Those Who Can: Teacher Quality and the Labor Market

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Abstract

The central question of this paper is what impact labor market conditions have on marginal entrance to the teaching profession, and what ramifications this has on ultimate instructor quality. This paper's hypothesis is that in times of economic distress and high private sector unemployment, like the recent recession, the expected quality of individuals who are hired for teaching jobs increases. Using data from the American Community Survey, North Carolina Education Data Research Center and The National Bureau of Economic Research, I find recession-caused migration into the education profession and document sorting on observable teacher ability, measured by scores on certification exams.

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I. Introduction

Do private labor market conditions have an effect on the observable quality of teachers hired, and subsequent student outcomes? Basic economic theory would suggest yes, as a weaker private labor market would result in higher relative salaries for public sector workers, cause more applicants for each opening and thus offer more choice to school administrators. This is an important question, as teacher quality has been shown to be a key input in student achievement and economic outcomes (Goldhaber 2002, Chetty et al 2015).

The two research questions this study proposes to answer are:

- do recessions cause worker migration from the private sector into the teaching profession?
- are teachers hired during poor labor markets fundamentally different from teachers hired during good labor markets, as measured by student results and observable teacher ability?

In this paper I show that potential teachers are responsive to recessions, and this translates into a significant gain for students. Research has shown that recessions have major long term effects on individuals entering the labor force (Oreopoulos, Wachter and Heisz, 2006). During a recession the probability density function of private sector wages faced by individuals will shift, while education hiring will remain relatively stable, as demand for teachers is more acyclic than the private sector (Berman and Pfleeger, 1997). This will change the expected wages being offered to teachers relative to other professions, without changing the local underlying political and cultural characteristics that determine wage level. Recessions effectively exogenously raise the relative expected wage for teaching.

The major contribution of this paper is to analyze the effect of labor market conditions on quality of new hires. Job seekers respond to incentives, and recession serves to lower their reservation wage by increasing the amount of effort it takes to search for a job. This makes it more likely they will accept a job with a relatively lower wage, like an American teacher (Borjas

2002). Using American Community Survey data this paper show this novel result: there are differing effects of recessions on the job market outcomes for college graduates with education and non-education majors, with evidence that non-education majors displace education majors in the teaching profession when a recession occurs as they are entering the labor market for the first time. There is also evidence that individuals sort into an educational degree if a recession occurs after age 19.

Additionally this paper matches two data sources from the NBER and administrative data from North Carolina, to uniquely analyze the direct effect of labor market conditions on the quality of teachers as measured by their certification test score. This paper finds that 5th grade and Algebra II recession hired teachers score better on the math section of the certification exams by about .1 standard deviation.

A working paper by Nagler, Piopiunik and West (NBER Working Paper No. 21393) looks at the effect of recession on Floridan elementary level students' test scores. This paper uses value added testing as a metric for student outcomes.[1] I adapted my original model to serve as a replication and extension, as well as expanding the scope of teachers to both elementary school and high school. They find that 5th grade teachers who are hired during a recession have on average .08 of a standard deviation higher math value added than non-recession teachers. This paper's result is smaller, about .04, but still significant. I also find that recession hired Algebra II teachers improve scores .07 of a standard deviation.

1. Literature Review

The relationship between government employees and the private labor markets has grown in prominence in the years following the great recession. Relatively stable public sector pay in the face of a weak job market has become a subject of considerable contention, and the interconnected role of unions, especially teacher's unions, has been pivotal in political battles at the national, state

[1] Chetty et al. (2015) offer substantial justification for using value added metrics as a measure of student outcomes

and local level.

At the core of this debate is whether public sector employees are fundamentally different from private sector employees. The literature has shown that public sector workers, including teachers, face different incentive structures from the private sector and public sector workers are influenced by a variety of factors not seen in private labor markets. Brueckner and Neumark (2014) find a relationship between public sector wage differentials and local amenities. They find that public sector workers are relatively better paid in areas with amenities that are difficult to duplicate elsewhere, such as climate or skill density. They also find that the strength of the public sector unions exacerbate this effect. As teachers are one of the largest groups of public sector workers, this finding is indicative of a close linkage between non performance related attributes and salary. Increased likelihood of a student being able to enter a high quality, over-subscribed school increases housing prices (Billings, Brunner and Ross 2014). Diamond (2015) also finds a great deal of responsiveness of public sector workers to their economic climate. Inelastic housing supply elasticity raises local governments' tax revenue and public sector workers capture a share of these rents either through increased compensation when formal collective bargaining is legal or by increased corruption when collective bargaining is outlawed. Boiled down, when the disciplining effects of taxpayers' voting with their feet through migration are mitigated, government workers benefit (Freeman 1986).

Teacher unions have been found to have substantial effects on teacher salary. Barrow and Rouse (2004) find that large school districts tend to overspend more than small ones. Rose and Sonstelie, (2010) find that the power of teacher unions rises with the number of eligible voters in a district, with power measured by the pay premium given to experienced teachers. Brunner and Squires (2013) show that the leaders of more powerful teacher unions are able to bargain for more generous returns to teacher seniority to the detriment of staffing ratios and base salaries. These papers indicate that teacher salary is determined by a variety of factors not related to teacher

quality, but rather a variety of political and environmental causes.

