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Abstract. Using the 3-year sample of the American Community Survey (ACS) for 2009 to 2011, we compute public school teacher salaries for comparison across U.S. states. Teacher salaries are adjusted for state differences in teacher characteristics, cost of living, household amenity attractiveness and federal tax rates. Salaries of non-teaching college graduates, defined as those with occupations outside of education, are used to adjust for state household amenity attractiveness. We then find that state differences in federal tax-adjusted teacher salaries relative those of other college graduates significantly affect the share of education majors that are employed as teachers at the time of the survey.

I. Introduction

The Great Recession exacerbated long-standing problems of educational funding in many U.S. states and heightened concerns over low teacher pay because of potential links to student performance (Figlio, 1997; Loeb and Page, 2000; Stoddard, 2005; Hendricks, 2014). According to the Center on Budget and Policy Priorities (Leachman and Mai, 2014), inflation-adjusted funding per student during the 2013-2014 school year stood below pre-recession levels in at least 35 states. The largest decline between fiscal years 2008 and 2014 occurred in Oklahoma, at nearly 23 percent, despite it having the sixth fastest growth in personal income from 2007 to 2013 among U.S. states (U.S. Bureau of Economic Analysis, 2014a). The cuts to educational funding left Oklahoma teacher pay ranked 49th in the country for the 2012-2013 school year (National Center for Education Statistics, 2014).

A common counter-argument to low public school teacher salaries in some states is that the cost of living and wages in general are lower in these states. There also can be state differences in teacher characteristics, working conditions and area household amenities. These other factors could be argued to potentially explain or justify low teacher pay in some states. Therefore, a primary purpose of this paper is to construct state-level estimates of average public school teacher salaries, while accounting for these other potential explanations for differences in state teacher salaries.

Early academic teacher salary comparisons simply adjusted for differences in cost of living. Fournier and Rasmussen (1986) adjusted teacher salaries using pooled data for 1970 and 1980 from the limited set of metropolitan areas for which the U.S. Bureau of Labor Statistics (BLS) estimated the cost of living (COL). They combined the metro results with housing values and taxes for nonmetropolitan areas to estimate state-level COL indices for 1980-1981. Nelson (1991) used price data for a sample of metropolitan areas from the American Chamber of Commerce Researchers Association (ACCRA) to produce state-level COL indices and adjust 1988-1989 teacher salaries for relative cost of living.

Subsequent studies further adjusted teacher salaries for differences in teacher characteristics, working conditions, and area amenity attractiveness. Walden and Newmark (1995) adjusted 1989-1990 teacher salaries for cost of living, teacher characteristics and working conditions. Stoddard (2005) further adjusted 1980 and 1990 teacher wages and salaries for household amenity differences across states. First, Stoddard calculated COL-adjusted teacher wages using existing indices by Fournier and Rasmussen (1986) and McMahon (1991). Then estimates of amenity attractiveness were obtained by analysis of state differences in characteristic-adjusted wages of non-teachers of the same educational class. The use of non-teachers to amenity-adjust teacher wages assumes equal capitalization of household amenities into wages and salaries of teachers and non-teachers. Taylor and Fowler (2006) used a similar approach to amenity-adjust 1999-2000 teacher salaries.

Therefore, using the 2009-2011 3-year sample of the American Community Survey (ACS), this paper first derives an updated, improved state ranking of adjusted public school teacher salaries. Like Stoddard (2005) and Taylor and Fowler (2006), we use wages and salaries of college-educated non-teachers to adjust teacher salaries. However, instead of simply using nominal wage differences of non-teachers, we estimate amenity differences based on net after federal tax real (cost-of-living-adjusted) wages, which should reflect household amenity differences (Roback, 1982; Winters, 2009). Adjustment for federal tax rates is needed to estimate quality of life because of the progressivity of the federal tax code and an absence of a connection between federal taxes and federal services received in a state (Albouy, 2008). The fully-adjusted differentials in teacher pay across states are demonstrated to be equivalent to federal-tax adjusted state differentials in pay between teachers and other college graduates.

We then examine whether state differences in fully-adjusted teacher salaries are related to the share of education majors residing in the state that are employed as teachers at the time of the ACS survey. The existence of teacher salary differentials after the adjustments we make suggests that teachers experience real differences in well-being from teaching in different states. This has important implications. Specifically, states offering low adjusted teacher salaries may experience

greater difficulty attracting and retaining qualified teachers. Low salaries may affect the teaching workforce through both migration and occupational decisions. Prospective teachers with strong ties to the profession but weak ties to particular locations paying low relative salaries are likely to relocate toward areas paying higher relative teacher salaries. Prospective teachers with strong ties to particular locations that pay low teacher salaries but weaker ties to the teaching profession are more likely to leave the profession. Teachers that continue to teach in low paying areas likely have constraints that limit their mobility both geographically and occupationally. Additionally, teacher pay inequities across space are often viewed as a matter of fairness among both teachers and their employers (Babcock, Engberg, and Greenbaum 2005). Thus, understanding how adjusted teacher salaries vary across states is an important issue for both policymakers and researchers.

Previous U.S.-based studies have found occupational switching based on relative teacher salaries. Baugh and Stone (1982) found teachers to be as responsive to wage differentials in changing occupations as were non-teachers. Murnane and Olsen (1989) also found salaries in teaching relative to others affecting how long an educator stayed in teaching. Stinebrickner (1998) found that the length of the first spell in teaching was responsive to wages, more so than improved working conditions. Gilpin (2011) found that inexperienced teachers are the most responsive to wage differentials between teachers and non-teachers, where higher salaries of experienced teachers have been reported to reduce the exit of less experienced teachers from the profession (Imazecki, 2005). Torres (2012) likewise found higher salaries and other positive acknowledgements keeping teachers in the profession. Regarding differences among teachers, Ingersoll and May (2012) found math and science teachers no more likely to leave the profession than other teachers, though previous evidence exists that engineering salaries affected shortages of mathematics and science teachers, mostly for females (Rumberger, 1987).

In the next section, we document the sources of our data and present our empirical model, in which we describe in detail the adjustments made to state teacher salaries for comparison. Estimated relative teacher salaries are reported in Section III. Among the primary findings are

that when comparing our unadjusted teacher salaries across states to previous rankings, the relative rankings have been highly persistent for at least thirty years. The largest shift in state rankings in our study occurs from adjusting teacher salaries for amenity attractiveness of the states. The state rankings are shown to be robust to considering: the efficacy of using other college graduate salaries to adjust for state amenity attractiveness, within state variation between metropolitan and nonmetropolitan areas, and characteristics of the teaching environment. In Section IV, we present our findings of the positive impact state teacher salaries, relative to those of other college graduates in the corresponding states, have on the likelihood of college graduates who majored in education to be employed as a teacher at the time of the ACS survey. Because of data limitations we do not examine teacher salary effects on migration. Section V contains a summary and conclusion.

II. Empirical Implementation and Data

We derive several different measures of relative teacher salaries in adjusting for teacher characteristics, geographic cost-of-living differences, the progressivity of the federal income-tax system, and geographic differences in amenities that affect the desirability of a location. Teacher salaries are adjusted separately for males and females and then combined based on their proportions in the teacher sample. Wages and salaries of non-teachers are used in amenity-adjusting teacher salaries.

