Those Who Can: Occupational Sorting and Recession

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Abstract

The central question of this paper is what effect an increase in risk in the private labor market has on the public labor market. This paper's hypothesis is that in times of economic distress and recession, the expected quality of individuals who are hired in low risk occupations 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 public education profession, document sorting on an observable measurement of teacher ability and find that recession hired teachers have higher value-added scores.

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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? Economic theory would suggest yes. If lower variation in salary and therefore lower reward to quality are attributes of public sector jobs, then public sector workers are negatively selected. Bonin et al. (2007) shows occupational sorting that matches low appetite applicants with professions low-earnings and low-earning-risk professions. During a recession, the reduction in private sectors salaries erodes this negative selection, causing an inflow of higher quality individuals from the private to the public sector.

The two research questions this study proposes to answer are:

- do recessions cause worker migration from the riskier private sector into the relatively acyclical public sector?
- are individuals hired during poor labor markets fundamentally different from those hired during robust labor markets, as measured by observable results and ability scores?

In this paper I show that individuals are responsive to recessions, and this translates into a significant gain in outcomes. Research has shown that recessions have major long term effects on individuals entering the labor force (Oreopoulos, Wachter, Heisz, 2006). While much past research has been done on individuals "upgrading" skill during recession, this paper instead focuses on recession caused occupational migration. During a economic downturn the probability density function of private sector wages faced by individuals will shift, while education hiring will remain relatively stable, as demand for public sector workers is more acyclic than the private sector (Berman and Pfleeger, 1997). This will change the expected wages being offered 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.

The major contribution of this paper is to analyze the effect of labor market conditions on

quality of new hires. In this paper I use primary and secondary level teachers as a quintessential example of public sector workers to test these hypothesis. 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. This is an important question, as teacher quality has been shown to be a key input in student achievement and economic outcomes (Chetty, Friedman, Rockoff 2015) and a policy with higher levels and variation in teacher salary could duplicate this recession effect.

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.

Finally, I follow a working paper by Nagler, Piopiunik and West (NBER Working Paper No. 21393) and look at the effect of recession on standardized test scores. I use value added testing as a metric for student outcomes.[1] I use teachers of both elementary school and high school. Nagler et al. 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. My 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]Chetty et al. (2015) offer substantial justification for using value added metrics as a measure of student outcomes

This paper is organized into four sections. In the first I look at recession as a motivator of labor market decision making. Specifically I look at whether recession impacts becoming a teacher, and if so, whether this effect is different for individuals who received a bachelors in an education related field compared to those who received a bachelors in a non-education related field. In the second and third sections I look at the effect of recession on observable measures of teacher quality. First I use the teacher's test scores on a certification test. Second I use students' test scores on a state mandated standardized test to generate a calculated measure of value added for each teacher. The fourth section contains falsification tests, balancing tests and tests of differential attrition.

1. Literature Review

Differential occupation risk has a major impact on worker characteristics. Murphy and Topel (1987) and Moore (1995) find that the professions with higher unemployment and earnings risk are compensated with higher wages. Hartog, et al. (2003) extends this to the finding that higher wages are also linked to higher earnings variability. Individuals who take riskier, more variable jobs are compensated for their uncertainty. Conversely, individuals who work safer jobs, such as those in the private sector, are paid relatively less. Bonin et al. (2007) and Fouarge, Kriechel and Dohmen (2014) identify risk inclined individuals and find they sort into riskier professions. Risk-adverse individuals will instead choose the lower-risk jobs, that as mentioned before, will be lower paid.

During recession this orderly sorting is disrupted. Not only will many occupations (particularly in the private sector) see large spikes in risk, but Moscarini and Vella (2008) find that there is a large increase in "noise" as workers enter jobs less suited for their level of risk desire. They also find that occupational mobility declines with age, family commitments and education. However during recession this decline is weakened, and is reversed for college graduates. Since my research focuses on public sector college graduates this increased occupational mobility during recession

will help drive my results. In my paper I do find evidence of this migration, and find that there is crowding out that occurs as a result of this migration.

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 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. 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. This casts doubt on whether public sector workers are responsive to the same incentives vis-a-vis salary as private sector workers.

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.

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. This paper's identification strategy is to 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, boosting the quality of the individual hired on average. This paper uniquely contributes to the literature by showing that teacher quality is impacted by economic recession.

II. Labor Market Inquiry

1. Data

I estimate a model using data from the National Bureau of Economic Research 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 recession occurs after they graduate with a bachelors degree. Since the late 1990s states have

[2] Figlio (1997), Dolton and Holloway, (2011) or Hanushek, Piopiunik, and Wiederhold (2015) show the relationship between nationwide cognitive skill tests or relative teacher salaries and student outcomes.