Teaching is a more stable profession than many private sector jobs, but offers less opportunity for wage growth. Wage dispersion has been rising at a faster rate in private sector jobs than in public sector jobs since the 1970s (Borjas 2002). This relative change in the wage structure influences labor supply decisions, and alters the sorting of workers between the two sectors. This alteration has led to high skilled workers such as college graduates to avoid the public sector, while high skilled public sector workers have increased incentives to leave for a private sector job. This paper does not attempt to answer what the determinants of public sector pay are, but rather argues that national recessions can be taken as exogenous shocks to wage structure, thus attempting to sidestep the endogeneity of salary determination. Demand for teachers is more acyclic than the private sector (Berman and Pfleeger, 1997), several types of analyses show that teachers earn significantly less than comparable workers in the United States (Allegretto, Corcoran and Mishel 2004). Rickman, Wang and Winters (2015) find a significant effect of relative wages on the choice to enter the education field. They compute public school teacher salaries for comparison across U.S. states and find that state differences in federal tax-adjusted teacher salaries relative to those of other college graduates, significantly affects the share of education majors that are employed as teachers. If there is an increase in individuals seeking teaching jobs when relative salary increases, recessions should increase numbers of applicants to teaching jobs. However, no paper to my knowledge has directly documented individuals sorting into teaching during recessions.

Recessions have negative long term effects on individuals entering the labor force, affecting salaries and opportunities long after the recession has passed (Oreopoulos, Wachter and Heisz, 2006) as well as future job mobility (Neal 1999). Personal attributes have been found to drive occupational sorting, as Fouarge, Kriechel and Dohmen (2014) show, individual risk appetite and patience has a large impact on career choice, and a mismatch between their personal predilections

and career choice increases probability of career migration. De Paola and Gioia (2012) investigate how risk attitudes affect the choice of majors and find that risk adverse students are less likely to choose majors that have higher drop-out rates. Since Educational degree seekers have been found to have a higher completion rate than the average student (SLU 2006), more risk adverse individuals may choose to sort into that occupation.

My paper is the only one to directly document a link between recessions and teacher test scores. [2] Salary differentials can be a result of an endogenous political or cultural process. An alternate exogenous cause of teacher salary change needs to be found. In this paper I use national recessions to fulfill this purpose, as a national recession is unrelated to local political machinations. If the prevailing economic climate is poor, individuals entering public service may experience unwelcome competition from unemployed private sector workers. This paper contributes to the literature by showing that teacher quality is impacted by economic recession, and offers this as an exogenous example of the interconnections between the private labor market and public workers.

2. Theory and Assumptions

Understanding the effect of the labor market at the time of entry to the teaching profession is very important to predict the type of teaching applicants that enter the profession in a given year. In order for my proposed use of labor market conditions to effect teacher quality, the hypothesized effect of the labor market on the decision to become a teacher must be valid.

A hypothesis explored in this research is that some labor force participants may be diverted away from their primary chosen professions and attempt to enter the teaching profession as an alternative to their first career choice. For example, an individual who would have become a journalist during a period of low unemployment may instead attempt to become an English teacher during a recession.

[2] Figlio (1997), Dolton and Holloway, (2009) or Hanushek, Piopiunik, and Wiederhold (2015) show the relationship between nationwide cognitive skill tests or relative teacher salaries and student outcomes.

A basic search model contains a cumulative density function of wage offer probabilities F(w), a cost of searching C and a discount factor β. Assuming that wages w are accepted or rejected sequentially, there is a reservation wage $\bar{w}$ that solves

$$\bar{w} = \beta[\bar{w} + \int_{\bar{w}}^{\infty} (w - \bar{w}) dF(w) - C]$$

During periods of high unemployment, the wage offer distribution shifts, and the average wage offer decreases. This leads to a decrease in the reservation wage, and a greater number of individuals would accept a teacher's salary, leading to more applicants for teaching jobs, and an increase in the average quality of new hires.

This paper makes the assumption that when there are a larger quantity of job applicants for a teacher position, and when the median quality of these applicants is higher, then, on average, the candidate that is hired will be higher quality, compared to the smaller, lower quality pool. More simply, anyone hired during a recession will be, on average, higher quality than a person hired during a period of economic growth, because getting hired during a recession is so much harder.

II. Labor Market Inquiry

1. Data

To estimate this, a regression with the decision to become a teacher as the dependent variable and labor market conditions as the independent variables is necessary. I estimate a model using data from the United States Bureau of Labor Statistics and the American Community Survey, courtesy of the Integrated Public Use Microdata Series. This regression looks at the effect of market conditions on the industry that a student finds employment in.

In this regression I wanted to explore the question of what happens to graduates when unemployment is high after they graduate with a bachelors degree. Since the late 1990s states have relaxed certification processes to allow individuals with bachelor degrees that are not in the

field of education to become teachers. This regression attempts to see if more of them enter the teaching profession during recessions.