II.1. Data

The primary data for this paper for wages and salaries come from the Integrated Public Use Microdata Series (IPUMS) maintained by Ruggles et al. (2010).[1] We use the American Community Survey (ACS) 2009-2011 3-year sample for the lower 48 states to measure salaries and worker characteristics.[2] We examine wage and salary income[3] for both teachers and other college graduates not employed in education. Following other studies (e.g., Stoddard, 2005),

[1] The IPUMS-USA website is https://usa.ipums.org/usa/.
[2] Due to their unique locations, Hawaii and Alaska were excluded from the sample.
[3] Wage and salary income comes from the IPUMS variable incwage, which reports pre-tax annual income received from employment, and therefore excludes self-employment income and unearned income. Hereafter, we use the terms "wage(s)" and "salary(ies)" interchangeably with wage and salary income.

teachers are defined as elementary and secondary school teachers that are employed by state or local governments.

To limit our measures to full-time workers, the sample is restricted to workers between 22 and 65 years old, who worked at least 35 hours a week for at least 27 weeks during the previous year. However, there might be some problems due to people misreporting their income, either intentionally or unintentionally. To reduce these concerns, we impose an additional criterion that the minimum salary should be $6,851.[4] These common criteria are applied to all workers, both in the teacher sample and the non-teacher sample.

Regional Price Parities (RPPs) used to adjust for cost-of-living differences come from the U.S. Bureau of Economic Analysis (2014b). Population estimates used in regression analysis of teacher salaries are collected from the Census Bureau of United States (2014). The federal income tax rate, personal exemption and the standard deduction of a single tax payer come from the U.S. Internal Revenue Service (IRS) (2014).

II.2. Characteristic-Adjusted Baseline Teacher Salaries

After constructing our sample, we first compute average natural log teacher salaries for each state without any adjustments. However, to accurately compare teacher salaries across states, it is necessary to adjust them for differences in teacher characteristics. Therefore, we run an ordinary least squares (OLS) regression of teacher salaries on a set of state dummy variables, while controlling for characteristics of the teachers. The basic regression equation for teachers (t) is as follows:

$$lnw_{ij}^{t} = \boldsymbol{\beta}^{t}\boldsymbol{X}_{ij}^{t} + \delta_j + \varepsilon_{ij} \qquad (1)$$

where lnw_{ij}^{t} is the natural log wage of teacher *i* in state *j*. $\boldsymbol{X}_{ij}^{t}$ represents the vector of characteristics of teacher *i* in state *j*. δ_j is the fixed effect of state *j* (i.e., the coefficient on the dummy variable for state *j*). ε_{ij} is the error term.

[4] According to U.S. Department of Labor, the minimum wage rate under the Fair Labor Standards Act was increased to $7.25 an hour for all covered, nonexempt workers since July 24, 2009. Thus, we use 7.25 times 35 hours times 27 weeks to calculate the minimum wage for the sample. The source of the minimum wage rate comes from http://www.dol.gov/whd/minwage/coverage.htm.

We control for several individual teacher characteristics in the regression. Firstly, to control for age and experience we include age interval indicators for: 25-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60 and 61-65. The age interval 22-24 is omitted to avoid perfect collinearity. Secondly, we add a dummy variable to indicate if the teacher has earned a master's or other graduate degree. Thirdly, we include interval indicator variables for time spent working including: working 40-47 weeks, 48-49 weeks, over 50 weeks,[5] working 40 hours per week, 41-48 hours, 49-59 hours and working over 60 hours per week. We define persons working 27-39 weeks and 35-39 hours per week to be the reference group. Fourthly, we control for race and ethnicity using indicators for Hispanic origin, Black or African American, Asian, and other nonwhite, making non-Hispanic whites the omitted base group. Fifthly, we include indicators for being married, having a child, having a child below age 5, speaking English at home, and low proficiency in speaking English. Finally, we include an indicator for working as a secondary school teacher.[6]

We run the regressions for male and female teachers separately, with the results reported in Table 1. We use the coefficients, $\boldsymbol{\beta}^{tm}$ and $\boldsymbol{\beta}^{tf}$, for male and female teachers, respectively, to predict characteristic-adjusted average log salaries of male and female teachers in each state. We then generate baseline characteristic-adjusted log teacher salaries for state *j*, $ln\widehat{w}_j^t$, by weighting these predicted male and female teacher salaries:

$$ln\widehat{w}_j^t = \alpha * \left(\widehat{\boldsymbol{\beta}}^{tm}\overline{\boldsymbol{X}}^{tm} + \hat{\delta}_j^m\right) + (1-\alpha) * \left(\widehat{\boldsymbol{\beta}}^{tf}\overline{\boldsymbol{X}}^{tf} + \hat{\delta}_j^f\right) \qquad (2)$$

where α is the percent of male teachers, $(1-\alpha)$ is percent of female teachers,[7] $\overline{\boldsymbol{X}}^{tm}$ and $\overline{\boldsymbol{X}}^{tf}$ are national mean characteristics for males and females respectively, $(\widehat{\boldsymbol{\beta}}^{tm}\overline{\boldsymbol{X}}^{tm} + \hat{\delta}_j^m)$ is the predicted average male log salary, and $\left(\widehat{\boldsymbol{\beta}}^{tf}\overline{\boldsymbol{X}}^{tf} + \hat{\delta}_j^f\right)$ is the predicted average female log salary.

[5] Starting with the 2008 ACS, weeks worked are only reported in broad intervals in the publicly available data.
[6] Descriptive statistics for teacher and non-teacher characteristics in appendix tables are available from the authors upon request.
[7] The male-to-female teacher ratio in the sample is 0.24:0.76.

II.2.3. Cost-of-living Adjusted Teacher Salaries

In addition to adjusting for teacher characteristics, Walden and Newmark (1995) demonstrate that assessments of teacher pay across states should take into account cost-of-living differences, in which Fournier and Rasmussen (1986) and Nelson (1991) find a positive relationship between teacher salaries and state cost-of-living (COL). Thus, we next further adjust characteristic-adjusted teacher salaries for cost of living to produce real differences in teacher salaries.

We use the average U.S. Bureau of Economic Analysis Regional Price Parities (RPPs) from 2009 to 2011. Following Aten, Figueroa and Martin (2013), we use the balanced results that can ensure the sum of nominal income across states equals the sum of personal incomes at RPPs. To be consistent with sample data, we weight RPPs from 2009 to 2011 using state population. We rescale the index using Alabama's value equal to 1 for normalization (not shown but available from the authors upon request). Other methods of adjusting for regional price differences are available (e.g., Albouy, 2008), but as shown below the use of non-teachers in amenity-adjusting teacher wages in natural logs causes the teacher salary comparison to be invariant to the choice of regional price deflators.

II.2.4. Amenity-Adjusted Teacher Salaries

In competitive markets with freely mobile individuals, spatial equilibrium requires that prices in housing and labor markets adjust so that identical workers obtain equal utility across all areas (Roback, 1982; Winters, 2009). Workers are willing to accept lower real wages to live in high-amenity areas. Thus, the real wage differences of non-teachers across states can be used to estimate how much of teacher wage differences across states are due to amenity differences, assuming identical preferences for amenities and local goods between the two groups. Following Stoddard (2005) and Taylor and Fowler (2006), we use the local amenity values inferred from non-teacher salaries to further adjust teacher salaries in the same state using the 2009-2011 3-year ACS sample.

