

# The Effect of Occupational Licensing Stringency on the Teacher Quality Distribution

Bradley J. Larsen, Ziao Ju, Adam Kapor, and Chuan Yu

Stanford and NBER, Stanford, Princeton and NBER, Stanford

January 2021

# Teacher Licensing

- Teacher qualifications a major concern for decades
  - e.g. A Nation at Risk (1983)
- Well-documented that public school teachers are not the highest-performing high-school/college graduates
  - Hanushek et al. 1995, Strauss et al. 2000, etc.
- Academics, teacher organizations, and policymakers have called for action to address low-quality teachers through changes in *occupational licensing* requirements for teachers
- Heated debates in 1990s & 2000s, arguing that **increased stringency**
  - Keeps out **low-quality** teachers (say the proponents)
  - Drives away **high-quality** teachers (say the opponents)
- Little evidence on what actually happens

**Note:** Terms “licensing” and “certification” used interchangeably

# Occupational Licensing Particularly an Issue Today

- Bipartisan support for understanding what works/doesn't, and eliminating unnecessary barriers
- Bloom et al. (2020): occ. lic. reform is one of four most important policy issues for economic recovery

Andrew Cline: Cut your own hair? Hope you had a license for that

NEW HAMPSHIRE  
**UNION LEADER**

Apr 20, 2020 Updated Apr 26, 2020

- Questions on teacher licensing surround COVID shortages

**AP**

**Teacher departures leave schools scrambling for substitutes**

By CASEY SMITH September 13, 2020

# Lots of Potential Ways to Define Quality

- Could define “quality” as
  - Ex-ante qualifications of teacher (prior to any teacher training)
  - Ex-post qualification of teacher (after training)
  - Teacher value-added (how well teacher improves student scores)
  - Parent or student satisfaction
  - Long-term well-being of students
- For this paper, **quality** = selectivity of teacher’s undergrad institution (a measure of ex-ante qualifications)
- Not taking a stance on “true” definition of quality; any of the above would be interesting to study
- This is just one quantifiable feature of selection into teaching important to policymakers (and is what our theoretical model captures)

# This Paper: Effects of Stringency on Quality Distribution

- Theoretical model of licensing in teacher market
- Panel data on 37 dimensions of teacher licensing requirements in each state from 1991–2007
- Micro data on teachers within each state-year

## Research question:

How does licensing stringency affect the *distribution* of teacher quality (average, 10<sup>th</sup> percentile, 90<sup>th</sup> percentile)?

## Preview of Findings

- Stricter licensing leads to
  - Significant increase in left tail
  - Small positive effect on the average and small negative (insignificant) effect on right tail
  - No detrimental effect for vulnerable subgroups (high-poverty or high-minority districts)
- Effects are driven by secondary school teachers (not elementary)
- Stringency changes that matter are those involving academic coursework requirements (others—certification exams, background checks, citizenship requirements, pedagogy training—have no detectable effects)

## Why the *Distribution*?

Broadly speaking, occupational licensing is all about the distribution—esp. the left *tail*

- The public interest argument for occupational licensing restrictions is that they improve the *left tail* of the quality, guaranteeing a *minimum quality* standard (e.g. Leland 1979)
- Most research on *quality*—in any occupation—focuses on *average quality* (and finds little effect).
  - Example: Angrist and Guryan (2008) finds stricter licensing (requiring certification tests) has no effect on *average* teacher quality
  - Similar finding in nearly all occupational licensing studies looking at quality outcomes (Carroll and Gaston 1981; Kleiner and Petree 1998; Kleiner and Kudrle 2000; Barrios 2019; Farronato, Fradkin, Larsen, and Brynjolffsen 2020)
- In any study with a *continuous* measure of quality, it is valuable to look at how licensing affects the *tails*
  - (but very few studies do)

## In teacher context, debate is *all* about the tails

- Proponents of stricter licensing argue it will weed out low-quality (left-tail) candidates from teaching (Darling-Hammond 1997)
- Opponents argue it will make teaching unappealing to high-quality (right-tail) candidates with high outside option wages (Ballou and Podgursky 1998)

