

**Economic and Professional Mobility in Rural Labor Markets:
Evidence from Public School Systems in Kentucky**

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Abstract

In this paper we consider the determinants of promotion to a principal position in rural school districts where school employment represents one of the major sources of economic and professional opportunity. Drawing on more than two decades of data on individual teachers in Kentucky, we find significant and pervasive differences between males and females in the probability of promotion to school administration for teachers throughout the state. However, these differences are especially pronounced in the remote, highly impoverished Appalachian region, where pronounced leakages are found along multiple critical junctures in the principal pipeline for female teachers. More specifically, we first find that female Appalachian teachers are much less likely to sit for the principal licensure examination. Further, we find that, even conditional upon having taken the certification exam—and holding constant a teacher's score on that test—female Appalachian teachers are dramatically less likely than their male Appalachian counterparts to go on to successfully obtain employment as a principal. We conclude by discussing our results in the context of both the teacher and principal staffing literatures and in the under-examined area of rural labor markets.

1. Introduction

Access to effective personnel remains a major source of variation between American public schools. The importance of teacher quality in explanations of student achievement differences is recognized among researchers and policymakers alike (e.g. Nye, Konstantopolous and Hedges 2004; Rockoff 2004; Rivkin, Hanushek and Kain 2005; Aaronson, Barrow and Sander 2007). School leadership has also received considerable attention, as studies have found substantial variation in principal effectiveness (Eberts and Stone 1988; Jacob and Lefgren 2008; Clark, Martorell and Rockoff 2009; Loeb, Kalogrides and Horng 2010; Grissom 2011; Grissom and Loeb 2011). In both staffing areas, schools serving disadvantaged students face particular challenges. Minority students, those from lower income families, and students with academic disabilities are less likely to have effective teachers and principals (Lankford, Loeb, and Wyckoff 2002; Roza 2003; Hanushek, et al. 2004; Gates, et al. 2005; Scafidi, Sjoquist, & Stinebrickner 2007; Branch, et al. 2009; Loeb, Kalogrides and Horng 2010; Beteille, Kalogrides and Loeb 2012)—a “plight” that is especially acute in urban settings (Lankford, Loeb and Wyckoff 2002; Papa, et al. 2002; Boyd, et al. 2005).

In recent years, policymakers have implemented a host of reforms directed toward evaluating existing teachers and, to some extent, their principals as well (Harris 2009; Koedel and Betts 2011; Winters and Cowen 2013). Although these reforms include professional development and training of existing staff, access to high quality employees begins and continues, quite literally, with recruitment and retention. As such, patterns of entry into and exit from public schools—especially disadvantaged schools—are one of the primary focal points for recent studies of both teacher and principal effectiveness (Boyd, et al. 2005; Loeb, Kalogrides and Horng 2010; Goldhaber and Hansen 2009, 2010; Goldhaber, Gross and Player 2011; Boyd, et al. 2011a, 2011b; Feng 2010; Feng and Sass 2011; Jacob 2011; Beteille, Kalogrides and Loeb 2012; Cowen, et al. 2012; Miller 2012; Fowles, et al. 2014).

Although some individual studies consider a variety of geographic contexts (e.g. Boyd, et al. 2005; Clotfelter, et al. 2006; Goldhaber, Gross and Player 2011; Cowen, et al. 2012; Miller 2012; Reininger 2012; Fowles, et al. 2014), this literature as a whole has been primarily concerned with urban districts. Such attention is understandable given not only the persistent historical disadvantages faced by students—especially minority students—in these schools, but also because many of the databases necessary for systematic research on these questions have until only in recent years been constructed and maintained by large urban school systems (Miller 2012). Only a handful of studies have explicitly focused on disadvantages faced by rural schools (Cowen, et al. 2012; Miller 2012), an oversight remaining in the literature despite lingering and in some cases intensifying conditions of extreme poverty found in many rural communities (Lowery 2014).