I have data on 3,447,752 college graduates under the age of 30 (to reduce occupation and location migration) gathered between the years 2009 and 2014. Using data from the National Bureau of Economic Research, I matched them to a recession dummy. The recession dummy is taken from the NBER's Business Cycle Dating Committee. It is coded as 1 if a national recession begins or is ongoing in that year. Local recession or employment data was not used as that would introduce the confounding possibility of labor mobility, which my data set is not equipped to handle.

Table 1 contains summary statistics on a selection of races, gender and whether the individual is in the labor force depending on educational major.

2. Empirical Methods

I then estimated the following fixed effect linear probability regression with clustered errors by state.

$$FieldofOccupation_{ist} = \alpha_s + LaborDummy_{ti} + \beta_1 RecessionDummy_{ti} + \beta_2 \chi_i + \epsilon_i$$

where Field of Occupation for person i, in state s and at time t is the field the person declared as their occupation in the ACS. It is an indicator variable that is one when the field is education related, and zero when it is not. This includes postsecondary teachers, preschool and kindergarten teachers, elementary and middle school teachers, secondary school teachers, special education teachers, and other education, training, and library workers. The labor dummy is a control variable that takes a value of 1 when the individual is currently in the labor force at the time of the survey. α_s is the state fixed effect. χ_i is gender and ethnic controls. The ethnic dummies include White, Black/Negro, American Indian or Alaska Native, Chinese, Japanese, other Asian or Pacific Islander, other race, two major races and three or more major races. ϵ is an error term.

3. Results

I ran two regressions for each age, one for individuals with a degree in education (includes elementary education, general education), and one with individuals who graduated in another field. Standard error is adjusted for 51 clusters by state and D.C.

Results are reported in table 2. Each row is a different dependent variable, specifically which age a recession occurred during. For instance an individual who turned 24 in 2007 will have a dependent variable of 1 in my age 24 regression but a dependent variable of 0 in my age 23 regression. The two columns report on the different results for education degree holders and degree holders not in the field of education.

The effect of recession after graduation was significantly positive. This result indicates that students graduating college with a degree not in education are reacting to a recession by seeking an education related profession. For education majors, their occupation becomes less likely to be in education when they graduate into a poor job market. For non-education majors, their occupation becomes significantly more likely to be in education when they graduate into a poor job market. So, recessions act as a mechanism in impacting labor market decision making: in poor job markets, individuals who earn degrees and would otherwise pursue a non-education related profession displace individuals who would have otherwise have pursued an education profession. If the displaced education majors are on average lower quality than those displacing them, we can explain why recessions effect teacher quality.

A recession at age 24-26 increases the likelihood of an non education degree holder becoming employed in the education industry by .022-.041 percent, and a recession at age 24 decreases the likelihood of an education degree holder becoming employed in the education industry by .045 percent. I include other ages to act as a falsification test. A balancing test for ages 24 is shown in table 3, and additional balancing tests are shown for ages 25-26 in tables 4 and 5. No consistent pattern can be seen in the relationship between control variables and recession dummies. I also

look at the relationship between recession and choosing to obtain an education degree in table 6, and find that it increases the probability of getting an educational degree if it occurs after age 19. Again the rows are different ages in which a recession occurred. There are statistically significant results long after graduation, which may be a result of how the ages overlap with recessions. For instance, an individual who is 28 during 2008, a recession, was 21 during 2001, a recession, and that recession may make them more likely to seek a teaching degree. I do not emphasize this result strongly however, because it is not as clear of an effect as the occupational sorting shown in table 2.

III. Teacher Quality Inquiry

In this section I run two regressions. The first looks at the effect of labor market conditions on observable teacher ability, measured by teacher qualification exams. The second replicates Nagler, et al. using data from a different state and extends their work to high school students.

1. Data

All student and teacher data was provided by the North Carolina Education Research Data Center (NCERDC). The North Carolina Education Research Data Center is a unique portal to a store of data from the North Carolina Department of Public Instruction (DPI) and the National Center for Education Statistics (NCES).

Using data on years of teacher experience, I match teachers to the year in which they were hired, then matched it to whether there was a recession in that year. The recession dummy is taken from the NBER's Business Cycle Dating Committee. It is coded as 1 if a national recession begins or is ongoing in the year in which the teacher entered their profession. Local recession or employment data was not used as that would introduce the confounding of labor mobility, which my data set is not equipped to handle. I was also able to obtain whether a teacher had earned a

Master's degree and included this as a control variable.

2. Teacher Test Scores

My data set included the Praxis teacher examination scores for a subset of the teachers being considered. To my knowledge the effect of the labor market conditions on teacher test scores has not been estimated.

Table 7 contains summary statistics on the races, genders, disabilities, limited english and free lunch for the 5th graders and Algebra II students that I have data on.

I ran a regression to estimate this effect:

$$TeacherTestScore_j = \beta_0 + \beta_1 RecessionDummy_{jt} + \beta_2 TeacherControls_j + \beta_3 YearFixedEffect + \mu$$

The variable of interest is a dummy variable that is 1 when a teacher is hired during a recession and 0 otherwise.

