for newly hired teachers for each year in the sample. Panel (b) shows the ENLACE score in percentiles at quantiles 0.1, 0.25, 0.75 and 0.9 for newly hired teachers for each year in the sample.

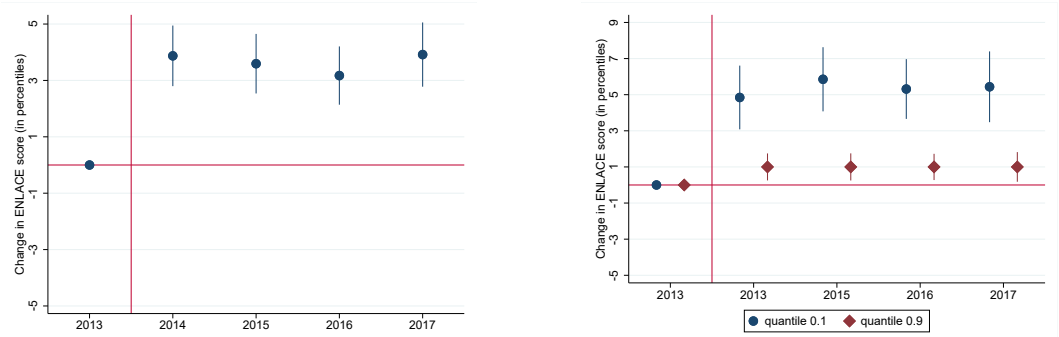
FIGURE A.3 **Quantile regression estimates**



Notes: The figure shows the difference in percentiles of the ENLACE score of newly hired teachers for quantile 0.25 in blue and quantile 0.75 in red with respect to 2012 corresponding to the $\beta_\pi(0.25)$ and $\beta_\pi(0.9)$estimates of equation (2). Regressions include state fixed effects and state job market controls and robust standard errors. Confidence intervals at the 95 percent level are shown in bars.

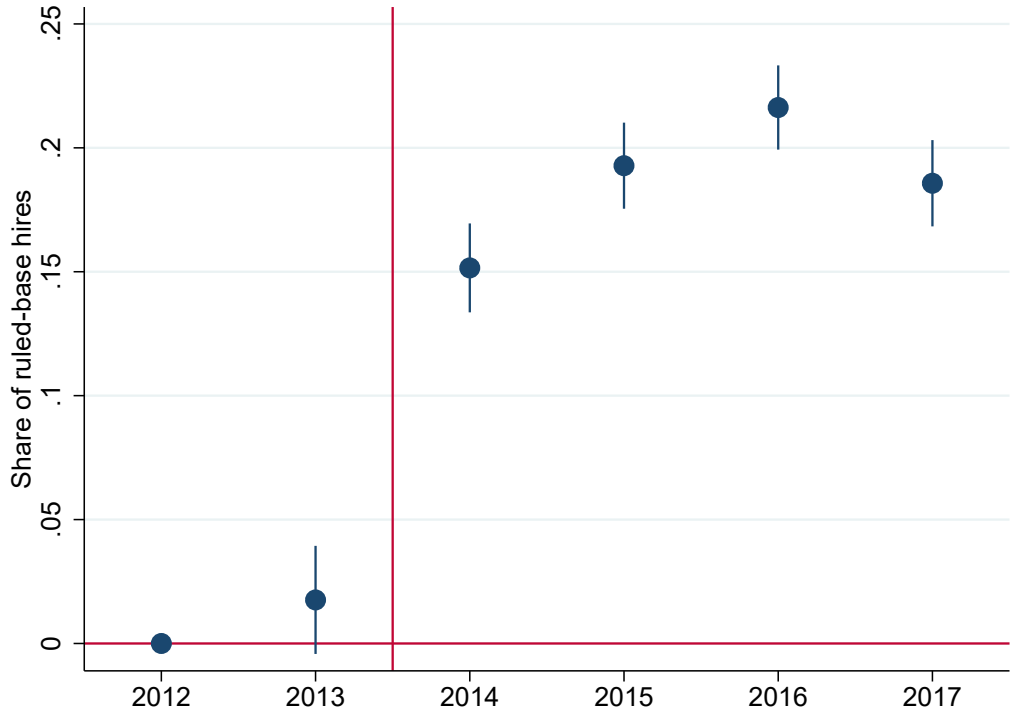
FIGURE A.4 **New teachers (4 & 5 years after graduating from secondary school): Change in ENLACE scores with respect to 2013**