In this paper, we focus one aspect of school staffing in rural, Appalachian Kentucky. Drawing on previous scholarship concerning principal recruitment and retention as well as our own work on teaching careers in this region, we examine the transition between teaching and principal positions made in areas in which districts must rely almost entirely

on a locally developed labor force to staff and lead their schools. Drawing on a unique individual-level dataset that spans nearly 25 years, we consider the academic, demographic and administrative characteristics (i.e. salary, credentials, experience-level) of teachers who advance to leadership positions at some point over their careers. We pay particular attention to characteristics that may signal opportunities or barriers to advancement, especially the role of gender, which earlier work has shown to be influential in teacher promotion.

The paper proceeds as follows. We begin by discussing the special problems that rural schools may face in recruiting and retaining teachers and principals. We also consider differences in rural communities, noting that some of the most remote regions of the country—including Appalachia—are among the most poor, and those which remain largely dependent on lifelong residents for economic development. We then discuss in detail our research questions and hypotheses, which center on the determinants of teacher promotion within and between Kentucky schools.

Our primary finding concerns the role of gender in explaining the transition to principalships in Appalachia. We find significant and pervasive differences between males and females in the probability of promotion to school administration for teachers throughout the state. However, these differences are especially pronounced in the Appalachian region, where pronounced leakages are found along multiple critical junctures in the principal pipeline for female teachers. More specifically, we first find that female Appalachian teachers are much less likely to sit for the principal licensure examination. Further, we find that, even conditional upon having taken the certification exam—and holding constant a teacher's score on that test—female Appalachian teachers are dramatically less likely than their male Appalachian counterparts to go on to successfully obtain employment as a principal. We conclude by discussing our results in the context of both the teacher and principal staffing literatures and in the under-examined area of rural education.

2. Background: Staffing Schools in Rural Appalachia

Attention to rural schools is lacking in the literature beyond the matters of administration and staffing (Arnold, et al. 2005; Ballou and Podgursky 1995; Sherwood, 2000; Ingersoll and Rossi, 1995; Miller 2012). Disadvantages based on geography, however, may be most glaring from the perspective of human resources exactly because school districts are generally defined by jurisdictions—counties, cities or towns—that either comprise or at least are contained within delineated local labor markets. In the education profession, there is considerable evidence that the boundaries of these local markets represent meaningful borders behind which most prospective employees seek and maintain employment. Teachers appear to place in school districts near their own hometowns (Boyd, et al. 2005) or pre-service training institutions (Fowles, et al. 2014) to a greater extent than comparable members of other professions (Reininger 2012). When teachers do move further away from one rural community, they tend to simply move to another, similarly rural environment (Cowen, et al. 2012).

The problem is more complex for hiring and retaining principals, who rarely enter their positions directly as new labor market participants, and instead tend to have served for a time as teachers themselves. A young person seeking to become a teacher may generally follow a well-defined pathway: licensure from a teacher preparation program, a period of internship or “student teaching,” followed by placement in a public school (Ballou 1996; Baker and Cooper 2005). Beyond some formal experience in the classroom, however, and the possibility of earning a graduate (typically master’s-level) degree in educational administration, prospective principals have few similarly structured routes to leadership. Unlike firms in for-profit firms or even other governmental agencies, few districts maintain formal processes to identify and train teachers for management positions (Grunow et al. 2010), with large districts like New York City being the general exception (Corcoran, Schwartz and Weinstein 2012).¹ Where informal processes exist, teachers may rely heavily on their existing superiors to “sponsor” their advancement (Myung, Loeb and Horng 2011). This implies that not only do individual teachers depend on existing school leaders—often more likely to be male, and white, than their employees—for the only major form of career advancement available in K-12 schools, but also that districts themselves also depend to a large degree on the ability of those existing school leaders to identify and train school leaders for the future (Myung, Loeb and Horng 2011). Given the relationship between teacher origin and employment, this dependence may be especially strong in rural schools, where the number of leadership opportunities may be exactly the number of buildings in the district, and the number of potential leaders may simply reflect the number of experienced teachers on the payroll.