Therefore, we regress non-teacher wages on individual characteristics and a set of state dummy variables, and use the estimated state fixed effects to measure differences in state household amenity attractiveness. The basic regression equation for nonteachers (nt) is:

$$lnw_{ij}^{nt} = \boldsymbol{\beta}^{nt}\boldsymbol{X}_{ij}^{nt} + \eta_j + \omega_{ij} \qquad (3)$$

where lnw_{ij}^{nt} is the natural log wage of non-teaching worker *i* in state *j*. X_{ij}^{nt} represents the vector of non-teaching worker's characteristics, which are the same as those defined for teachers in Equation (1) (except for the secondary teacher indicator). η_j is the fixed effect for state j. $\omega_{ij}$is the error term. We estimate the regression for male and female workers separately.

To control for sorting based on occupations and industries, we also include a vector of dummy variables for an individual's industry and occupation. Based on the ind1990 IPUMS variable, the vector includes the industries of agriculture, forestry and fisheries, mining, construction, manufacturing, transportation, communications and other public utilities, wholesale trade, retail trade, finance, insurance and real estate, business and repair services, personal services, entertainment and recreation services, professional and related services and industry of public administration; we omit the category of active duty military. We include a vector of occupation indicators based on the OCC1990 IPUMS variable including: managerial and professional specialty, technical, sales and administrative support, service, farming, forestry and fishing, precision production, craft and repair and operators, fabricators and laborers (omitting military occupations). Table 2 shows the coefficients of non-teacher characteristics from the wage regressions (for both with and without adjusting for occupation and industry).[8]

Using the non-teacher regression results and national means for the characteristics, we predict characteristic-adjusted average log salaries for male workers, ($\widehat{\boldsymbol{\beta}}^{ntm}\overline{\boldsymbol{X}}^{nm} + \hat{\eta}_j^m$), and female workers, ($\widehat{\boldsymbol{\beta}}^{ntm}\overline{\boldsymbol{X}}^{nf} + \hat{\eta}_j^f$), for each state. As Albouy (2008) argued, federal taxes reduce the net income that households gain from moving to a region offering higher wages because of the progressivity of the federal tax code and these mostly are not matched by higher federal

[8] An appendix table containing statistics and regression results for the industry and occupation control variables is available from the author upon request.

expenditures in the region, which then distort wages in spatial equilibrium. We do not adjust for differences in state tax rates because they also are likely associated with differences in state expenditures, which can provide offsetting benefits to households for the higher taxes and would then not distort wages (Yu and Rickman, 2013). We then calculate the after-tax natural log salaries by netting out the average federal income tax rate from the predicted non-teaching workers' characteristic-adjusted average salaries of each state:

$$lna\widehat{w}_j^{nt} = \left(\widehat{\boldsymbol{\beta}}\overline{\boldsymbol{X}}^{nt} + \hat{\eta}_j\right) + \ln(1 - ATR_j) \qquad (4)$$

where $lna\widehat{w}_j^{nt}$ represents after-tax, characteristic-adjusted, non-teacher average log salary in state j. ATR_j is the average federal income tax rate in state j. We calculate equation (4) for males, $lna\widehat{w}_j^{ntm}$, and females, $lna\widehat{w}_j^{ntf}$, accordingly.

To calculate the average federal income tax rate (ATR) of non-teachers in each state, we firstly calculate, $\widehat{w}_j^{nt}$, characteristic-adjusted wages of non-teachers, following the procedure described above and using equation (3). Because the 3-year ACS dollar amounts had been converted to 2011 real values and the federal income tax schedule did not vary much from 2009 to 2011, we use 2011 tax information in the calculation.[9] We give every individual one personal exemption, e, and the standard deduction for a single taxpayer, d, to compute taxable income for the average non-teaching worker in state j:

$$t\widehat{w}_j^{nt} = \widehat{w}_j^{nt} - e - d \qquad (5)$$

We then apply these taxable incomes to the tax rates:

$$tax_j^{nt} = \sum_{k=1}^{6} t\widehat{w}_{jk}^{nt} * MTR_{\,k} \qquad (6)$$

[9] 2011 federal income tax rates, personal exemption, 3700, and standard deduction, 5800, for a single tax payer are collected from Internal Revenue Services (IRS) (2014).

where tax indicates the taxes payable by the average non-teaching worker in state j. $t\widehat{w}_{jk}^{nt}$ is the taxable income of non-teaching worker of the tax brackets from 1 to 6, while k represents the tax brackets.[10] MTR_k is the marginal tax rate of the relevant tax bracket.

Using the tax payable divided by characteristic-adjusted income, we derive the average tax rate (ATR) of non-teachers for each state:

$$ATR_j^{nt} = \frac{tax_j^{nt}}{\widehat{w}_j^{nt}} \qquad (7)$$

We also use a similar procedure derive the ATR of teachers in state j, ATR_j^t.[11]

Using equation (4) and the cost-of-living index described in section II.2.3, we calculate:

$$lnac\widehat{w}_j^{nt} = lna\widehat{w}_j^{nt} - lncol_j \qquad (8)$$

where $lnac\widehat{w}_j^{nt}$ is the after-tax, cost-of-living, and characteristic-adjusted non-teacher average log salary in state j. col_j represents the cost-of-living index value in state j. The real after tax wages of non-teacher males, $lnac\widehat{w}_j^{ntm}$, and females, $lnac\widehat{w}_j^{ntf}$, are estimated accordingly. We next calculate real after-tax log wages differences of non-teachers relative to Alabama:

$$\xi_j = lnac\widehat{w}_j^{nt} - lnac\widehat{w}_{AL}^{nt} \qquad (9)$$

where *j=AL* denotes the state of Alabama. Using equation (9), we estimate the value of ξ_j for males, ξ_j^m, and females, ξ_j^f, separately. Using the male-to-female teacher ratio, α: $(1-\alpha)$, we estimate the weighted average of ξ_j as:[12]

$$\hat{\xi}_j = \alpha * \xi_j^m + (1-\alpha) * \xi_j^f. \qquad (10)$$

Because $\hat{\xi}_j$ indicates the amenity values across states, we use it to further adjust teacher salaries:

$$lnac\widetilde{w}_j^t = lnac\widehat{w}_j^t - \hat{\xi}_j \qquad (11)$$

[10] For example, if the nonteaching worker's taxable income is 40,500 in 2011, then his tax payable for that year is 6250 by applying the marginal tax rate to each tax bracket: 0.10*8500+ 0.15*(34500-8500)+ 0.25*(40500-34500).
[11] An appendix table containing federal income tax rates across states is available from the authors upon request.
[12] The ratio of male-to-female non-teaching workers, 0.58:0.42 differs from the male-to-female teacher ratio, 0.24:0.76. Considering that preferences for local amenity attractiveness might differ between male and female teachers, we use the male-to-female teacher ratio, 0.24:0.76 to compose teachers' amenity values ξ_j across states.

where $lnac\widetilde{w}_j^t$ is average log teacher salaries in state *j* adjusted for amenities, federal taxes, cost-of-living, and teacher characteristics. $lnac\widehat{w}_j^t$ is after-tax, cost-of-living, teacher characteristic-adjusted, average log salary in state *j*.

From equations (8)-(11), it follows that the impact of the term $lncol_j$ would be cancelled out in comparing teachers with non-teachers, while the variation of different federal income tax effects on teacher and non-teacher wages remains. Thus, equation (11) simplifies to equal the federal tax-adjusted and characteristic-adjusted wage difference between teachers and non-teachers:

$$lnac\widetilde{w}_j^t = lna\widehat{w}_j^t - lna\widehat{w}_j^{nt} \qquad (12)$$

That is, the differences in federal tax adjusted teacher salaries relative to those of other college graduates across states reveals state differences in fully-adjusted teacher salaries. The derivation assumes equal capitalization of household amenities into salaries between teachers and other graduates and an absence of effects of varying working conditions for teachers across states, assumptions which are tested in robustness analysis below.