I was able to match 441 Algebra II teachers and 3700 5th grade teachers to the Praxis math test. This is fewer than the subsequent Value Added analysis due to the test not being recorded prior to the early 90s and the fact that teachers may have taken an alternative certification test. The Praxis test included is the Pre-Professional Skills Test (Math score). When teachers had taken multiple tests I kept only the score from the first test taken. There is no reason to think that the teachers matched are more or less susceptible to labor market conditions at time of hire, so the estimate will remain unbiased. I normalized teacher test score to have a mean of zero and a standard deviation of one. Teacher controls include gender and ethnicity. Standard errors are clustered by hire year. Results are reported in Table 11. The two columns are for 5th grade teachers and Algebra II teachers respectively.

3. Results

I find that Fifth grade teachers hired during a recession scored significantly better than teachers not hired during a recession. 5th Grade recession hires scored .1 standard deviations higher and Algebra II teachers scored .11 standard deviations higher. This lends credence to my theory that the recession teachers are individuals of higher academic ability driven into the teacher profession by a slack job market.

4. Value Added

I follow Nagler, Piopiunik and West as closely as possible. First I construct a measure of teacher value added using 3rd, 4th and 5th grade test scores from over 2 million North Carolina students between 1995-2011. I then use the same techniques on a group not looked at by Nagler, et al: High School Algebra students. Using math scores from 8th grade as well as Algebra I and II standardized scores, I use the same model to evaluate labor market conditions on student outcomes.[3]

[3]Historically the measurement of student outcomes has been contentious. While a good teacher can have a profound impact on learning outcomes, evaluating teachers has lead to a great deal of controversy, as the validity of commonly used value added metrics has been called into question. "High stakes tests" adds to stress faced by students and teacher retention and pay resulting from their value added metric has added additional pressure to these examinations. Chetty, Friedman, and Rockoff (2014) offer support for the effectiveness of a using value added evaluation to estimate student outcomes. Their paper looks at elementary and middle school teachers who have substantially improved the standardized test scores of their students. They found that students assigned to high value added teachers are more likely to attend college, less likely to experience teen pregnancy, and earn higher salaries. These high value added teachers are correlated with a lasting positive effect on those students' lives beyond academics. Chetty, et al. tracked 2.5 million students over 20 years. Replacing a teacher whose value added measurement is in the bottom 5 percent with a teacher from the center of the value added distribution would increase the present value of students' lifetime income by approximately 250,000 dollars per classroom. Rivkin, Hanushek and Kain (2005) find that improving teacher quality, as measured by student test scores, one standard deviation has the same effect as reducing classroom size by ten students. Hanushek (1992) shows that high quality teachers can obtain a gain of 1.5 grade level equivalents while a poor teacher will only accomplish 0.5 grade level

5. State Comparison

While Nagler, et al. use administrative data from Florida, the data in this paper comes from North Carolina. Using information obtained from USC Rossier, Table 6 compares and contrasts key statistics in each state. The two states are largely similar, though Florida pays its teachers more, North Carolina has a slightly higher wage relative to the average wage in the state. Both states allow lateral entry.[4] To become certified as a teacher in Florida, an individual needs to complete a number of college credit hours, a teacher preparation course, and Florida General Knowledge Test and the Florida Subject Area Examinations. Certification testing in Florida is run by FTCE (Florida Teacher Certification Examinations), and is specific to Florida. North Carolina uses the standard Praxis Pre-professional Skills Test (PPST), along with subject specific tests (Praxis II). States offer alternative licensure programs for teachers who do not have the experience required for a traditional license. This is an alternate route to teaching for individuals outside of the public education system. Floridans can qualify for a temporary certificate with a Bachelor's Degree and a passing score on the Florida Subject Area Examination, and North Carolinians can do the same if they pass the Praxis exam or equivalent certification exam.

As shown by Lott, and Kenny (2013), the strength of teacher's unions can have significant

equivalents during an entire academic year of teaching. The evidence suggests that there is teacher level heterogeneity that leads to dramatic differences in student outcomes. If the teacher is important, then improving the teacher is a surefire way to improve student outcomes. A working paper by Hanushek, Piopiunik, and Wiederhold (NBER Working Paper No. 20727) uses a test of teacher cognitive skills as a variable for teacher quality, and then instrument it with the level of non-education public sector wages. While Hanushek, et al. were forced to estimate student-teacher relations due to not having direct student-teacher relationship data, their result shows a very important reevaluation of how responsive teacher quality is to labor market conditions. They noted that the countries with the highest level of teacher ability and student results were those who raised relative teacher salaries to a point where they were recruiting from the top echelon of graduating college classes. This is a result that reinforces my narrative: higher paid teachers lead to higher quality teachers, lead to better student outcomes.