(a) OLS estimates **(b) Quantile regression estimates**



Notes: The figure (a) shows the difference in percentiles of the ENLACE score of newly hired teachers with respect to 2013, corresponding to the β_π estimates of equation (1). The figure (b) shows the difference in percentiles of the ENLACE score of newly hired teachers for quantile 0.1 in blue and quantile 0.9 in red with respect to 2013 corresponding to the $\beta_\pi(0.9)$ and $\beta_\pi(0.1)$ estimates of equation (2). Regressions include state fixed effects and state job market controls and robust standard errors. Confidence intervals at the 95 percent level are shown in bars.

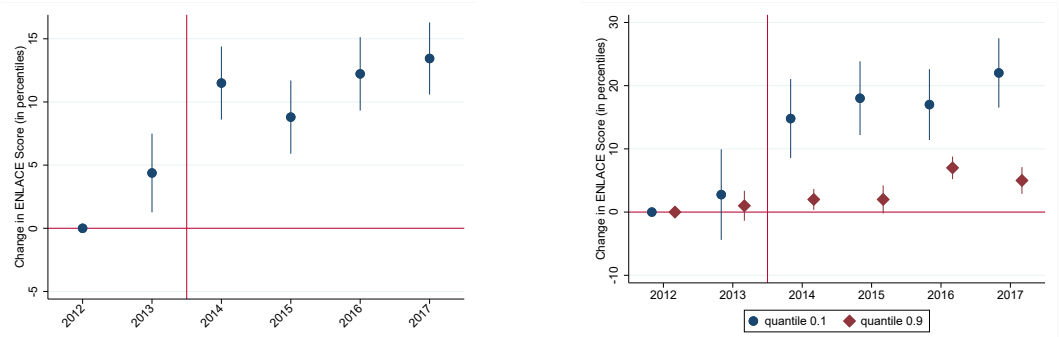
FIGURE A.5 **OLS estimates: change in share of rule-based hires (2012: mean = 67.7)**



Notes: The figure shows the difference in the share of rule-based hires within the newly hired teachers with respect to 2012, corresponding to the β_π estimates of equation (1). Regressions include state fixed effects, state job market controls, and robust standard errors. Confidence intervals at the 95 percent level are shown in bars.

FIGURE A.6 **Rule-based - Discretionary hires skills gap: Change with respect to 2012**

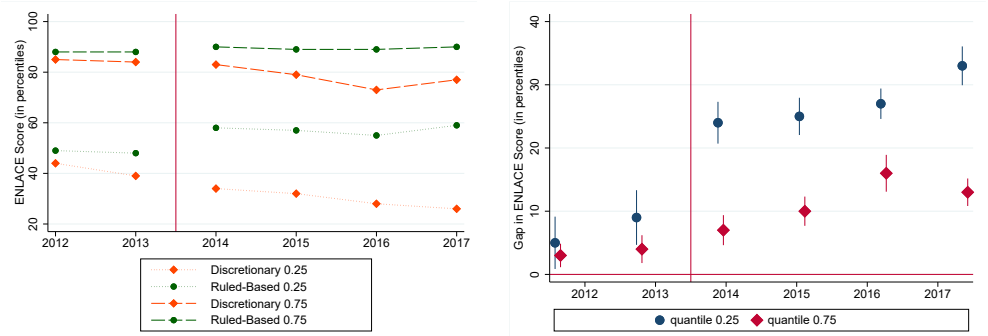
(a) OLS estimates **(b) Quantile regression estimates**



Notes: Panel (a) shows the estimates of the skills gap in percentiles of the ENLACE score of rule-based over discretionary hires with respect to 2012. Panel (b) shows the estimates of the skills gap in percentiles of the ENLACE score of rule-based over discretionary hires with respect to 2012 for quantiles 0.1 and 0.9. Regressions include state fixed effects and state job market controls and robust standard errors. Bars show confidence intervals at the 95 percent level.