III. Findings

III.1. Results for Teacher Salary Rankings

Table 3 reports the average teacher salary log differentials across states relative to Alabama for 2009-2011. We report several measures that differ in the adjustments made. Column (1) shows the average teacher salary log differential computed directly from the ACS with no adjustments. Column (2) reflects adjustments for teacher characteristics, and column (3) contains differentials after adjustments for teacher characteristics and cost-of-living differences. Column (4) shows differentials that adjust for teacher characteristics, cost-of-living differences, the progressive nature of the federal tax code, and amenity differences, computed without imposing industry and occupation controls. Column (5) differentials include the adjustments from column (4) after controlling for industry and occupation in the non-teacher sample.

Standard deviations of the relative log salary differentials appear in the final row of Table 3. They reveal that each adjustment reduces the variation in teacher salaries, suggesting that

differences in unadjusted state teacher salaries are partly explained by these other factors. The largest reduction occurs from adjusting for state differences in cost of living.

Table 4 lists the state rankings of teacher salaries for the corresponding columns in Table 3. The rankings, from 1 to 48, represent the highest to lowest teacher salaries. Column (1) of Table 4 shows that New York, New Jersey, California, Connecticut, and Rhode Island are the top five highest teacher salary states; South Dakota, Oklahoma, North Dakota, Mississippi and Montana are the five states with the lowest unadjusted teacher salaries in the 2009-2011 ACS. The ranking in column (2) of Table 4 shows that characteristic-adjusting teacher salaries does not significantly change the ranking among states in column (1). The correlation between the rankings in columns (1) and (2) is 0.98. The largest change occurred for Louisiana with its ranking increasing from 31 to 24. North Carolina has the second largest change in that its ranking increased from 42 to 36. New York, New Jersey, California and Rhode Island remain the highest four teacher salary states. Connecticut fell from 5 to 6, while Maryland's rank increased from 6 to 5. Characteristic-adjusted teacher salaries in South Dakota, Oklahoma, Mississippi and Montana remain in the bottom five, while the rank of North Dakota increased to 43 from rank 46, and West Virginia fell from 43 to 44 becoming one of the lowest five teacher salary states.

The state rankings for cost-of-living (and characteristic) adjusted salaries are shown in column (3) of Table 4. The results indicate that the cost-of-living adjustment has a larger impact on the comparison of teacher salaries across states than adjusting for teacher characteristics, consistent with the pattern of standard deviations of the log salary differentials shown in Table 3. The correlation of the rankings between the unadjusted salaries in column (1) with the cost-of-living adjusted salaries is 0.83. Rhode Island has the highest cost-of-living adjusted salaries, followed by Michigan, Ohio, New Jersey and California. Among these, only Michigan and Ohio are not in the top five in terms of unadjusted salaries. Vermont was lowest ranked, with Montana, South Dakota, Oklahoma and Arizona rounding out the bottom five states. Only Arizona and Vermont were not in the bottom five in terms of unadjusted salaries. Fournier and Rasmussen (1986) also note a number of states shifting in the rankings after adjusting teacher

salaries for cost of living, though the correlation of the two sets of rankings is 0.86. A comparable correlation of 0.84 exists between the unadjusted and cost-of-living adjusted teacher salary rankings of Nelson (1991).

Adjusting for amenity differences has a greater effect on correlation between the rankings. The correlation of the ranking between columns (1) and (4) is 0.29, while that between columns (1) and (5) is 0.40.[13] The correlation of the average ranking of columns (4) and (5) with the ranking of the COL-adjusted salaries in column (3) is 0.51, approximately equal to that found by Stoddard (2005) and Taylor and Fowler (2006) between the two sets of rankings. The highest ranked states in both rankings, in order are Wyoming, Michigan, Rhode Island and Pennsylvania. Wisconsin is fifth in the column (4) ranking, while Delaware is fifth in the column (5) ranking. The five states dropping the most in the rankings (averaged across columns (4) and (5)), in order are: Texas, Connecticut, Maryland, Georgia and Virginia. The five states moving up the most in the rankings, in order are: Montana, Vermont, Maine, Idaho and South Dakota. There are nineteen states that either moved up or dropped by more than ten ranks. The large shift in ranking suggests that teacher salary comparisons based on unadjusted salaries or even COL-adjusted salaries are likely significantly misleading.

The correlation of our unadjusted teacher salaries with those for: 1980-1981 (Fournier and Rasmussen, 1986) is 0.79; 1989-1990 (Walden and Newmark, 1995) is 0.89; and 1999-2000 (Taylor and Fowler, 2006) is 0.77. This suggests a high degree of persistence over time in teacher salary rankings that continues today. The correlation of the average ranking from columns (4) and (5) with the amenity-adjusted ranking for 1990 of Stoddard (2005) is 0.47.

III.2. Robustness of the Amenity-Adjusted Rankings

Using other college graduate wage and salary differences across states for comparing teacher salaries assumes that household amenity attractiveness is equally capitalized into non-teacher and teacher salaries. Based on their empirical analysis, Brueckner and Neumark (2014)

[13] The ranking shown in column (4) is highly correlated to the ranking showing in column (5) (r= 0.97).

conclude that public sector wages do not fully reflect the presence of high amenities, particularly those for public sector workers who are union members.[14] It also is possible that teachers and non-teachers have different preferences for natural amenities. Therefore, we next examine whether the difference between the after federal tax salaries of teachers and that of other college graduates is related to natural amenities in the state. If teachers do not pay the full price of natural amenities relative to other college graduates, the difference should be positively and significantly related to the natural amenity attractiveness of the state. We also examine whether the effect depends on the percent of unionized state teachers.

Regressions are run using other college graduate salaries that control for industry and occupation (column (5) of Table 3), though the results are not affected by instead using the other college graduate wages obtained by not controlling for industry and occupation (column (4) of Table 3). Natural amenities are measured by a scale constructed by Economic Research Service (ERS) of the United States Department of Agriculture.[15] The amenity scale is derived from the relationship between population growth and its relationship to six measures (McGranahan, 1999): (1) average January temperature; (2) average January days of sun; (3) a measure of temperate summers; (4) average July humidity; (5) topographic variation; and (6) water area as a proportion of total county area.

The results are shown in Table 5. The results for the model that only includes the natural amenity scale variable are shown in column (1). The negative sign on the amenity scale variable suggests that, if anything, teachers pay more for the presence of attractive amenities. The amenity scale variable becomes insignificant though when teacher unionization and its interaction are added to the regression. This is true using either the percent of teachers who are members of a union (column (3)) or the percent of teachers covered by a union (column (4)), where in both cases the interaction variable also is insignificant. In results not shown, using the

[14]Previous literature has found that teacher unions increase teacher salaries, especially for experienced teachers (West and Mykerezi, 2011; Winters, 2011; Cowen and Strunk, forthcoming).