The social, economic and cultural conditions in rural communities differ from each other, just as life in one large city is a distinct experience than that in another. More than half (56 percent) of all school districts in the United States are classified as “rural,” and more than 10 million children are enrolled in them. But many of these areas, while located outside of major metropolitan areas, are directly accessible nevertheless from large population centers, and themselves have access to airports, interstate highways, entertainment and other amenities which may expand their market for teachers, doctors and other professionals (Miller 2012). On the other hand, at least 5 million students attend school in “distant” or “remote” geographic areas marked disproportionately by high levels of poverty (Provasnik, et al. 2007; Cowen, et al. 2012).

Within Appalachia—the vast region officially defined by the federal government as spanning from Northeastern Mississippi to Southwestern New York—the link between geographic isolation and economic hardship is stark, and corresponding indicators like unemployment, disability rates, obesity and life expectancy mark much of the region even as many of the nation’s urban areas thrive (Lowery 2014). These conditions vary in severity, however, across the region. While most of Pennsylvania lies officially in “Appalachia,” the economic status of every county in the states was rated “transitional” or “competitive” for the most recent year available (2015) by the federal government (Appalachian Regional Commission 2014). Conversely, the majority of counties in Mississippi, Tennessee, and West Virginia were rated “at risk,” or “distressed.” In

¹ Germane to this paper, Kentucky does require a 1-year internship for new principals after they are hired, but does not serve as a training opportunity for prospective applicants.

Kentucky, 37 the commonwealth's 54 Appalachian counties are classified as "distressed"—the most dire rating available—and of the remainder, 12 were rated "at risk" and no county received a "competitive" economic rating (Appalachian Regional Commission 2014).

It is on Kentucky that the present paper is focused. The commonwealth represents an important case study not only for the extreme poverty in much of its Appalachian counties but because these counties constitute a distinct geographic region within the state's own borders (Figure 1). The eastern half—Appalachia—is mountainous terrain, reeling from the decline of the coal industry, where median income was lower in 2014 than in 1979, and in some locations government subsidy represents half of all income (Lowery 2014). In the western half (which itself is still largely rural), per capita annual income is \$6,000 higher and other indicators like educational attainment and health outcomes more favorable (Cowen, et al., 2012; Fowles, et al. 2014). Perhaps more important are the tangible and intangible benefits that come from living near the cities of Louisville and Lexington, the southern suburbs of Cincinnati, two major research universities (with their perennial college basketball powers), the largest Toyota manufacturing center outside of Japan, an Amazon distribution center, the corporate headquarters of Papa John's pizza, the bourbon and thoroughbred racing industries—all of which are located within Kentucky but outside Appalachia. Equalizing educational conditions between these two very different areas—at least along the narrow domain of school funding disparities—was the focal point of Kentucky's Educational Reform Act (KERA) of 1990, which initially provided comparable revenue for Appalachian and non-Appalachian districts before new funding inequalities arose after the year 2000 (Streams, et al. 2011).

[Figure 1 about here]

Perhaps most important of all to this study is the notion of spatial fixity in Appalachia: the rooting of people to place (Fowles, et al. 2014). Many contemporary educational reform policies implicitly rely on dynamic conditions parents choosing between schools, teachers recruited or dismissed on the basis of prior performance, students shuffling between buildings closed or reorganized. Those reforms targeting school staffing and school leadership depend no less on access to improving labor supply (e.g., Rothstein forthcoming). Dismissed ineffective teachers must be replaced by new, presumably more effective ones; accountability sanctions that remove principals from low performing schools are only as successful as the next principal to assume the job. We have already stressed that previous explorations of teaching in Appalachian schools indicate a different career experience, one almost entirely defined by individual teacher-school matches made immediately after college (Cowen, et al. 2012; Fowles, et al. 2014), and one which on outside efforts to reform may have only the most limited short-term impact (Streams, et al. 2011). Here we consider whether access to school leadership positions—in particular the transition from a teaching position to that of principal—is distinctive in these settings as well.