FIGURE A.7 **Rule-based vs. discretionary hires: ENLACE score**

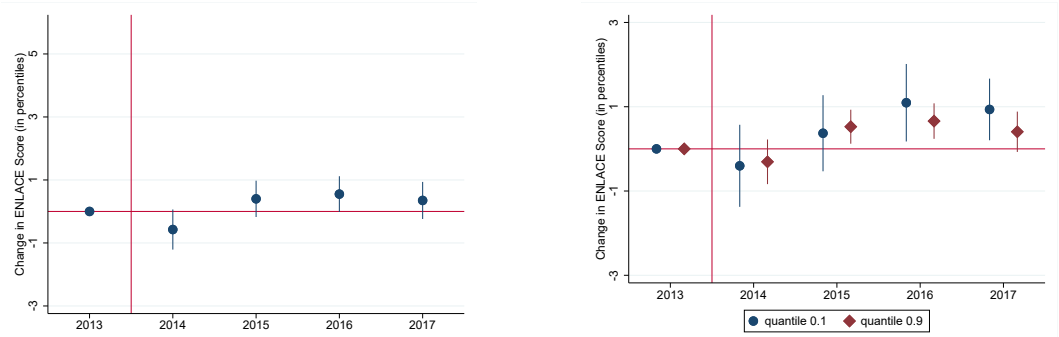
(a) 25th and 75th percentiles **(b) Quantile regression estimates: yearly gaps**



Notes: Panel (a) shows the ENLACE score in percentiles at quantiles 0.25 and 0.75 for rule-based and discretionary hires for each year in the sample. Panel (b) shows the estimates of the annual gaps in ENLACE score in percentiles at quantiles 0.25 and 0.75 between rule-based and discretionary hires; regressions include state fixed effects and robust standard errors. For Panel (b), bars show confidence intervals at the 95 percent level.

FIGURE A.8 **Rule-based applicants (4 & 5 years): Change in ENLACE scores with respect to 2013**

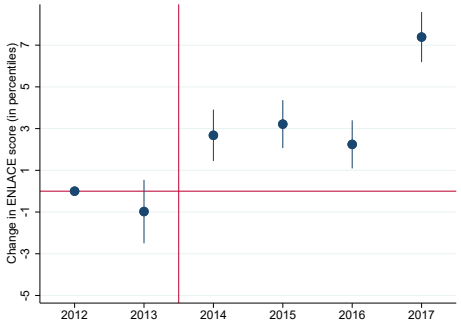
(a) OLS estimates **(b) Quantile regression estimates**



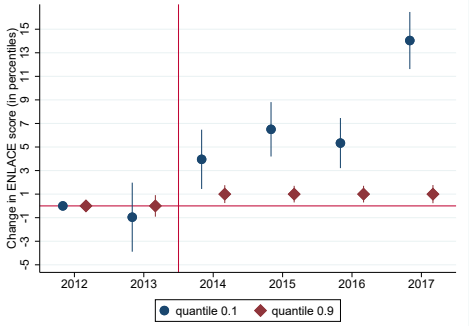
Notes: The figure (a) shows the difference in percentiles of the ENLACE score of rule-based applicants (4 & 5 years) with respect to 2013, corresponding to the β_π estimates of equation (1). The figure (b) shows the difference in percentiles of the ENLACE score of rule-based applicants (4 & 5 years) for quantile 0.1 in blue and quantile 0.9 in red with respect to 2013 corresponding to the $\beta_\pi(0.9)$ and $\beta_\pi(0.1)$ estimates of equation (2). Regressions include state fixed effects and robust standard errors. Confidence intervals at the 95 percent level are shown in bars.

FIGURE A.9 **Rule-based hires: Change in ENLACE score with respect to 2012 and 2013**

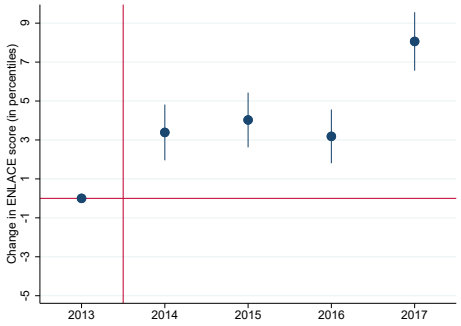
(a) OLS estimates with respect to 2012



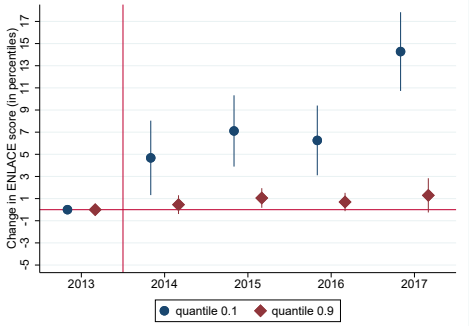
(b) Quartile regression estimates respect to 2012