[15] The natural amenity dataset and documentation can be found at http://www.ers.usda.gov/data-products/natural-amenities-scale.aspx (last accessed January 19, 2015).

estimates of state quality of life by Albouy (2008, Table A2), which reflect both the presence of man-made and natural amenities, in place of the ERS amenity scale variable produces nearly the same results as those in Table 5; the only notable difference is that the Albouy state amenity variable is statistically insignificant in the column (1) model, though still negative in sign. Therefore, the evidence supports using other college graduate salaries to measure amenity effects on teacher salaries at the state level.

Given potential intrastate variation in cost of living, natural amenities and differences in the spatial patterns of residence between teachers and other college graduates within states (Taylor, 2008), we next examine whether the state teacher amenity-adjusted salary rankings are affected by comparing teachers in metropolitan areas versus nonmetropolitan areas with other college graduates in the respective areas. All steps above applied at the state level are now applied for metropolitan and nonmetropolitan areas of states separately and aggregated based on population in metropolitan versus nonmetropolitan areas to produce revised state rankings. Yet, in results not shown for brevity, the ranking is not much affected. The correlation of the ranking from column (5) of Table 4 with the revised ranking obtained from separately estimating metropolitan versus nonmetropolitan areas is 0.91. Michigan, Pennsylvania and Rhode Island remain in the top five, while Arizona, New Mexico, North Carolina and Virginia all remain in the bottom five, where Oklahoma slightly improved in the ranking from forty-fourth to fortieth. The largest move downwards is Wyoming, from first to nineteenth, while the largest move upwards is North Dakota, from nineteenth to fifth.

In addition to amenity attractiveness of the area, characteristics of the students and education environment may affect the attractiveness of the state to teachers and their salaries (Walden and Newmark, 1995; Stinebrickner, 1998; Imazeki, 2005; and Martin, 2014). Therefore, we also regress the fully-adjusted teacher salary differences on several variables that proxy for the teaching environment in several specifications for the period 2009-2011: the pupil-to-teacher ratio in public elementary and secondary schools; the percentage of public school students eligible for free/reduced-price lunch program; the share of public school students pre-

kindergarten through the twelfth grade who were white; the percentage of public school students who were limited English proficient or were English language learners; and the percentage of public school students having an Individualized Education Program. Control variables, measured for 2009-2011, include the ratio of the K-12 student population to overall state population and natural log of state median income.[16] We also separately include measures to capture state and local public sector unionization effects on teacher salaries: for state and local public sector employees we include the sector union member ratio, the bargaining agreement coverage ratio, and a variable measuring their bargaining rights (Valletta and Freeman, 1988). In results not shown, across a multitude of specifications, we do not find a significantly positive wage compensating differential for a more challenging teaching environment. Only for specifications when the bargaining rights variable is the measure of unionization is one of the teaching environment variables consistently significant: the ratio of Individualized Education Program students is significantly and positively related to the fully-adjusted teacher salaries. Thus, because of the lack of consistent significant effects of teaching environment variables, we do not further adjust teacher salaries.

III.3. Salary Impacts on the Probability of Teaching for Education Majors

We next use microdata from the 2009-2011 ACS to examine the effects of state differences in federal tax-adjusted teacher salaries relative to those for other college graduates (i.e., the values in column 5 of Table 3 hereafter referred to as relative teacher salaries) on the decision to teach at the time of the ACS survey for education majors. Although this includes teachers who long ago earned their college degree, the results in the previous section and the estimates in the literature reviewed suggest high persistence in relative teacher salaries over at least a thirty year period. In addition, sixty percent of the teachers surveyed in the ACS during 2009-2011 were born in their state of residence at the time of the survey. Finally, because of the robustness of the state teacher rankings to other potential confounding factors demonstrated

[16] All right-hand-side variables related to public schools were obtained from the National Center for Education Statistics at http://nces.ed.gov/.

above, the differences in federal tax-adjusted salaries can be thought to well-represent state differences in fully adjusted teacher salaries.[17]

Our sample for this analysis includes all persons whose educational attainment is a bachelor's degree or higher and who report a first or second college major in the field of education. This includes several sub-categories of education majors such as general education, elementary education, special needs education, etc. We consider both all education majors jointly and some specific majors separately. We also limit our main sample to education majors of ages between 30 and 59 to focus on mid-career professionals. Many state pension systems allow teachers to retire at age 60 and those eligible for retirement may respond differently to relative teaching salaries than mid-career teachers. Similarly, many young workers are often still settling on their preferred career path, and the age 30 cutoff also largely removes the recession effect on those recently graduating college.[18] We first report regression results for the full sample ages 30-59 and then report separate results for 10-year age ranges: 30-39, 40-49, and 50-59.

Our dependent variable for this analysis is a dummy variable equal to one if a person is an elementary or secondary school teacher and employed by a state or local government. We estimate linear probability models. Our baseline specification includes several individual characteristics and a few geographic control variables. The individual characteristic controls include dummies for five-year age group, black, Asian, Hispanic, other non-white, citizenship classification, English spoken at home, and English is poor. We estimate separate models by gender and pooled models including both genders.[19] The pooled gender models also include a female dummy variable and interactions between it and the above individual variables. All models also include year dummies. We choose not to include variables that are potentially

[17] For those with strong geographic attachments, low teacher salaries in some states may cause a reduction in the number of students majoring in education. Our data do not allow us to consider this possibility. The ACS also does not include detailed data on in- and out-migration, so we cannot examine the effects of state differences in the salaries of teachers on their decision to migrate. These imply that our estimates on the decision to teach understate overall teacher labor supply effects of salary differences, including ignoring potential effects on teacher quality.
[18] The results are not greatly changed by altering the age range used in constructing the salaries (22-65). This is not surprising as teachers can be backward and forward looking regarding wages in the decision to teach.
[19] We use our overall teacher wage estimates because of concerns with measurement error. For small sub-samples of males, particularly those by major, measurement error could severely bias the estimates downwards.

endogenous such as graduate education, marital status, and having children. However, we also estimate regressions including these controls and the results are qualitatively similar.

We only have 48 states so we have to be somewhat parsimonious with state controls. We first include three census region dummies for the Midwest, South, and West, making the Northeast the omitted base region. We also included the state unemployment rate and the percentage of primary and secondary teachers in the state who teach in a public school. This last variable captures variation in public-private school enrollment and employment across states. It is measured using the ACS but the results are robust to measuring it using the Current Population Survey (CPS), alleviating concerns of potential endogeneity.

We also look at differences for some specific college majors within the field of education. The ACS provides both a broad education major category and 15 detailed education major categories. The codes, descriptions, and frequencies for each of these detailed categories are reported in Table 6. Some categories are much smaller or larger than others. However, we note that the Census Bureau codes college majors into pre-defined groups based on written responses and some respondents may report their general major rather than their specific major, e.g., a secondary education major may report their major as education. The "general education" category may be used somewhat as a residual category for such respondents.

We first examined each of the categories separately but doing so yielded very small sample sizes for several categories. Our preferred approach was to combine the 15 subcategories into four groups: a) general education; b) elementary education; c) math, science and computer education; and d) all other education majors. The first two are the largest two single subcategories (codes 2300 and 2304, respectively) and are sufficiently large to permit reliable analysis without combining them with other categories. We are especially interested in the math, science, and computer education majors group, which combines two related detailed education major categories (codes 2305 and 2308). Math, science and computer education is often a key concern for policymakers so we are especially interested in how these majors' teaching decisions are affected by relative teacher salaries. Furthermore, this group may have especially good labor

market opportunities outside of teaching and be especially likely to leave the teaching profession if they receive low salaries as teachers. Most school districts operate on a "single salary schedule" so that teacher pay is based on experience and education and does not depend on the field taught or area of certification.