*“Our nation faces a daunting challenge in making sure that we have a sufficient supply of well-educated, well-prepared teachers for our children. There is surely widespread agreement that good teachers are vital to our future. However, there is not widespread agreement about how we accomplish this goal. Some propose that we raise standards for entry into the teaching profession, while others suggest that we lower unnecessary barriers.”*

(Diane Ravitch, NYU Ed School Faculty, 2003 White House conference)



## A Simple Model of the Teacher Market

- Finite mass of workers. Each worker  $i$  has quality  $q_i$ , which is  $i$ 's *outside option* wage (WLOG  $q_i \sim [0, 1]$ )
- Teaching pays wage  $w$  for all  $i$  (fixed by collective bargaining)
- To become a teacher,  $i$  must pay licensure cost  $c_i = c(r, q_i)$ , where  $r$  parameterizes licensing *stringency*
- Choose to be teacher if  $w - c_i \geq q_i$
- All of the interesting results come from  $c(r, q_i)$
- $c(r, q_i)$  increasing in  $r$ , decreasing in  $q_i$ , and convex in  $q_i$

# How Licensing Stringency Affects the Quality Distribution

Let

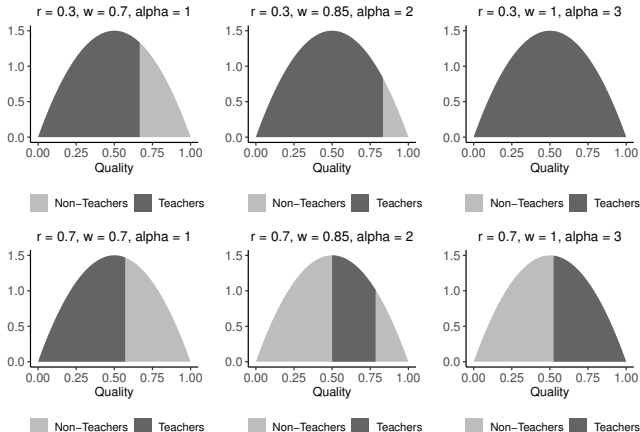
- $q_L$  be lowest-quality worker who becomes a teacher
- $q_H$  be the highest

**Proposition 1.**  $q_L$  increases weakly and  $q_H$  decreases weakly as stringency ( $r$ ) increases.

- $q_H$  decreases when stringency increases because marginal high-quality teachers prefer their high outside option wage
- $q_L$  increases when stringency increases because licensure costs are especially high for low-quality workers
- Proof is simple ( $q_L$  and  $q_H$  = roots of a quadratic equation)

# Effect of Stringency Increase on Quality Distribution

Cost function:  $c(r, q_i) = \alpha r(1 - q_i)^2$ .  $r$  increases from 0.3 (first row) to 0.5 (second row)



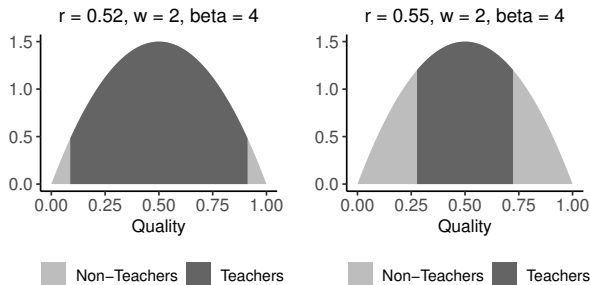
- First column: Only right tail shifts (and slightly)
- Second column: Both tails shift inward
- Third column: Only left tail shifts

## A Null Effect on Average: A Possibility Result

Cost function:  $c(r, q_i) = \beta r / (1 + q_i)$ .  $r$  increases from 0.52 (left) to 0.55 (right)

**Proposition 2.** *An increase in stringency can result in changes to the tails of the distribution of teacher quality without necessarily changing its mean.*

- Proof demonstrates conditions under which this can occur
- Offers explanation for null effect in lit (Angrist-Guryan 2008)

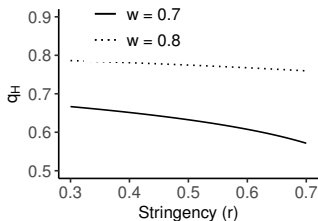


## Vulnerable School Districts

- Consider now multiple *districts*, one paying  $w$  and one paying  $\tilde{w} > w$
- $\tilde{w}$  can be higher nominal wage or higher in non-wage amenities (working conditions, parental support, funding for activities, safety); literature shows these are lower in high-poverty or high-minority districts
- One additional assumption:  $\frac{\partial^2 c(r, q_i)}{\partial q_i \partial r} < 0$ . Means that increases in stringency raise the licensure cost more for low-quality workers