(c) OLS estimates respect to 2013

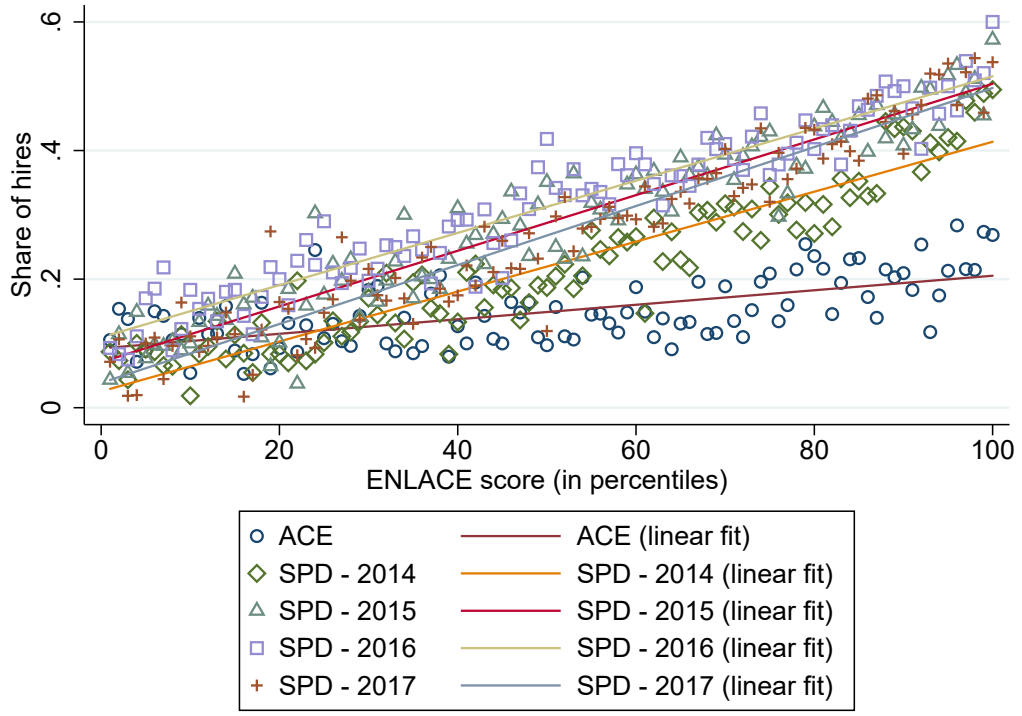


(d) Quartile regression estimates with respect to 2013



Notes: Panel (a) shows the difference in percentiles of the ENLACE score of rule-based newly hired teachers with respect to 2012, corresponding to the β_π estimates of equation (1). Panel (b) shows the difference in percentiles of the ENLACE score of rule-based newly hired teachers for quantile 0.1 in blue and quantile 0.9 in red with respect to 2012, corresponding to the $\beta_\pi(0.1)$ and $\beta_\pi(0.9)$ estimates of equation (2). Panel (c) shows the difference in percentiles of the ENLACE score of rule-based newly hired teachers with respect to 2013, corresponding to the β_π estimates of equation (1). Panel (d) shows the difference in percentiles of the ENLACE score of rule-based newly hired teachers for quantile 0.1 in blue and quantile 0.9 in red with respect to 2013, corresponding to the $\beta_\pi(0.1)$ and $\beta_\pi(0.9)$ estimates of equation (2) Regressions include state fixed effects, state job market controls and robust standard errors. Bars show confidence intervals at the 95 percent level.

FIGURE A.10 **Rule-based applicants: Probability of being hired by ENLACE percentile and year**



Notes: The figure shows probability of being hired by each percentile in ENLACE score for ACE and SPD (yearly). A linear fit is included.