We first demonstrate the necessity for adjusting teacher salaries for the analysis by examining the relationships for different salary measures with the decision to teach in Table 7. Column (1) shows the impacts on both genders who majored in education; column (2) reports the impacts on females; whereas, column (3) lists the impacts on males. As shown in Table 7, both the unadjusted teacher salaries (Panel A) and the characteristic-adjusted teacher salaries (Panel B) are insignificantly related to the decision of an education major to remain a teacher for females and for both sexes combined. The only significant results are for males. After adjusting for cost-of-living, however, the overall relationship becomes positive and significant (Panel C). Further adjusting for household amenity differences causes the relationship to become more positive (Panels D and E), regardless of controlling for industry and occupation of non-teachers in estimating natural amenity attractiveness. The differences from adjusting for amenities are more pronounced for females, though they are not statistically different than those in Panel C.

Based on the above results and the convention of controlling for occupation and industry in quality-of-life studies (Roback, 1982; Albouy, 2008), we use the model in Panel E for further investigation. The positive and statistically significant results shown in Panel E indicate that a higher teacher salary increases the probability of college graduates ages 30-59 who majored in education to stay in teaching. Using the pooled coefficient, the difference in teacher salaries between the highest (Wyoming) and lowest (Virginia) paid states changes the probability of an education major staying in teaching by about six percent; the corresponding effect for males is about eight percent.

Table 8 reports the impact of relative teacher salaries on the probability of teaching for education majors by age range. Columns 1-3 again show the results for both genders combined, females, and males, respectively. Panels B, C and D show that the positive effect primarily

occurs for the 40-49 and 50-59 age groups. The coefficients are positive for the 30-39 age group but are insignificant. Moreover, the results in column (3) suggest that higher salaries affect males more than females.

Table 9 displays the estimated effects of relative teacher salaries on the probability of teaching for different education major groups. Columns 1-3 again present results for both genders, females, and males, respectively. Panel A, B, C and D show the results for the major of general education, elementary education, math, science and computer education, and all other education majors, respectively. Panel A shows that salary has a positive impact on general education major college graduates. Panel B shows that higher relative salaries have positive impacts on females who majored in elementary education. Panel C shows that higher salary positively affects the probability of males who majored in math, science, and computer education to stay in teaching, in which the difference in teacher pay between Wyoming and Virginia increases the probability by about twenty one percent. Panel D shows that higher salary also increases the probability of being a teacher for males who majored in all other education fields.

Overall, the results support previous findings that higher relative teacher salaries more likely keep teachers from leaving the profession (Baugh and Stone, 1982; Murnane and Olsen, 1989; Stinebrickner, 1998; Imazecki, 2005; Torres, 2012).[20] Our results also are supportive of previous findings that relative salaries matter more for math and science teachers (Rumberger, 1987), though the effect we found was for males and not for females, and contrasts with that reported by Ingersoll and May (2012).

IV. Summary and Conclusions

In this paper, we estimate and compare U.S. state public school teacher salaries using the 2009-2011 American Community Survey. We compare teacher salaries after adjusting them for

[20] It is difficult to compare our point estimates to those of previous studies because of differences in empirical specification and research design, in which our study considers a longer time period and uses a different dependent variable. Closest are the estimates of 0.11 to 0.14 reductions in the probability of leaving the teaching profession (during different two-year windows) for a difference in wage of 1 percent of Baugh and Stone (1982) and the 0.26 increase in probability a teacher stays in the profession more than five years for a 1 percent increase in wage of Stinebrickner (1998).

state differences in teacher characteristics, cost of living and natural amenity attractiveness. Natural amenity attractiveness is estimated by wages of non-teaching college graduates after adjusting for federal taxes, worker characteristics, and cost-of-living. The adjustment for natural amenities shifts the state rankings of teacher salaries the most. In comparing our estimated nominal teacher salaries to previous estimates in the literature, it is found that the relative rankings of state teacher salaries have been highly persistent over recent decades.

In sensitivity analysis, we demonstrate the robustness of the teacher salary rankings. Firstly, we demonstrate that state amenity attractiveness is equally capitalized into teacher and other college graduate wages and salaries, supporting the use of other college graduate wages and salaries to amenity-adjust teacher wages. Secondly, we amenity-adjust teacher salaries separately for metropolitan and nonmetropolitan areas within states and then combine them to produce state amenity-adjusted teacher salaries. Yet, this adjustment does not much affect the rankings. Thirdly, we determine that amenity-adjusted state teacher salaries are not consistently related to measures of the teaching environment, suggesting that no further adjustment in teacher salaries was necessary for comparison.

Finally, we examined the impact of the difference in federal tax-adjusted salaries between teachers and non-teaching college graduates on the probability that an education major college graduate was employed as a teacher at the time of the ACS survey. We first demonstrate the necessity of our adjustments for establishing a link between teacher salaries and the decision to remain a teacher. The positive effect is strongest for those between the ages of 40 and 59, especially for males. In an examination of the effect by detailed major, we find significant effects for both males and females who had a general education major. For elementary education teachers, only the effect for females is significant, while for math, science and computer teachers and those in all other education fields, only the effect for males is significant. The effect for males in math, science and computers is largest among all estimated effects and is a particular concern given increased interest in Science, Technology, Engineering and Mathematics (STEM) education as a means to boost regional economic productivity (Winters, 2014).

Although analysis at the state level averages out district-level differences that may be important, our results are useful for policy discussions of state funding for education. State differences in teacher salaries and educational funding could be further examined for their effects on state educational and economic outcomes. In addition to increasing class sizes and creating teacher shortages, the effects of low educational funding on teacher salaries may have adverse effects on teacher quality. Low salaries in a number of states have been linked to teacher shortages and the need to fill vacant positions with unlicensed teachers and to recruit internationally (Creno, 2014; Strauss, 2015; Wendler, 2015). To the extent educational outcomes are harmed, low funding could reduce long-term state economic productivity and growth (Bensi, Black and Dowd, 2004; McMahon, 2007).

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Table 1. Coefficients of Teacher Characteristics, 2009-2011 ACS

Variables	Male (1)	Female (2)
Age 25-30	0.265***	0.195***
	(11.44)	(19.65)
Age 31-35	0.370***	0.295***
	(15.91)	(29.20)
Age 36-40	0.466***	0.367***
	(20.01)	(35.83)
Age 41-45	0.503***	0.407***
	(21.48)	(39.15)
Age 46-50	0.558***	0.442***
	(23.78)	(42.67)
Age 51-55	0.583***	0.495***
	(24.77)	(48.57)
Age 56-60	0.600***	0.524***
	(25.32)	(51.28)
Age 61-65	0.548***	0.518***
	(21.83)	(46.45)
Hispanic Origin	0.00133	0.00844
	(0.126)	(1.308)
Black or African American	-0.0578***	-0.0211***
	(-4.963)	(-3.742)
Asian	0.0145	-0.0115
	(0.795)	(-0.928)
Other Nonwhite	-0.0170	-0.0318***
	(-0.916)	(-2.944)
Masters Degree+	0.157***	0.174***
	(33.99)	(65.32)
40-47 Weeks	0.145***	0.122***
	(10.56)	(17.68)
48-49 Weeks	0.135***	0.117***
	(6.633)	(10.19)
50+ Weeks	0.193***	0.155***
	(15.43)	(24.68)
40 Hours	-0.00497	0.0337***
	(-0.695)	(7.997)
41-48 Hours	0.0380***	0.0663***
	(4.490)	(13.64)
49-59 Hours	0.0576***	0.0639***
	(7.667)	(13.85)
60+ Hours	0.102***	0.0551***
	(7.400)	(5.206)
Have Child	0.0314***	-0.0249***
	(5.386)	(-8.076)
Have Child 5-yrs	0.00202	0.0402***
	(0.322)	(10.27)
English at Home	0.0290***	0.0143**
	(2.944)	(2.441)
English Poor	0.0329	-0.0286
	(0.573)	(-0.861)
Married	0.0380***	0.00711**
	(6.097)	(2.393)
Secondary school teacher	0.0237***	0.0182***
	(5.244)	(5.566)
State fixed effects	Y	Y
Observations	21,070	66,671
R-squared	0.362	0.341