**Proposition 3.** *When stringency increases, the upper tail of quality decreases less in a district paying  $\tilde{w}$  than in a district paying  $w < \tilde{w}$ . The difference in effects on the left tail and average in the two districts is ambiguous.*

# Best Teachers Driven Away from High-Poverty Districts



- *“You have to be a combination of a social worker and Mother Teresa to work in those schools. Those kids deserve a decent education, but we as teachers deserve a decent work atmosphere. We deserve to be safe. I worked so hard to get my license, I did all this schooling, and the last thing I heard, America was a country of free choice.”* (Teacher in New York, NY Times, 2000)
- Similar finding to past theory (Shapiro 1986) and some empirical work (Kleiner 2006): Benefits from licensing may accrue to high-income areas

## Data on Teachers

- National Center for Education Statistics School and Staffing Survey from 1993, 1999, 2003, 2007
- Construct a pseudo panel of teachers for all years 1991–2007 using year teacher started teaching
  - 1991 teachers = third-year teachers in **1993** survey
  - 1992 teachers = second-year teachers in 1993 survey
  - 1993 teachers = first-year teachers in 1993 survey
  - 1994 teachers = sixth-year teachers in **1999** survey (etc.)
- SASS data includes teacher's undergrad institution; we link to selectivity data (average SAT of entering freshmen)
  - ⇒ This is our quality measure
- Other SASS data:
  - Teacher: race, earnings, union membership
  - School/district: urban/rural/suburban dummies, % minority, % free lunch

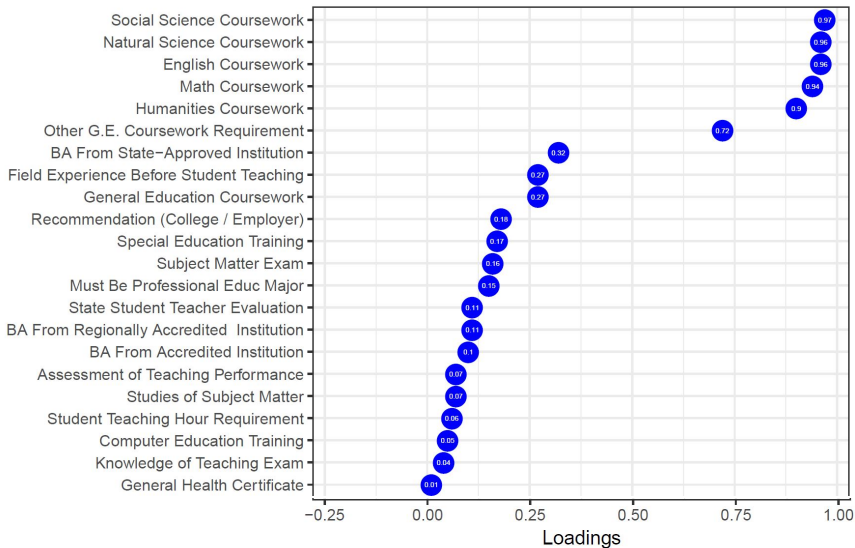
## Data on Licensing Requirements

- We collected information on 37 different dimensions of teacher licensing requirements for all states for as many years as possible from 1991–2007. Mainly from NASDTEC manuals
  - We have released this data (and all state-year data from the paper) on my website
- Examples: coursework requirements, exams, student teaching, pedagogy training, background checks, fees, citizenship
- All 37 requirements codified as dummies, with 1 = more strict
- Use principal factor analysis to construct one-dimensional licensing stringency index from **first principal factor**
- Let  $Stringency_{st}$  denote stringency in state  $s$  and year  $t$