Tables

TABLE A.1 **OLS estimates: New teachers: Change in ENLACE score with respect to 2012**

	(1)	(2)	(3)
2013	-0.800	-0.781	-1.004
	(0.758)	(0.761)	(0.776)
2014	2.835***	2.969***	2.697***
	(0.619)	(0.631)	(0.629)
2015	3.131***	3.516***	3.170***
	(0.585)	(0.644)	(0.586)
2016	2.146***	2.645***	2.179***
	(0.580)	(0.696)	(0.588)
2017	3.609***	4.492***	3.835***
	(0.595)	(0.867)	(0.618)
No. of obs.	24,904	24,904	24,904
State FE	Yes	Yes	Yes
Job market controls	No	Yes	No
Job market lagged variation controls	No	No	Yes

Notes: The table shows estimates of the β_π coefficients for equation (1), each column with a different set of controls. The dependent variable is the ENLACE score in percentiles. New teachers incoming in the cycle 2012–13 are the excluded category. Job market controls include the state unemployment rate and the average monthly income of workers with at least 13 years of education in sectors other than education services. Job market variation controls are the annual percentage changes of the job market controls. Robust standard errors $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

TABLE A.2 **Quantile regression estimates: New teachers: Change in ENLACE score with respect to 2012**

	(q 0.1)	(q 0.9)
2013	-0.436	1**
	(1.878)	(0.502)
2014	4.685***	1.000**
	(1.370)	(0.437)
2015	6.964***	1.000***
	(1.264)	(0.388)
2016	5.882***	1.000**
	(1.173)	(0.389)
2017	6.717***	1.000**
	(1.319)	(0.409)
No. of obs.	24,904	24,904
State FE	Yes	Yes
Job market lagged variation controls	Yes	Yes

Notes: The table shows estimates of the β_π coefficients for equation (2). The first column shows the estimates for quantile 0.1, and the second column shows the estimates for quantile 0.9. The dependent variable is the ENLACE score in percentiles. New teachers incoming in the 2012–13 cycle are the excluded category. The job market variation controls are the annual percentage changes of the state unemployment rate and the average monthly income of workers with at least 13 years of education in sectors other than education services. Robust standard errors $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

TABLE A.3 **OLS estimates: Rule-based applicants: Probability of being hired by ENLACE score**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ACE	SPD	All	2014(SPD)	2015(SPD)	2016(SPD)	2017(SPD)
ENLACE Score	0.00127***	0.00431***	0.00127***	0.00412***	0.00432***	0.00404***	0.00476***
	(0.000155)	(0.0000718)	(0.000155)	(0.000141)	(0.000146)	(0.000148)	(0.000138)
SPD			-0.0290***				
			(0.0107)				
SPD*ENLACE			0.00308***				
			(0.000171)				
No. of obs.	7,635	48,023	55,658	10,828	11,987	12,673	12,535

Notes: This table shows the regression coefficients of the ENLACE score in percentiles as the independent variable and a dummy variable taking the value of 1 if the rule-based applicant was hired and 0 otherwise as the dependent variable. Column (1) shows the results for the ACE rule-based applicants and column (2) for the SPD rule-based applicants, column (3) for all the sample including an interaction of a dummy variable taking the value of 1 for 2014 and after and 0 otherwise and ENLACE score and columns (4) to (7) for each year of the SPD rule-based applicants. Year fixed effects included for columns (1) and (2). Robust standard errors * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE A.4 **OLS estimates: Rule-based applicants: Probability of obtaining a high entry examination score by ENLACE score**

	(1)	(2)	(3)	(4)
	Top quartile SPD	Top quartile ACE	Top half SPD	Top half ACE
ENLACE Score	0.00801***	0.00553***	0.00822***	0.00851***
	(0.0000635)	(0.000165)	(0.0000665)	(0.000168)
No. of obs.	51,642	7,609	51,642	7,609

Notes: This table shows the regression coefficients of the ENLACE score in percentiles as independent variable and a dummy variable taking the value of 1 if the rule-based applicant scored in the Top 25 percent of SPD (column 1), Top 25 percent ACE (column 2), Top 53 percent SPD (column 3), Top 53 percent ACE (column 4) and 0 otherwise as the dependent variable. State fixed effects and a dummy variable taking the value of 1 for those applying for high school positions and 0 otherwise are included as controls. Robust standard errors * $p < 0.10$, ** $p < 0.05$, ***