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 2. Coefficients of Non-teacher Characteristics, 2009-2011 ACS

	without Ind&Occ Control		with Ind&Occ Control	
	Male	Female	Male	Female
Variables	(1)	(2)	(3)	(4)
Age 25-30	0.270***	0.280***	0.259***	0.245***
	(49.33)	(62.67)	(49.90)	(58.55)
Age 31-35	0.459***	0.459***	0.443***	0.410***
	(80.43)	(95.52)	(81.62)	(90.58)
Age 36-40	0.599***	0.578***	0.581***	0.524***
	(103.6)	(116.2)	(105.8)	(111.7)
Age 41-45	0.672***	0.631***	0.651***	0.574***
	(114.8)	(122.9)	(117.2)	(118.9)
Age 46-50	0.706***	0.648***	0.682***	0.590***
	(119.5)	(127.0)	(121.5)	(122.8)
Age 51-55	0.701***	0.627***	0.678***	0.573***
	(118.1)	(123.4)	(120.3)	(119.8)
Age 56-60	0.647***	0.584***	0.637***	0.538***
	(107.3)	(110.0)	(111.2)	(107.8)
Age 61-65	0.613***	0.534***	0.602***	0.493***
	(93.27)	(84.75)	(96.35)	(83.08)
Hispanic Origin	-0.147***	-0.0975***	-0.117***	-0.0826***
	(-32.41)	(-21.82)	(-27.23)	(-19.61)
Black or African American	-0.246***	-0.107***	-0.208***	-0.0961***
	(-59.38)	(-33.06)	(-52.08)	(-31.15)
Asian	-0.0264***	0.0370***	-0.0406***	0.0280***
	(-6.426)	(8.602)	(-10.37)	(6.916)
Other Nonwhite	-0.124***	-0.0651***	-0.107***	-0.0578***
	(-17.09)	(-9.347)	(-15.51)	(-8.731)
Masters Degree+	0.289***	0.267***	0.224***	0.209***
	(141.7)	(123.9)	(110.8)	(98.73)
40-47 Weeks	0.288***	0.290***	0.292***	0.295***
	(33.08)	(35.56)	(35.31)	(37.98)
48-49 Weeks	0.515***	0.435***	0.495***	0.431***
	(49.91)	(43.17)	(50.52)	(45.02)
50+ Weeks	0.614***	0.585***	0.578***	0.563***
	(94.39)	(93.67)	(93.11)	(94.20)
40 Hours	-0.159***	-0.00994***	-0.171***	-0.0233***
	(-45.77)	(-3.189)	(-51.59)	(-7.961)
41-48 Hours	-0.0144***	0.171***	-0.0465***	0.133***
	(-3.766)	(45.65)	(-12.71)	(37.25)
49-59 Hours	0.122***	0.288***	0.0923***	0.247***
	(32.28)	(72.52)	(25.60)	(65.16)
60+ Hours	0.154***	0.269***	0.161***	0.258***
	(25.07)	(30.93)	(27.44)	(31.05)
Have Child	0.0741***	-0.00158	0.0718***	-0.00212
	(29.17)	(-0.626)	(29.51)	(-0.890)
Have Child 5-yrs	0.0155***	0.109***	0.0148***	0.0959***
	(5.210)	(32.06)	(5.140)	(29.34)
English at Home	0.113***	0.0881***	0.0956***	0.0703***
	(34.16)	(25.75)	(30.29)	(21.72)
English Poor	-0.482***	-0.455***	-0.339***	-0.322***
	(-42.29)	(-36.42)	(-32.75)	(-28.87)
Married	0.163***	0.0575***	0.140***	0.0432***
	(63.96)	(27.25)	(57.70)	(21.54)
State Fixed Effects	Y	Y	Y	Y
Industry and Occupation Controls	N	N	Y	Y
Observations	487,234	350,455	487,234	350,455
R-squared	0.248	0.244	0.320	0.331

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3. Relative Teacher Salaries, 2009-2011

State	Unadj. (1)	Char. Adj. (2)	COL Adj. (3)	Fully Adj. Wo. Ind&Occ (4)	Fully Adj. w. Ind&Occ (5)
Alabama	0.000	0.000	0.000	0.000	0.000
Arizona	-0.050	-0.042	-0.131	-0.126	-0.123
Arkansas	-0.070	-0.050	-0.036	0.005	-0.006
California	0.300	0.289	0.090	0.002	0.008
Colorado	0.000	-0.017	-0.114	-0.089	-0.094
Connecticut	0.290	0.254	0.056	-0.026	-0.010
Delaware	0.190	0.211	0.072	0.069	0.079
Florida	-0.010	0.021	-0.069	-0.025	-0.034
Georgia	0.060	0.053	0.015	-0.038	-0.033
Idaho	-0.080	-0.081	-0.108	0.010	-0.009
Illinois	0.120	0.137	0.033	-0.016	-0.012
Indiana	0.030	0.036	0.020	0.054	0.053
Iowa	-0.010	0.000	0.014	0.069	0.061
Kansas	-0.070	-0.072	-0.073	-0.030	-0.039
Kentucky	-0.010	-0.031	-0.021	0.015	0.008
Louisiana	-0.030	0.025	0.002	0.013	0.006
Maine	-0.030	-0.042	-0.114	0.056	0.043
Maryland	0.250	0.259	0.054	-0.026	-0.013
Massachusetts	0.230	0.203	0.033	-0.024	-0.020
Michigan	0.230	0.200	0.149	0.135	0.138
Minnesota	0.080	0.066	0.002	0.005	0.000
Mississippi	-0.150	-0.110	-0.088	-0.020	-0.035
Missouri	-0.080	-0.078	-0.059	-0.047	-0.053
Montana	-0.120	-0.108	-0.143	0.046	0.021
Nebraska	-0.090	-0.083	-0.075	0.018	0.001
Nevada	0.080	0.076	-0.016	-0.011	-0.058
New Hampshire	0.080	0.065	-0.089	-0.007	-0.015
New Jersey	0.310	0.338	0.116	0.036	0.048
New Mexico	-0.050	-0.067	-0.107	-0.089	-0.092
New York	0.330	0.286	0.055	0.051	0.054
North Carolina	-0.100	-0.052	-0.073	-0.081	-0.081
North Dakota	-0.150	-0.096	-0.071	0.033	0.008
Ohio	0.130	0.117	0.120	0.071	0.075
Oklahoma	-0.160	-0.132	-0.136	-0.056	-0.057
Oregon	0.080	0.050	-0.025	0.019	0.013
Pennsylvania	0.170	0.172	0.088	0.097	0.099
Rhode Island	0.280	0.287	0.184	0.121	0.122
South Carolina	-0.050	-0.038	-0.058	-0.005	-0.012
South Dakota	-0.200	-0.180	-0.139	-0.004	-0.030
Tennessee	-0.090	-0.073	-0.082	-0.056	-0.058
Texas	0.000	0.055	-0.015	-0.083	-0.068
Utah	-0.020	0.002	-0.056	0.027	0.016
Vermont	-0.010	-0.047	-0.145	0.035	0.012
Virginia	0.050	0.067	-0.059	-0.142	-0.132
Washington	0.150	0.102	-0.018	-0.039	-0.041
West Virginia	-0.100	-0.108	-0.097	0.002	-0.004
Wisconsin	0.090	0.069	0.048	0.071	0.065
Wyoming	0.150	0.137	0.081	0.198	0.187
Standard Deviation	0.140	0.130	0.083	0.065	0.064