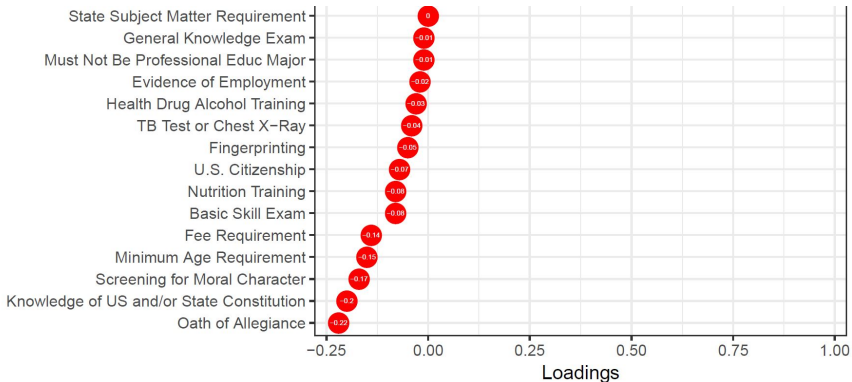
# Stringency Score Correlation with Individual Req's

Stringency score mainly captures variation in coursework req.'s; center of much of debate



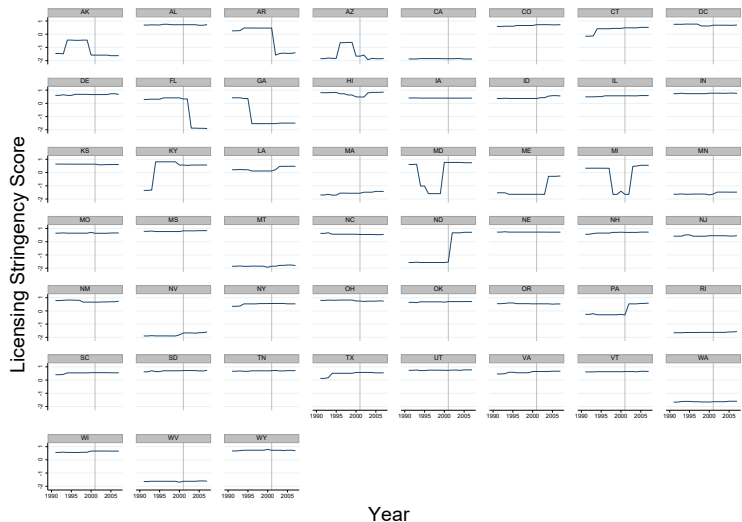
# Stringency Score Correlation with Individual Req's