3. Research Questions and Methodology

Two of our earlier studies in this region help fix both our research questions and our methodological approach concretely. In Cowen, et al. (2012) we examined the probability that individual teachers transferred between schools and districts, or left the Kentucky school system between 1986 and 2005. We found, briefly, that Appalachian teachers were less likely to transfer but more likely to exit the profession. In Fowles, et al. (2014), we examined the placement of first-year teachers in the school system. That analysis found that the teachers with strongest pre-service credentials were systematically less likely to be first employed in Appalachian schools, regardless of origin.

In this paper we are interested in modeling another probability: that of transitioning from teaching into a principal position. In our empirical specifications, we estimate several variations of the following general theoretical model:

$$\text{Prob}(\text{principal}) = f(\text{teacher characteristics, district characteristics,} \\ \text{teacher characteristics} \times \text{district characteristics}) \quad (1)$$

Drawing on the discussion above, it is the interaction of the teacher and district characteristics that are of particular interest, as these terms permit us to search for systematic differences in the characteristics of the teachers that become principals across Appalachian and Non-Appalachian locales.

Our core dataset for this exercise is a variation of that employed in our earlier work on teacher initial placement and we refer interested readers there for more details on its construction (Fowles et al. 2014). Broadly, it is a unit-record database of all new public school teachers employed at all public schools throughout the state covering the years 1987 to 2005. The dataset contains the socioeconomic and demographic characteristics of those teachers at the time of their initial employment; information on the subject areas for which each teacher is initially certified to teach; his or her scores on various certification and licensure exams; and educational background including the institution at which each teacher completed the baccalaureate degree. We supplement this core dataset with data on the individual school districts drawn from state administrative data, data collected by the U.S. Census Bureau, and data from the Common Core of Data collected by the National Center for Education Statistics. Finally, our key dependent variable—whether or not a particular teacher ever becomes a public school principal—is generated from a historical school-by-year list of principals provided to us by the Kentucky Educational Professional Standards Board, which is the state agency charged with overseeing the credentialing of all public school staff in the state.

Critically, the fine-grained resolution of our administrative data permits us to specify and test empirical models that unpack equation (1), thereby assessing not only the overall potential “leakiness” of the teacher-to-principal pipeline in aggregate across teachers and districts of varying characteristics, but also to evaluate the pipeline across those places and individuals at various critical junctions along its duration. Here, we focus on two critical points in a teacher’s potential transition into a principal role: 1) whether or not a particular teacher is ever observed to sit for the state’s mandatory principal licensure

exam, and 2) given that a teacher has successfully passed this exam (and thereby met one of the state's key requirements for being a principal), whether or not that teacher actually successfully obtains employment as a principal. These analyses complement and extend our more general specification.

Drawing on these data and the general theoretical model outlined in Equation 1, our estimated models are all variations of the following empirical specification:

$$\begin{aligned} \Pr(P_i = 1) = & \beta_0 + \beta_1 Appal_d + \beta_2 Gender_i + \beta_3 (Appal_d \times Gender_i) \\ & + \beta_4 X_i + \beta_5 D_d + \alpha_r + \gamma_t \end{aligned} \quad (2)$$

In this specification, i indexes individual teachers, d individual districts, r regions of the state, and t the individual years in which the teachers in our dataset obtain first employment. P represents the probability of a particular event (described in detail below) occurring at some point over the arc of a given teacher's career as observed in our administrative data. $Appal$ is an indicator variable, set equal to one if the teacher initially places in an Appalachian school district. $Gender$ is an indicator variable set equal to one if the teacher is male. X is a vector of other germane teacher characteristics including race (white or non-white), age at the time of initial placement, an indicator variable set equal to one if a teacher holds a math or science certification at time of initial employment, and a set of indicators variables for the teacher's baccalaureate university. D is a set of district-level controls, including district size (measured as the natural log of total district student enrollment), the percent of the district's students that are non-white, and the per capita income and population density of the district's county. We also include a full set of both region (α) and year (γ) dummy variables in order to control for the impact of any unobserved, time-invariant regional characteristics and common exogenous time-varying shocks, respectively. The year dummy variables also control for the fact that teachers first appearing in our data in earlier years logically have a greater probability of becoming a principal simply because we observe them longer and for a broader proportion of their careers.