[4]Lateral entry allows individuals to obtain a teaching position and begin teaching right away, while obtaining a professional educator's license as they teach as long as they have a bachelor's degree.

effects on test scores. They can also affect teacher retention and ease of new hires. North Carolina and Florida do not systemically differ in their treatment of teacher's unions. According to Winkler, Scull and Zeehandelaar's (2012) ranking of overall teacher union strength, Florida is ranked 50th of the U.S. States and D.C, and North Carolina is ranked 40th. In terms of membership and resources they are tied at 47th. For bargaining status (mandatory, permitted, or prohibited), scope of bargaining, right of unions to deduct agency fees from nonmembers, and legality of teacher strikes, Florida is ranked 35th and North Carolina is ranked 48th. Regarding the union's involvement in politics (Teacher unions' share of financial contributions to state candidates and political parties, and their representation at the Republican and Democratic national conventions), Florida is ranked 36th and North Carolina is ranked 29th. As North Carolina's union is marginally stronger than Florida's, I would expect the impact of labor market conditions on teacher displacement to be less.

Taking these comparison's into account, Florida and North Carolina share many attributes, including alternate licensure and weak unions, and I expect the results from North Carolina to be comparable to the results that Nagler, et al. found in Florida.

6. Data

I was able to obtain standardized end of grade test scores from 3rd, 4th, 5th and 8th graders from 1995 to 2011. End of course standardized Algebra I and Algebra II test scores were included from 1999-2011. I was then able to match these scores to a variety of student characteristics using unique student identifier codes, as well as to their 5th grade and Algebra II teachers.

For each year and grade I normalized the test scores. I coded a variety of dummy control variables. Ethnicity includes White, East Asian, Black, non white Hispanic, Indian and Mixed. Leaning disabled took a value of 1 if the student was flagged as learning disabled in one or more of reading, math, writing, other, oral, fluency, computational skills, calculation skills or listening. Limited English took a value of one if the student had a positive L.E.P. status. A lunch assistance

dummy had a value of one of the student was on free or reduced lunch.

Student test scores are the state end of grade standardized math tests in grades 3, 4, 5 and 8 as well as end of course standardized test scores for Algebra I and II, normalized by grade and year to have a mean of zero and standard deviation of one. The dependent variables are the grade 5 and Algebra II scores. My student characteristic controls are dummies for gender, ethnicity, free/reduced lunch, learning disability and limited English proficiency. The school control variables were the proportion in each school of different ethnicities and free/reduced lunch students. Grade by year fixed effects are also included. Nagler, et al. also include classroom level controls, which my data does not include.

The test lag coefficient is constrained using the technique of Jackson and Bruegmann (2009). Quoting them, "there is attenuation bias on the coefficient of lagged test scores, due to measurement error in test scores. If lagged test scores are correlated with other covariates (very likely), this will bias the coefficients for all covariates." I ran a 2sls IV regression, using 3rd grade math scores as an instrument for 4th grade math scores and 8th grade math scores as an instrument for Algebra I scores. The coefficient this generated was then used as the lag variable coefficient in my value added generating regression. The 4th grade coefficient (β_1 = .971545) is almost identical to Jackson and Bruegmann (.97), which is as expected, as they used the exact same data set in their paper, albeit for an shorter span of years. The coefficient estimated using this IV regression is higher than it otherwise would have been (.971545 versus .8027556 for 4th grade and 1.060309 versus .7997208 for Algebra I)

7. Empirical Methods

I run the following regression:

$$MathScore_{igst} = \beta_0 + \theta_j + \beta_1 MathScore_{igs(t-1)} + \beta_2 StudentControls_i + \beta_3 SchoolControls_{st} + \beta_4 Grade/Year_{tg} + \mu_{itgs}$$

for student i, teacher j, year t and grade g.

θ is a teacher fixed effect and will generate the value added for the teacher used in the next section. This regression includes a set of demographic controls for the students and schools. Due to the fact that this inquiry requires its estimates of teacher value-added to be comparable across schools, I do not include school fixed effects. Something worth noting is that the teacher code attached to the student test score in this data is not always the teacher that taught the class, it is the teacher that administered the test. So if the original teacher was sick, or busy, or any other reason for being absent on the day of the exam, a different teacher will get the credit (or the blame) for the students test scores. If either good or poor teachers consistently missed their test day (perhaps poor teachers are lazier, or good teachers have more important things to do) this could cause bias in the results. However, the NCEDRC estimates that the correct teacher is recorded over 95 percent of the time, and barring any convincing arguments for bias, it is safe to assume that this small flaw in the linkage will only result in additional noise in the data, rather than a false signal.

To look at the effect of the job market on the quality of teachers, I used a fixed effects regression.

$$TeacherValueAdded_j = \beta_0 + \beta_1 RecessionDummy_{jt} + \beta_2 TeacherControls_j + \mu_j$$

The variable of interest is a dummy variable that is 1 when a teacher is hired during a recession and 0 otherwise.

Teacher controls include gender, ethnicity, masters degree, and 30 years of experience dummies (Papay and Kraft, forthcoming). This again matches West, et al. Standard errors are clustered by hire year. The data I use has 22,693 5th grade teachers, and 2924 Algebra II teachers. Summary statistics are reported in Table 10. Results are reported in Table 12. The two columns in the table are the two regressions I ran for each group of teachers.