Stringency score slightly negatively correlated with background check, fee



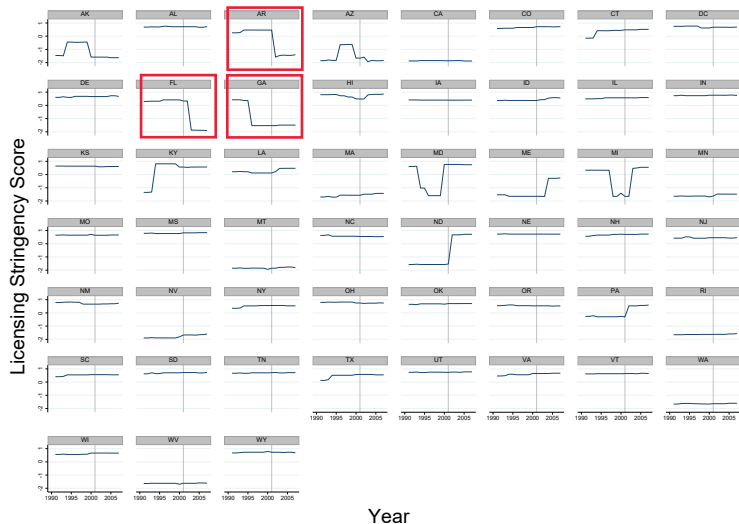
# Variation in Stringency Across States

Wide variation across states and time



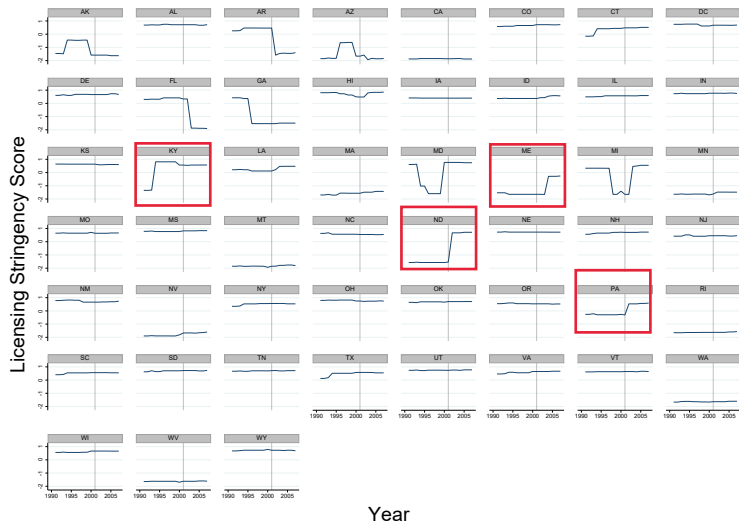
# Some States Only Decreased Stringency

Decrease observed in AR (2002), FL (2003), GA (1996)



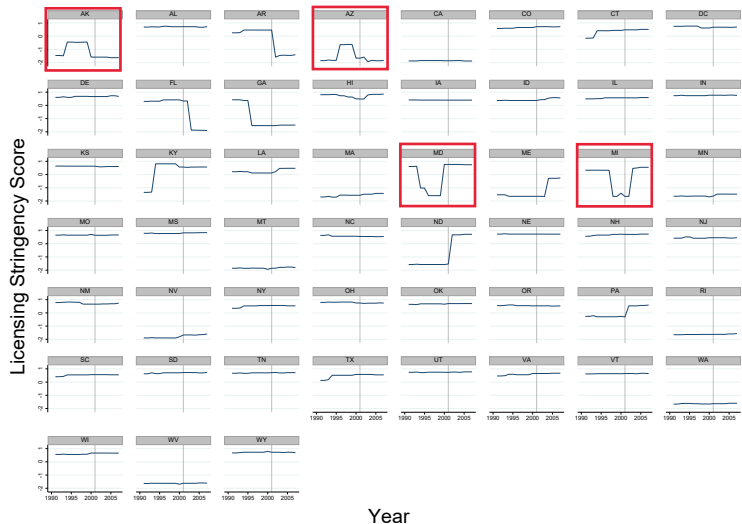
# Some States Only Increased Stringency

Increase observed in KY (1994), ME (2004), ND (2002), PA (2002)



# Some States Did Both

Increased and decreased: AK, AZ, MD, MI



## What Drives This Variation? Is it Exogenous?

- From our reading of contemporary discussions:
  - *all* states concerned about shortage of high-quality teachers
  - states differed in opinion of how to best solve problem; some increased stringency, some decreased
  - States are “laboratory of democracy” (Louis Brandeis)
- Exploring this empirically: Regress stringency on political party measures, historical measures ( $\neq$  normal schools, early licensing requirements, womens suffrage), labor market conditions, union strength, demographics
  - ⇒ Nothing explains stringency changes except possibly Democratic-ness associated with lower stringency (consistent with Democratic/teacher union ties) or student enrollment growth
- Law and Marks (2009): Nothing explains differential timing of adoption of teacher certification requirements
- Kleiner and Soltas (2020): “... the political sources of variation in licensing policy are often so arcane and arbitrary as to be plausibly as good as random.”

## Main Empirical Approach

- Let  $q_{st}$  be a moment of distribution of quality within state  $s$  and year  $t$  (mean, 10th or 90th percentile)
- Grouped quantile regression (Chetverikov, Larsen, Palmer 2016) with two-way fixed effects:

$$q_{st} = \alpha + \gamma_s + \lambda_t + \text{Stringency}_{st}\delta + W'_{st}\theta + \varepsilon_{st}$$

- $\gamma_s$  — state effect
- $\lambda_t$  — year effect (absorbs experience too)
- $W_{st}$  — other state-by-year controls
- Units for  $q_{st}$  = standard deviations of college selectivity
- Units for  $\text{Stringency}_{st}$  = standard deviations of stringency index
- $\delta$  = effect of 1 standard deviation increase in stringency



## Results for All Teachers Sample

A. All Teachers	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

- Includes all teachers (later analyze secondary/elementary separately)
- Each cell in table is separate regression (*Stringency* effect  $\delta$ )
- Outcomes differ across rows (avg, 10th, 90th percentile)
- Controls  $W_{st}$  differs across columns