We present three general sets of estimates, each of which relies upon a common set of regressors. The first utilizes our "ever observed as a principal" indicator as the dependent variable, thereby looking at the teacher-principal pipeline as a whole. The second estimates we report substitute as the dependent variable an indicator set equal to one if a teacher is ever observed to sit for the Kentucky Principals Test (KYPT), a test that is required for principal certification in the state. Our third empirical specification is similar to the first, with two exceptions. First, we estimate it utilizing only the subsample of teachers that are observed to have sat for the KYPT. Second, we add to our covariates a variable recording the teacher's score on KYPT from the final time the exam was taken, as well as a continuous variable that records the number of unique times a teacher is observed sitting for the KYPT. Our rationale for these individual specifications will be discussed below.

4.) Results

Table 1 reports germane descriptive statistics for these variables (excluding the baccalaureate degree indicators and the region and year dummy variables) for the 19,254 teachers that comprise our analytical sample. All reported teacher characteristics are set at the values observed in the first year of a teacher's employment. Table 1 also presents some descriptive statistics of the individual public school districts in which our teachers are employed. Since the observations in our dataset are at the individual teacher level, the district characteristics reported in Table 1 should be interpreted as averages that are weighted by the relative distribution of teachers across the individual districts.

[Table 1 about here]

As this table demonstrates, approximately 11 percent of teachers in our sample at some point sit for the KYPT assessment, and approximately 4 percent of teachers in our sample are ever observed to be employed as a principal. Roughly one in five teachers is male, and only three percent of our teachers are non-white. Approximately one-fifth of the teachers in our sample hold certifications to teach a course in science or mathematics at the time of initial employment. The average teacher is nearly 29 years of age at the time of first employment, although we observe a high degree of heterogeneity around this average. Approximately one third of teachers observed in our data initially place in Appalachian school districts. Beyond this, the individual districts that employ the teachers in our sample vary widely in terms of size and student population, as well as the socioeconomic conditions of the county in which the teacher's school district resides.

We employ these data in logistical regressions to estimate the parameters of Equation (2), first utilizing the "ever observed as a principal" indicator as the dependent variable. The results are presented in Table 2. For ease of interpretation, we report exponentiated coefficients (odds ratios) rather than the coefficients themselves and suppress reporting of estimated parameters associated with the year, region, and baccalaureate institution indicator variables.

[Table 2 about here]

As these results demonstrate, there appears to be significant and systematic heterogeneity in the probability that a teacher goes on to hold a principal position across the individual teachers in our sample. Teachers that are older at time of initial employment are less likely to become principals, as are teachers that initially place in poorer and less densely populated areas. Conditional on securing a teaching position, non-white teachers are much more likely than their white counterparts to become principals. Teacher certified in math or science are no more or less likely to become principals than teachers certified in other areas, holding all else constant. Finally, controlling for the other covariates in the model, baccalaureate institution is not a statistically significant predictor of a teacher becoming a principal.

We now turn to our variables of interest: the impact gender, of placing in Appalachia, and the interaction of the two. Conditional on teaching in a public school, the odds of an otherwise average male becoming a principal are over four times that of an otherwise average female. We do find that teachers initially placing in Appalachia are less likely to become principals even after controlling for county average wealth and population density, although the estimated coefficient is only statistically significant at the 0.10 level. Finally, the coefficient of our interaction term demonstrates that gender inequity in promotion to principal positions is statistically significantly larger in Appalachian school districts than in the rest of the state. To provide a sense of the magnitude of these differences, we utilize our estimates to produce average adjusted predictions of becoming a principal for males and females both within and outside Appalachia, holding the impact of other covariates constant.