8. Results

I find that a recession in year of hire improves 5th grade test scores by .037 standard deviations and Algebra 2 scores by .07 standard deviations. The 5th grade coefficient is about half that estimated by West, et al. This may be a result of unseen attenuation bias from my imperfect teacher student matching, missing classroom level controls, or simply be a lower estimate in a range around the true parameter. The Algebra II coefficient is higher, but less significant, likely due to a smaller sample size.

9. Falsification Tests

The main hypothesis advanced by this paper is that the teachers hired during recessions have a higher ability. In order to check whether this is a spurious result, I ran four regressions where the dummy variable indicated if the teacher had been hired up to four years before the recession. So the first regression has a dummy that is 1 when the teacher was hired one year after the recession. I ran regressions twice for each year, once for teacher's value added, and once for their certification test score.

$$TeacherValueAdded_j = \beta_0 + \beta_1 RecessionDummy_{j(t-n)} + \beta_2 TeacherControls_j + \mu_j$$

$$TeacherTestScore_j = \beta_0 + \beta_1 Recession_Dummy_{j(t-n)} + \beta_2 TeacherControls_j + \mu_j$$

The variable of interest is a dummy variable that is 1 when a teacher is hired n years before a recession and 0 otherwise. The results are shown in Table 13. There was a total of 16 regressions ran, one for each combination of recession year - n dummy, grade and whether I was looking at the value added or certification scores for each teacher.

The lack of any significant trend in these results support that the effect generated by the recession year dummy did not happen by chance. There is a weak indication that teachers hired in the two years preceding a recession (when the economy is moving through the peak of the business cycle) are lower quality, which is consistent with the hypothesis of this paper, specifically a strong job market diverts good teachers away from the education occupation.

10. Differential Attrition

In this section I run two regressions that attempt to reveal any teacher attrition, that is, teacher's leaving the profession. This could be concerning if low skill teachers hired during a recession are more likely to leave the teaching profession that high skill teachers. If that is the case, my results could be driven by differential attrition rather than the recession teachers having higher skills at time of hire.

The first regression reprises my earlier regressions, but instead of a dummy variable that is coded as 1 if the teacher was hired during a recession, it is coded as 1 if the teacher is hired during a specific year. If there is a clear trend that shows teachers hired during earlier recessions scoring significantly higher than teachers hired during more recent recessions, then there is cause for concern that the earlier recession also contained lower skill teachers that left the profession before they could be recorded.

$$TeacherValueAdded_j = \beta_0 + \beta_1 SpecificRecessionDummy_{jt} + \beta_2 TeacherControls_j + \mu_j$$

$$TeacherTestScore_j = \beta_0 + \beta_1 SpecificRecessionDummy_{jt} + \beta_2 TeacherControls_j + \mu_j$$

Results are shown in Table 14. There were 16 regressions, one for each combination of recession year, grade and whether value added or certification scores were used.

I find no clear downward trend in teacher value added (columns 1 and 2). In fact, I find some evidence of an upward trend in value added, indicating that high skill teachers leave the teaching profession at a higher rate than lower skill teachers. Again, this is consistent with the model of job market pressures. There may be a slight decrease in the certification skill scores of Algebra II teachers (column 4).

The second attrition test codes a dummy variable that attempts to capture teacher attrition directly. Specifically it is coded as 1 when there are no records for that teacher after 2009. I regress this on the value added, certification test scores and recession dummy as dependent variables, keeping the same teacher controls.

$$TeacherValueAdded_j = \beta_0 + \beta_1 AttritionDummy_{jt} + \beta_2 TeacherControls_j + \mu_j$$

$$TeacherTestScore_j = \beta_0 + \beta_1 AttritionDummy_{jt} + \beta_2 TeacherControls_j + \mu_j$$

$$RecessionDummy_j = \beta_0 + \beta_1 AttritionDummy_{jt} + \beta_2 TeacherControls_j + \mu_j$$

Results are in Table 15. There are a total of 8 regressions, 4 in the first row that regress the recession dummy on the attrition dummy for the two groups of teachers in each grade and 2 more for each grade, one for value added and one for the certification test.

Attrition does not have a significant effect on whether a teacher was hired during a recession, nor does it significantly impact value added or certification scores. I do not find attrition to be a significant factor in my findings.

IV. Conclusion

These results have important ramifications for policy makers. If the average quality of applicants is increasing during times of high employment, the hiring process should become largely counter cyclical, hiring relatively more during times of economic distress. This would allow the education system to gain higher quality teachers, likely at lower cost, as well as functioning as a counter recessionary measure. Indeed, as the public education system is a large percentage of the GDP of the United States, a policy change that encouraged recessionary hiring could have a significant impact on alleviating and shortening recessionary periods.

This paper also shows the response of college students and graduates to labor market conditions. When teaching is seen as relatively more favorable, there is an increase in teacher quality. Increasing beginning teacher salaries to a point where the teaching profession attracts the top graduates will make it seem a more prestigious career choice and create a virtuous cycle.

The success of Japanese and Nordic education models cannot be solely attributable to cultural differences, but also to the fact that the relative pay of teachers is so much higher. Emulating the countries emphasized by Hanushek, Piopiunik, and Wiederhold, and recruiting from the top echelons of college graduates, as well as paying a salary compatible with attracting such a elite group will have a large effect on the outcomes for American students. Higher quality teachers have a large effect on their student outcomes, and additional funding to raise teacher salaries should be made a priority.