## Results for All Teachers Sample

<b>A. All Teachers</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

Column 1: Only state and year controls

Finding: Significant, positive effect on left-tail (10th percentile)

## Results for All Teachers Sample

A. All Teachers	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

Column 2: School characteristics:

- dummies for city/suburban makeup (SASS)
- % free lunch, % minority enrollment (SASS)
- total education spending, total enrollment (CCD)
- # charter schools (CCD)

## Results for All Teachers Sample

<b>A. All Teachers</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

Column 3: Teacher market conditions:

- public/private school teacher wages in starting year (CPS)
- public/private school teacher wages in survey year (SASS)
- union membership in survey/starting year (SASS, CPS)
- district salary schedule in survey year (SASS)

## Results for All Teachers Sample

<b>A. All Teachers</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

Column 4: Non-teacher market conditions:

- unempl. rate (survey/starting year), quadric terms, lags (BLS)
- Bartik measure of local wage growth (constructed from CPS)
- per-capita income (CPS)
- average wages overall (CPS)

## Results for All Teachers Sample

<b>A. All Teachers</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

Column 5: Education policy controls:

- financial adequacy reform (Lafortune et al. 2018)
- # desegregation orders (Reardon et al. 2012)
- collective bargaining laws (Valletta and Freeman 1988, Frandsen 2016)

## Results for All Teachers Sample

<b>A. All Teachers</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

Column 6: Political controls:

- Party of governor/legislature (Klarner 2013)
- lame duck governor indicator (Klarner 2013)
- Democratic minus Republican vote share in last gov. election (constructed from CQ Press)

## Results for All Teachers Sample

<b>A. All Teachers</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0181 (0.0257)	0.0275 (0.0308)	0.0156 (0.0250)	0.0175 (0.0254)	0.0192 (0.0242)	0.00671 (0.0287)	0.0163 (0.0283)	0.0584** (0.0248)
10th Percentile q: Stringency	0.155*** (0.0438)	0.154*** (0.0499)	0.143*** (0.0391)	0.131*** (0.0412)	0.153*** (0.0425)	0.160*** (0.0453)	0.141*** (0.0427)	0.181*** (0.0596)
90th Percentile q: Stringency	0.0241 (0.0401)	0.0304 (0.0476)	0.0344 (0.0469)	0.0509 (0.0348)	0.0234 (0.0377)	0.0142 (0.0453)	0.0413 (0.0486)	0.0530 (0.0548)
Observations	857	857	857	857	857	857	857	857
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

Column 7: All from columns 1–6

Column 8: All from columns 1–7 plus state-specific linear trends



# Elementary School Teachers: Stringency Has No Effect

<b>B. Elementary</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.00420 (0.0276)	0.0268 (0.0300)	-0.00530 (0.0313)	-0.00453 (0.0374)	0.00590 (0.0270)	-0.0131 (0.0333)	-0.000124 (0.0391)	0.0690 (0.0461)
10th Percentile q: Stringency	0.0835 (0.0610)	0.102 (0.0615)	0.0574 (0.0652)	0.0373 (0.0778)	0.0900 (0.0586)	0.0817 (0.0671)	0.0433 (0.0693)	-0.00104 (0.0827)
90th Percentile q: Stringency	-0.0142 (0.0535)	0.0455 (0.0534)	-0.0249 (0.0574)	-0.00663 (0.0500)	-0.0151 (0.0555)	-0.0401 (0.0602)	0.0295 (0.0609)	0.0913 (0.0960)
Observations	696	696	696	696	696	696	696	696
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

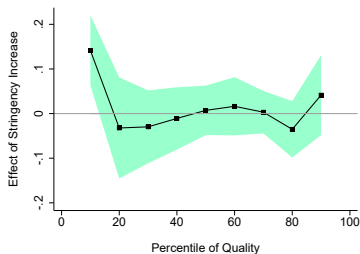
- Sample is slightly smaller (696 state-by-year cells instead of 857)
- No significant effect in any specification