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 obtained American Community Survey data on 365,520 college graduates over age 18 and under the age of 28 at the time of census (to reduce occupation and location migration, as well as to avoid respondents who had experienced multiple recession periods[3]) gathered between the years 2009 and 2014 using IPUMS. 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, age and whether the individual is in the labor force depending on educational major. Education degree holders are disproportionately female, non-Asian and are more likely to currently hold a job than individuals with a degree from a different field.

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

[3]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, and give a false signal about recessions at age 28.

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 education degree, census year, 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 the regression with a recession dummy for ages 22-24. I also ran a separate regression for ages 19-21 to act as a falsification test. Standard error is adjusted for 51 clusters by state and D.C.

Results are reported in table 2. Each cell is a separate regression. The dependent variable is a dummy that takes the value of unity when the individual works in an educational occupation. The rows are different age during recession dummies, and the columns are different subsamples depending on the type of degree the individual graduated with. I include the same ethnic, labor force and gender controls for every regression. For example, the coefficient reported for the first regression is an independent dummy variable with value unity for the people who turned 19-21 during a recession (so birth cohorts 1987-1989).

The effect of recession after graduation was significantly positive only for individuals who do not hold an education degree, and has an effect of .09 percent. It is insignificant for education degree holders. This would indicate that recession is a motivator for non education degree holders to enter the teaching profession.

Something to note is that this dataset does not pass balancing tests as the observables of college graduates change depending on the cohort that you are looking at. To this end I also ran a regression looking only at individuals graduating college before and during the great recession,

and excluding those who graduated after 2009. My result is till significant, though the coefficient is lower at .06 percent. In this subsample the observable characteristics of college graduates do not change as a result of the recession, and I pass balancing tests on those observables. I follow this practice of comparing recession affected individuals only to pre-recession individuals in the later two sections.

I include ages before graduation to act as a falsification test and find no significant results.

III. Teacher Test Scores 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.

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.

I ran a regression to estimate this effect:

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

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. Summary statistics are detailed in Table 3. Teachers are predominately female and non-Asian Algebra teachers to a lesser degree than 5th grade teachers. Standard errors are clustered by hire year. Results are reported in Table 4. The two columns are for 5th grade teachers and Algebra II teachers respectively. I also run this regression only on teachers hired during a recession or 5 years previous to a recession, to match my labor sorting regressions and to ensure I am getting a clean comparison between individuals hired in the zenith and nadir of the business cycle.

2. 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 .107 standard deviations higher and

Algebra II teachers scored .114 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. The recession plus 5 years previous subsample shows similar results, though my 5th grade coefficient becomes weaker.

IV. Teacher Value Added Inquiry

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 considered 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.[4]

[4]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 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

1. 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.[5] 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 effects on test scores. They can also affect teacher retention and ease of new hires. North Carolina and Florida systemically differ in their treatment of teacher's unions, with North Carolina having

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.

[5]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.

stronger union rights. 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 stronger than Florida's, I would expect the impact of labor market conditions on teacher displacement to be less.

2. 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.

Table 5 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. Algebra students are relatively white with fewer learning disability students than the 5th grade standardized test takers.

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)

3. Empirical Methods

I run the following regression:

$$MathScore_{igst} = \beta_0 + \theta_j + \beta_1 MathScore_{igs(t-1)} + \beta_2 StudentCon_i + \beta_3 SchoolCon_{st} + \beta_4 GradebyYearFE_{tg} + \mu_{itgs}$$

for student i, teacher j, school s, 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. Hire year was established by using the most recent record of the teachers level of experience and matching it to their most recent test, then taking the previous year to the first test date which is when the profession switch would be made, or two years previous to the test date in the case of Algebra II, to account for the greater difficulty in switching professions into high school relative to elementary school. Standard errors are then 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 7. Results are reported in Table 8.

The two columns in the table are the two regressions I ran for each group of teachers. I also run this regression only on teachers hired during a recession or 5 years previous to a recession, to match my labor sorting regressions and to ensure I am getting a clean comparison.

4. 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. When I run the regression on the subsample of recessions plus 5 years previous, my coefficients strengthen slightly.

V. Falsification and Attrition

1. 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 9. 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.

2. 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. 1980-81 was combined due to lack of observations. A test year fixed effect was added to ensure I am comparing teachers who taught at the same time. Algebra II

certification is omitted due to lack of observations on a year by year basis.

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

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

Results are shown in Table 10.