V. Appendix

Table 1: *ACS Summary Statistics*

	Non-Edu Degree	Edu Degree
Number of Individuals	3,395,979	51,773
Percentages		
Male	51.35	19.37
White	71.86	89.13
Black	12.61	4.47
Asian	5.59	3.03
Labor Force	64.67	89.66

Notes: This table is made up of summary statistics for my ACS data, used to run the regressions contained in tables 2-7. The first panel is the number of individuals in each group. The second panel is the percentage of control attributes within each group. The first column is individuals with a bachelor's degree in an non-education related field, the second column is individuals with a bachelor's degree in a education related field. Asian is defined as individuals who responded Chinese, Japanese or Other Asian.

Table 2: *Education Occupation Regression*

Recession at Age	Edudegree	NonEdudegree
18	-.00234369**	-.00007934
	(.0009716)	(.00006903)
19	-.00009135	-.00001948
	(.00155656)	(.00005554)
20	.00033285	-.0000816
	(.00128595)	(.0000779)
21	-.00316095***	-.00003501
	(.00105308)	(.00009817)
22	-.00175085*	.00003192
	(.00099603)	(.0000719)
23	-.00098703	-.00001852
	(.00120474)	(.00012838)
24	-.00045343***	.00022146***
	(.00125221)	(.00007826)
25	.00139149	.0004099***
	(.00142759)	(.00011138)
26	.00577887***	.00038116***
	(.00165881)	(.00012737)
27	.00505333**	.00016034
	(.00236463)	(.00016954)
28	.00086211	-7.985e-07
	(.00245307)	(.00017677)
29	.0029572	-.00001918
	(.00440781)	(.00028995)

Notes: This table is created from regressing a recession dummy that takes a value of 1 when an individual experiences a recession at a certain age on whether they are employed in the education occupation when asked to respond to the ACS. The columns show differing effects depending on whether the individual has a education or non-education related degree, This also functions as a falsification test similar to table 13.

Table 3: *Balancing Test*

Recession at 24		
Dependant Variable	Edudegree	NonEdudegree
Woman		
	-.0066417	.0024975**
	(.0052459)	(.0010213)
Black		
	.0110157	-.0049895***
	(.0102192)	(.0029314)
Native American		
	.0234014	-.0032949
	(.0342267)	(.00007826)
Chinese		
	.0442122	.0000401
	(.0310716)	(.0034614)
Japanese		
	-.0639421	-.0022673
	(.0484727)	(.0063252)
Other Non-White		
	.0419446**	-.0011995
	(.0196613)	(.0024478)

Notes: This is a regression of control variables on the recession dummy. Further balancing tests are shown in tables 3 and 4, but age 24 is where I find evidence of non education degree crowding out, so I consider it the most important to my result. Other Non White are individuals

who responded Other when asked about race.

Table 4: *Balancing Test part 2*

Recession at 25		
Dependant Variable	Edudegree	NonEdu Degree
Woman		
	.0006792*	.0018792*
	(.2855733)	(.0010035)
Black		
	.0113301	-.0021507
	(.0108342)	(.0016358)
Native American		
	.0834609*	-.0086266*
	(.0472276)	(.0049603)
Chinese		
	-.00045343***	.0001014
	(.00125221)	(.0028768)
Japanese		
	.0318116	-.0212687*
	(.0413493)	(.0110574)
Other Non-White		
	.029653**	-.0022287*
	(.0141502)	(.0013159)

Table 5: *Balancing Test part 3*

Recession at 26		
Dependant Variable	Edudegree	NonEdu Degree
Woman		
	.0037714	-.000304
	(.0039491)	(.0009634)
Black		
	.0184202	-.0003984
	(.0122594)	(.0019526)
Native American		
	.0662504**	-.0113286***
	(.0302218)	(.0034391)
Chinese		
	-.0000477	-.0082485*
	(.037524)	(.004726)
Japanese		
	.091887	.0167654**
	(.0716241)	(.0072862)
Other Non-White		
	-.0300891	-.0003569
	(.0190637)	(.0034101)

Table 6: *Education Degree Regression*

Recession at Age	
17	-.00347261***
	(.00031855)
18	-.00179683***
	(.00024181)
19	.00022003
	(.00019981)
20	.00148529***
	(.00037897)
21	.00291712***
	(.00043563)
22	.00289264***
	(.00046731)
23	.0023229***
	(.00049312)
24	.00178702***
	(.00042307)
25	.0015738***
	(.00039686)
26	.00129211***
	(.0003548)
27	.00117488**
	(.0005061)
28	.00244063***
	(.00054925)
29	.00133386
	(.00092174)

Table 7: *Student Summary Statistics*

	Grade 5	Algebra II
Total Number of Students	3,183,773	582,454
Percentages		
Male	50.96	45.88
Asian	2.02	2.52
Black	28.5	24.61
Hispanic	7.27	4.24
Indian	1.49	1.07
Mixed	2.47	1.80
Learning Disability	6.63	1.65
Limited English	1.08	1.68
Free/Reduced Lunch	23.3	29.57

Notes: The first panel is the number of students in each group. The second panel is the percentages of each control attribute in that group.