## Secondary School Teachers: Clear Left Tail ↑

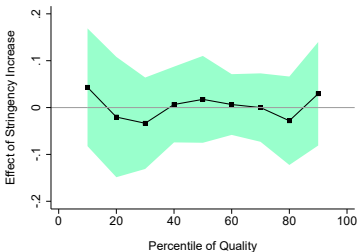
<b>C. Secondary</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average q: Stringency	0.0296 (0.0254)	0.0301 (0.0337)	0.0356 (0.0273)	0.0337* (0.0193)	0.0309 (0.0236)	0.0228 (0.0268)	0.0312 (0.0274)	0.0279 (0.0341)
10th Percentile q: Stringency	0.149*** (0.0325)	0.143*** (0.0419)	0.140*** (0.0326)	0.127*** (0.0364)	0.147*** (0.0289)	0.158*** (0.0342)	0.140*** (0.0383)	0.167*** (0.0523)
90th Percentile q: Stringency	-0.0381 (0.0739)	-0.0623 (0.0781)	-0.00790 (0.0734)	-0.0284 (0.0450)	-0.0366 (0.0711)	-0.0388 (0.0726)	-0.0328 (0.0482)	-0.00349 (0.0680)
Observations	815	815	815	815	815	815	815	815
State, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Characteristics		Yes					Yes	Yes
Teacher Market Conditions			Yes				Yes	Yes
Non-teacher Market Conditions				Yes			Yes	Yes
Education Policy Controls					Yes		Yes	Yes
Political Conditions						Yes	Yes	Yes
State-specific Trends								Yes

- Significant increase in left tail of quality
- Insignificant increase in average and decrease in right tail
- Results robust to excluding any one state
- Results not driven by attrition or cross-state moves

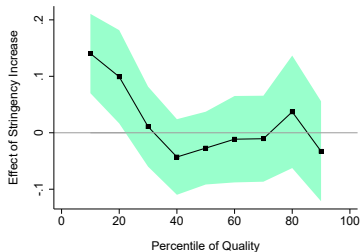
# Effects of Stringency Increase, All Percentiles



(a) All Teachers



(b) Elementary School Teachers



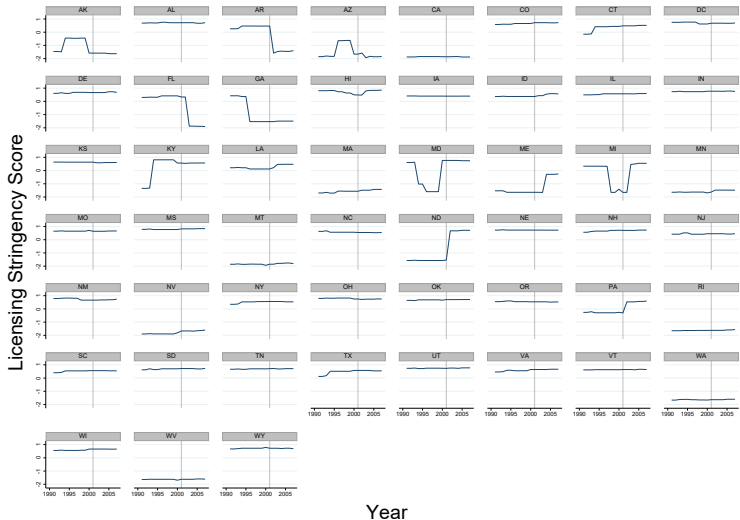
(c) Secondary School Teachers

# A Closer Look at Timing of Stringency Changes for Secondary School Teacher Effect

- Estimates could potentially be driven by pre-trends
- State-of-the-art methods for testing for pre-trends in two-way FE settings are most powerful with sharp design (binary treatment, staggered adoption)
  - de Chaisemartin and d'Haultfoeuille (2020) (dCdH), Goodman-Bacon (2019), etc.
- Create treatment **dummy** for “high” vs. “low” stringency and create two samples:
  - high-to-low sample = always high + always low + high-to-low
  - low-to-high sample = always high + always low + low-to-high