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. It seems that more severe recessions such as 1980-81 and 2007-08 have a much more severe impact on both value added and certification than shorter duration recessions such as 1990 or 2001.

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 11. 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.

3. Balancing Tests

Table 12 and 13 shows a regression of Individual, Student and School level observables on the treatment variable, which is recession after graduation or at time of hire. School controls are the proportion of that type of student in that school, which is only available for certain variables. For my ACS data I need to limit my sample to pass balancing tests, as the recession changed the observables of college graduates. Post recession college graduates had a higher proportion of females and non-whites. For the North Carolina data, I find no significant result of observables on my treatment variable, and my F scores are insignificant, ranging in probability from .44 to .58.

VI. 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.

VII. Appendix

Table 1: *ACS Summary Statistics*

	Non-Edu Degree	Edu Degree		All
Number of Individuals	334,691	30,829		2,019,486
Percentages				
Male	43.84	18.73		51.18
White	76.70	89.31		71.57
Black	6.51	4.45		12.15
Asian	11.58	2.87		4.8
Labor Force	86.27	90.55	72.71	

Notes: This table is made up of summary statistics for my ACS data, used to run the regressions contained in tables 2-3. 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*

Entire Sample		
Recession at Age	Edudegree	NonEdudegree
19-21	.00067835	-.00010451
	(.0010924)	(.00022899)
22-24	.00133434	.000963***
	(.00112629)	(.00027786)
Pre Recession Sub-Sample		
19-21	-.00072147	-.0003116
	(.00138955)	(.0002545)
22-24	-.0002311	.00064314**
	(.00121275)	(.00025069)

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. The first panel is my entire sample, which fails balancing tests, and the second is a subsample that excludes post-recession observations that passes balancing tests.

Table 3: *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 4: *Teacher Math Score regression*

	5th Grade	Algebra II
Hired in recession	.10739791*	.11468167**
	(.05371536)	(.05125446)
Ethnic controls	YES	YES
Gender controls	YES	YES
Subsample	.0531297*	.1123249*
	(.0297731)	(.0647693)
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. The first panel is my entire sample and the second is a subsample that excludes post-recession observations in order to match my labor sorting regression. Both samples pass balancing tests.

Table 5: *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 6: *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 7: *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 8: *Teacher Value Added regression*

	5th Grade	Algebra II
Hired in recession	.0373917***	.0705392*
	(.0122074)	(.0390345)
Experience Dummy	YES	YES
Ethnic controls	YES	YES
Gender controls	YES	YES
Subsample	.0458194***	.1096588**
	(.0148793)	(.049731)
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. The first panel is my entire sample and the second is a subsample that excludes post-recession observations in order to match my labor sorting regression. Both samples pass balancing tests.

Table 9: *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 10: *Attrition 1*

	Value Added		Certification Score
	5th Grade	Algebra II	5th Grade
1980-81	.02695301***	.15500636	
	(.01012379)	(.13638222)	
1990	.01213874	-.0415668	
	(.01468411)	(.12876576)	
2001	.01000397	-.06083326	-.0518645
	(.01318996)	(.05961745)	(.0345013)
2007	.07830627***	.02394479	.1478395***
	(.01960964)	(.08020938)	(.0348863)
2008	.08235301***	.24133456***	.1302555***
	(.03550584)	(.11245701)	(.0357959)

Notes: There was not enough 5th grade certification scores in my data set to do an attrition test for the recessions in 1980 and 1990.

Table 11: *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.

Table 12: *Balancing Test*

Entire Sample	
Black	-.0085195**
	(.0029208)
Hispanic	-.0152657*
	(.0055015)
Female	-.005848**
	(.0017987)
Sub-Sample	
Black	-.0042449
	(.003082)
Hispanic	-.005377
	(.0058161)
Female	-.0027925
	(.0022543)

Notes: This is a regression of individual level observables on the treatment variable for my labor market sorting regression. The first panel is my entire sample, which fails, and the second excludes post recession variables, which passes.

Table 13: *Balancing Test*

	Student Control	School Control
F score	0.87	0.95
Prob > F	0.5843	0.4414
Black	.0202727	-.0176336
	(.010194)	(.0682675)
Hispanic	.0188191	.0053445
	(.0311497)	(.0540049)
White	.0119048	-.032867
	(.01217)	(.0508018)
Male	-.0001716	
	(.0007364)	
Learning Disabled	.0007825	
	(.00486)	
Limited English	.0144246	
	(.0453632)	
Reduced Lunch	-.0009783	-.0195115
	(.0226035)	(.0268331)

Notes: This is a regression of Student and School level observables on the treatment variable. School controls are the proportion of that type of student in that school, which is only available for certain variables.

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