[Table 3 about here]

As this table shows, there are sizable gender differences in the probability of becoming a principal in both Appalachian and non-Appalachian regions. Holding all else constant, the predicted probability a non-Appalachian male becoming a principal is 3.7 times that of an otherwise identical non-Appalachian female (8.4 percent versus 2.3 percent). The gender differential is even more pronounced in Appalachia, where the probability of a male who takes a first placement in Appalachia becoming a principal are 6.1 times that of an otherwise identical female (13.4 percent versus 2.2 percent). The estimated probabilities for males and females are statistically significantly different from each other in both regions. The estimated probabilities for males are significantly different across regions but not for females. Figure 2 displays these differences graphically.

[Figure 2 about here]

Finally we can evaluate the statistical significance of the double-difference: the inter-regional difference of the intra-regional gender differences. As one would expect, based on all previous results, the male/female difference in estimated probability is statistically significantly larger in Appalachia than in non-Appalachia ($\chi^2(1) = 23.352, p > \chi^2 < .0001$). In other words, while there are gender inequities in the probability of becoming a principal across all public school districts in the state, these differences are particularly acute in the Appalachian region of the state.

Having identified significant gender differences in the principal pipeline across regions in the state, we now estimate alternative models designed to gain some resolution as to the point(s) at which the leaks in the pipeline occur. As such, we re-estimate Equation (2), substituting as the dependent variable a binary variable set to one if a given teacher is ever observed sitting for the KYPT assessment. The KYPT assessment evaluates the teacher's knowledge of school administrative law and is a mandatory assessment for principal certification in Kentucky.

While successfully passing the KYPT assessment is not the only requirement for certification as a principal, we focus on it exclusively for two reasons. First, Kentucky,

like many states, has introduced significant changes to the licensure and certification processes and requirements for certified professional staff in public schools in the past three decades. Passing the KYPT assessment is one of the few principal certification requirements that has been a consistent requirement for all years covered in our data. Second, many of the other requirements for principal are more general and may be amenable to other purposes beyond pursuit of employment as a principal, such as obtaining a Master's degree in education. As such, we focus on the KYPT, unlike other certification requirements, it unambiguously speaks to the test-taker's desire to become a principal. Table 4 presents the regression results.

[Table 4 about here]

These results tell a substantively consistent story to those presented above. Older teachers at the time of initial placement and teachers initially placing in larger and poorer districts are less likely to sit for the KYPT assessment. Again, we see large differences in whites and non-whites, with the odds of a non-white teacher sitting for the exam being nearly 2.3 times that of his or her white counterparts. Again, we observe suggestive evidence of a decreased probability of sitting for the exam across all Appalachian teachers, and we still observe statistically and substantively large differences in the likelihood of otherwise equivalent males and females sitting for the exam. As before, these differences are exacerbated in Appalachian regions. Table 5 reproduces Table 3 but substitutes average predicted probabilities of sitting for the KYPT assessment.

Similar to the results presented in Table 3, we continue to find significant differences in probabilities across genders and regions. Non-Appalachian males are over three times as likely to sit for the KYPT assessment as otherwise identical non-Appalachian females, while Appalachian males are more than 3.5 times as likely than Appalachian females. As before, the double-difference indicates greater gender inequity in probability of sitting for the exam for teachers in Appalachia ($\chi^2(1) = 16.25, p > \chi^2 = .0001$). Figure 3 displays this relationship graphically.

[Figure 3 about here]

In other words, the regional factors that drive differences in probabilities of becoming a principal across genders manifest themselves early in the principal pipeline, functioning to encourage female exit. This effect is especially strong in the Appalachian regions, holding other factors constant.

Finally, in order to assess yet another critical point in the teacher pipeline, we re-estimate Equation (2) but restrict our sample to only the 2,120 unique teachers that are recorded in our data as having sat for the KYPT assessment. This provides an alternative vantage point to that presented above in that we are comparing the outcomes of only the subset of teachers who clearly desire to become principals. Because women are far less likely to seek principal employment (or, more precisely, to seek the possibility of employment by taking the KYPT), it is important

Further, in order to control for the potentially confounding impact of systematic quality differences among male and female Appalachian and non-Appalachian teachers that affect the likelihood of attaining a principal position, we estimate a second regression model that includes two additional control variables: an indicator set equal to one if a teacher is observed taking the KYPT assessment on multiple occasions (implying either a failing score or a score sufficiently low as to impact job prospects), and the natural log of the teacher's KYPT assessment score for the last time that teacher is observed taking the test. These two sets of estimates are presented in Table 6. Column (1) of that table reports the results of estimating Equation (2) as specified, while Column (2) expands that specification by including the quality variables as additional control variables.