Table 4. Teacher Salary Rankings, 2009-2011

State	Unadj. (1)	Char. Adj. (2)	COL Adj. (3)	Fully Adj. Wo. Ind&Occ (4)	Fully Adj. w. Ind&Occ (5)
Alabama	23	27	20	26	23
Arizona	33	33	44	47	47
Arkansas	36	35	26	22	25
California	3	2	5	25	17
Colorado	24	29	43	46	46
Connecticut	4	6	9	35	27
Delaware	9	7	8	8	5
Florida	26	25	31	34	35
Georgia	20	21	16	38	34
Idaho	38	41	41	21	26
Illinois	14	11	13	31	29
Indiana	22	23	15	10	10
Iowa	27	28	17	7	8
Kansas	37	38	33	37	37
Kentucky	28	30	24	19	18
Louisiana	31	24	19	20	20
Maine	32	32	42	9	12
Maryland	6	5	11	36	30
Massachusetts	7	8	14	33	32
Michigan	8	9	2	2	2
Minnesota	16	18	18	23	22
Mississippi	45	46	37	32	36
Missouri	39	40	30	40	39
Montana	44	45	47	12	13
Nebraska	40	42	35	18	21
Nevada	17	15	22	30	42
New Hampshire	18	19	38	29	31
New Jersey	2	1	4	13	11
New Mexico	34	37	40	45	45
New York	1	4	10	11	9
North Carolina	42	36	34	43	44
North Dakota	46	43	32	15	19
Ohio	13	13	3	6	6
Oklahoma	47	47	45	41	40
Oregon	19	22	25	17	15
Pennsylvania	10	10	6	4	4
Rhode Island	5	3	1	3	3
South Carolina	35	31	28	28	28
South Dakota	48	48	46	27	33
Tennessee	41	39	36	42	41
Texas	25	20	21	44	43
Utah	30	26	27	16	14
Vermont	29	34	48	14	16
Virginia	21	17	29	48	48
Washington	11	14	23	39	38
West Virginia	43	44	39	24	24
Wisconsin	15	16	12	5	7
Wyoming	12	12	7	1	1

Table 5. Teacher versus Other College Graduate Amenity Effects

VARIABLE	(1)	(2)	(3)	(4)
Natural Amenity Scale	-0.00659*		0.000814	0.00167
	(-1.698)		(0.0444)	(0.0882)
% Union Member		0.134***	0.140***	
		(3.689)	(4.157)	
Natural Amenity Scale*% Union Member			-0.0122	
			(-0.446)	
% Union Covered				0.141***
				(4.137)
Natural Amenity Scale*% Union Covered				-0.0135
				(-0.476)
Observations	48	48	48	48
R-squared	0.057	0.225	0.285	0.283
F-statistic (p-value)	0.096	0.001	0.002	0.002

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Detailed Codes and Frequencies for Education Majors Sample Ages 30-59

College Major Code and Description		Frequency	Percent
2300	General Education	36,975	24.84
2301	Educational Administration and Supervision	1,033	0.69
2303	School Student Counseling	389	0.26
2304	Elementary Education	47,236	31.73
2305	Mathematics Teacher Education	2,723	1.83
2306	Physical and Health Education Teaching	9,557	6.42
2307	Early Childhood Education	5,140	3.45
2308	Science and Computer Teacher Education	2,258	1.52
2309	Secondary Teacher Education	8,069	5.42
2310	Special Needs Education	8,259	5.55
2311	Social Science or History Teacher Education	3,781	2.54
2312	Teacher Education: Multiple Levels	2,903	1.95
2313	Language and Drama Education	6,452	4.33
2314	Art and Music Education	7,604	5.11
2399	Miscellaneous Education	6,489	4.36

Table 7. Effects of Different Teacher Salary Measures on the Decision to Teach

	(1) Both Sexes	(2) Females	(3) Males
A.			
Unadjusted Mean Teacher Salaries	0.048	0.024	0.130
	(0.033)	(0.034)	(0.050)**
B.			
Characteristic Adjusted Teacher Salaries	0.047	0.021	0.136
	(0.034)	(0.034)	(0.054)**
C.			
COL Adjusted Teacher Salaries	0.145	0.107	0.264
	(0.056)**	(0.055)*	(0.087)***
D.			
Fully Adjusted without Ind & Occ	0.209	0.175	0.306
	(0.072)***	(0.072)**	(0.097)***
E.			
Fully Adjusted with Ind & Occ	0.183	0.160	0.247
	(0.068)**	(0.067)**	(0.098)**

Notes: Each coefficient-standard error pair is from a separate regression. All regressions include individual and geographic controls. The sample includes education majors ages 30-59. Standard errors in parentheses are clustered by state.

*Significant at 10% level; **Significant at 5%; ***Significant at 1%.

Table 8. Relative Teacher Salaries and Probability of Teaching for Education Majors by Age

	(1) Both Sexes	(2) Females	(3) Males
A. Ages 30-59			
Relative Teacher Salary	0.183	0.160	0.247
	(0.068)**	(0.067)**	(0.098)**
B. Ages 30-39			
Relative Teacher Salary	0.123	0.134	0.085
	(0.102)	(0.100)	(0.157)
C. Ages 40-49			
Relative Teacher Salary	0.265	0.211	0.423
	(0.082)***	(0.090)**	(0.112)***
D. Ages 50-59			
Relative Teacher Salary	0.167	0.139	0.241
	(0.071)**	(0.073)*	(0.094)**

Notes: All regressions include individual and geographic controls. Standard errors in parentheses are clustered by state. *Significant at 10% level; **Significant at 5%; ***Significant at 1%.

Table 9. Effects on Probability of Teaching by Education Major Group

	(1) Both Sexes	(2) Females	(3) Males
A. General Education			
Relative Teacher Salary	0.280	0.285	0.264
	(0.093)***	(0.104)***	(0.112)**
B. Elementary Education			
Relative Teacher Salary	0.102	0.123	-0.056
	(0.066)	(0.070)*	(0.156)
C. Math, Science, and Computer Education			
Relative Teacher Salary	0.331	0.104	0.672
	(0.198)	(0.256)	(0.282)**
D. All Other Education Majors			
Relative Teacher Salary	0.145	0.084	0.258
	(0.073)*	(0.073)	(0.107)**

Notes: All regressions include individual and geographic controls. The sample includes ages 30-59. Standard errors in parentheses are clustered by state.

*Significant at 10% level; **Significant at 5%; ***Significant at 1%.