Table 8: *N.C. and Florida Comparison*

	North Carolina	Florida
Mean Elementary Salary	43,200	49,820
Mean Secondary Salary	44,730	52,640
Teacher Salary vs. State Average	1.28	1.23
Vacation Weeks per Year	15	15
Pupil/Teacher Ratio	14.12	14.33
Expenditure per Pupil	9,088	11,819

Notes; This table compares key statistics between North Carolina, my source of data, and Florida, where West, et al. sources their data.

Table 9: *Teacher Certification Score Summary Statistics*

	Grade 5		Algebra II	
	Recession	Non-Recession	Recession	Non-Recession
Number of Teachers	782	2,918	74	367
Percentages				
Male	9.72	11.00	36.49	32.15
Asian	0.38	0.38	0	1.63
Black	11.51	13.88	14.83	16.35
Hispanic	0.38	0.31	0	1.09
Indian	0.90	1.17	0	.27
Mixed	0.38	0.31	1.35	0

Notes: The first panel is the number of teachers in each group. The second panel is the percentages of each control attribute in that group.These are the teachers who I was able to match to the Praxis PPST. They are all included in the larger group of teachers that are used for the value added regression, see table 10.

Table 10: *Teacher Value Added Summary Statistics*

	Grade 5		Algebra II	
	Recession	Non-Recession	Recession	Non-Recession
Number of Teachers	3,942	18,751	575	2,349
Percentages				
Male	10.88	10.23	35.48	35.04
Asian	.30	.28	.70	1.61
Black	13.62	14.08	10.78	14.18
Hispanic	.60	.45	1.04	.72
Indian	.68	.89	1.04	.47
Mixed	.22	.19	.35	.26
Masters Degree	22.89	23.44	32.65	34.03

Notes: The first panel is the number of teachers in each group. The second panel is the percentages of each control attribute in that group.

Table 11: *Teacher Math Score regression*

	5th Grade	Algebra II
Hired in recession	.10739791*	.11468167**
	(.05371536)	(.05125446)
Ethnic controls	YES	YES
Gender controls	YES	YES

Notes: The independent variable of interest is the recession dummy, the dependent variable is the certification score obtained.

Table 12: *Teacher Value Added regression*

	5th Grade	Algebra II
RecDum	.0373917***	.0705392*
	(.0122074)	(.0390345)
Experience Dummy	YES	YES
Ethnic controls	YES	YES
Gender controls	YES	YES

Notes: The independent variable of interest is the recession dummy, the dependent variable is the teacher's value added.

Table 13: *Falsification Test*

	Value Added		Certification Score	
	5th Grade	Algebra II	5th Grade	Algebra II
Recession-1	-.0476634	-.0630376	-.04573648	-.08558957
	(.10972009)	(.0693325)	(.10877057)	(.05109763)
Recession-2	-.04443858	-.0078595	-.07636872	-.03061457
	(.04614624)	(.084638)	(.04671956)	(.0447887)
Recession-3	.03918466	.065524	.06768578	-.17954778
	(.05717472)	(.0586436)	(.05798671)	(.03036966)
Recession-4	.07512292	-.067671	.0685745	-.02235235
	(.06424916)	(.0663962)	(.06351492)	(.0548125)

Notes: The 4 rows are years preceding a recession. The columns are different groups of teachers and different dependent variables.

Table 14: *Attrition 1*

	Value Added		Certification Score	
	5th Grade	Algebra II	5th Grade	Algebra II
1980	.02430204**	-.0576082*		
	(.00926318)	(.03182457)		
1990	.01391623	-.02413111		
	(.01485423)	(.10419588)		
2001	.01610316	-.04049513	-.05186452	.14794173***
	(.01170539)	(.06303701)	(.03450126)	(.03550093)
2007	.06649582***	.01002184	.14783949***	.11034113**
	(.01754523)	(.0734248)	(.0348863)	(.03848889)
2008	.07041498***	.23490248***	.1302555***	.08769406**
	(.02777009)	(.12433981)	(.03579588)	(.03756964)

Notes: There was not enough certification scores in my data set to do an attrition test for the recessions in 1980 and 1990.

Table 15: *Attrition 2*

	Value Added		Certification Score	
	5th Grade	Algebra II	5th Grade	Algebra II
Recession	-.08590634	-.08199557	-.08039573	-.15305409
	(.06368004)	(.07176308)	(.0841072)	(.15173938)
Value Added	.01777684	.04515967		
	(.01249187)	(.03650339)		
Certification Test Score			-.06149843	.04892467
			(.04079742)	(.08644482)

Notes: The first panel is a regression of the attrition variable on the recession dummy variable for each group of teachers. The second panel is a regression of the attrition variable on the Certification Score variable for each group of teachers. The third panel is a regression of the attrition variable on the Value Added variable for each group of teachers. Remember that the certification score teachers are a subset of my value added teachers. See tables 9 and 10.

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