# Low-to-High vs. High-to-Low Samples

Wide variation across states and time

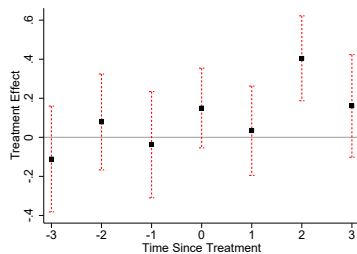


## Repeating Main Analysis on H2L & L2H Samples

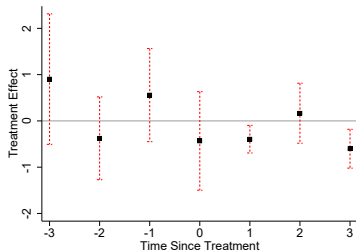
<b>A. Continuous Treatment</b>	(1)	(2)	(3)	(4)
Average q: Stringency	0.0133 (0.0312)	0.00813 (0.0337)	0.0770*** (0.0266)	0.0951*** (0.0318)
10th Percentile q: Stringency	0.151*** (0.0475)	0.139** (0.0528)	0.113*** (0.0392)	0.143*** (0.0498)
90th Percentile q: Stringency	-0.0627 (0.0910)	-0.0403 (0.0643)	0.0623 (0.0454)	0.0243 (0.0515)
<b>B. Dummy Treatment</b>	(1)	(2)	(3)	(4)
Average q: Stringency	0.0304 (0.0583)	0.00784 (0.0623)	0.138*** (0.0430)	0.185*** (0.0510)
10th Percentile q: Stringency	0.312*** (0.0916)	0.255** (0.115)	0.183* (0.0987)	0.218** (0.106)
90th Percentile q: Stringency	-0.0654 (0.198)	-0.0355 (0.129)	0.136* (0.0812)	0.0507 (0.0964)
Observations	727	727	737	737
Sample	H2L	H2L	L2H	L2H
State, Year FE	Yes	Yes	Yes	Yes
All Controls		Yes		Yes

# Event Study

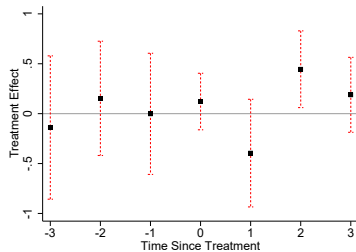
A la dCdH



(d) Avg. Quality, Low-to-High



(e) 10th Per., High-to-Low



(f) 10th Per., Low-to-High

## Effects on Potentially Marginalized Subgroups

- High-poverty or high-minority districts: harder time attracting high-qualified teachers
- Model predicts upper tail decreases weakly *more* in these districts when stringency increases. Ambiguous effect on left tail and average
- Modified regression, splitting each state-year cell in half:

$$q_{stj} = \alpha + \gamma_s + \lambda_t + \text{Stringency}_{st}\delta + W'_{st}\theta + \text{HighPoverty}_{stj}\psi \\ + \text{Stringency}_{st} * \text{HighPoverty}_{stj}\eta + \varepsilon_{stj}$$

- $\text{HighPoverty}_{stj}$  is indicator variable denoting whether cell  $j \in \{0, 1\}$  in state  $s$  and year  $t$  contains high-poverty ( $j = 1$ ) or low-poverty ( $j = 0$ ) districts
- Interested in  $\eta$ , coefficient on interaction





## Does Stricter Licensing Reduce Teacher Diversity?

- Previous work: Stricter licensing can drive out minorities
  - Federman et al. 2006; Angrist-Guryan 2008
- Replace LHS with **fraction minority** in state-year cell
- Finding: Increased stringency doesn't reduce diversity

	(1)	(2)	(3)
Black: Stringency	-0.00973 (0.0139)	-0.0139 (0.0251)	-0.00754 (0.0102)
Asian: Stringency	0.00103 (0.00355)	-0.0000994 (0.00398)	0.000889 (0.00303)
Hispanic: Stringency	0.0154*** (0.00480)	0.0129* (0.00744)	0.0173** (0.00805)
Nonwhite: Stringency	-0.0111 (0.0116)	-0.0180 (0.0223)	-0.00742 (0.00983)
Observations	857	696	815
Sample	All	Elem	Sec
All Controls	Yes	Yes	Yes



# Conclusion/Discussion

- Model:
    - Increased stringency can increase left tail, decrease right tail, or both – and have no effect on average
    - Explains *both* sides of debate, and the historical null empirical result for average quality
  - Empirical findings:
    - Robust increase on left tail from stringency increase
    - Insignificant increase of average and decrease of right tail
    - No evidence of pre-trends
    - No evidence of negative effects on teacher diversity or on high-poverty, high-minority districts
    - Effects driven by coursework requirements for secondary school teachers
- = evidence on *what works* in licensing (coursework requirements) and what doesn't
- Data now publicly available