[Table 6 about here]

The additional quality controls are jointly highly statistically significant ($\chi^2(2) = 11.08$, $P > \chi^2 = .0039$) and individually signed as expected (higher assessment scores increase the probability of becoming a principal while taking the KYPT assessment multiple times decreases that probability). However, looking across Columns (1) and (2), their inclusion does not meaningfully impact the other parameter estimates. This implies that there is not strong collinearity between our observed quality measures and other teacher observables included in the model.

Both models display consistent patterns to those observed above, with some differences. We no longer observe differences in probabilities among white and non-white teachers or a uniform shift in probabilities for all teachers placing in Appalachian districts. Similar to the previous models, older teachers are less likely and teachers initially placing in more densely populated districts are slightly more likely to become principals.

Finally, as above, in Table 7 we report predicted probabilities of obtaining a principal position based on the results in Table 6. Among KYPT takers, Appalachian women are the least likely to obtain a principal position, compared to their counterparts outside Appalachia or to males in either region. Men in Appalachia are 1.8 times more likely to obtain a position than men in the same locale. Figure 4 displays these differences graphically, displaying estimates based only on the model with the additional controls for our observed measures of quality.

[Table 7 about here]

[Figure 4 about here]

Interestingly, as Figure 4 shows, this is the first result that finds a substantively and statistically significant lower probability of success for female Appalachian teachers as compared to their non-Appalachian counterparts ($\chi^2(1) = 4.06$, $p > \chi^2 = 0.044$). So, unlike earlier models, the gender gap in the Appalachian region is not driven solely by increased probabilities of success for males across the two regions. While we do observe that trend here, it is exacerbated by a decreased probability of success for females in Appalachia as well.

5. Discussion

Although this paper broadly concerns the transition between teaching and principal positions broadly, the empirical evidence centers around a particular, and glaring, difference in that transition across geographic locales. Our results provide clear and consistent evidence that women are far less likely to be promoted to principals in the Kentucky public school system. As we show, these results can be partly explained by the disproportionate number of males sitting for principal licensure exams—our measure of interest in the position—but also by gender differences among the population of those who actually do demonstrate such interest in a principalship. These male-female differences are particularly strong in Appalachia, implying significant challenges to obtaining career advancement within school districts in that that region.

This pattern is troubling for a number of reasons. The first, and most directly relevant to school systems, are the implications of our results for developing school leaders. In most areas of the country, districts have few formal processes to identify and train future administrators (Grunow et al. 2010), and where these program exist they tend to be found in large-capacity, urban districts like New York City (Corcoran, Schwartz and Weinstein 2012). Informal processes in which individual teachers rely on superiors to “sponsor” their advancement are common, with individual teachers relying heavily on their supervisors for advancement (Myung, Loeb and Horng 2011). Although our data do not allow us to explore the matter concretely here, if such informal “sponsorship” processes are in place in Kentucky, they may explain why women are so unlikely not only to obtain a principal position but to even sit for the principal exam in the first place. It is possible that women, especially women in Appalachia, simply receive less encouragement to consider leadership roles.

Such a pattern would be worrisome enough in a scenario in which women who did receive such encouragement, at least, had similar chances to obtain a job. Our results strongly imply, however, that obstacles remain even for those who take the principal exam *and even after accounting for performance on that exam* and controlling for where teachers received their college degree. More than 45 percent of males who take the principal exam in Appalachia receive a principal position, compared to only 25 percent of women—a difference of nearly two-fold.

More generally, these results are troubling in the context of a region already characterized by economic hardship and a culture of spatial fixity. For many residents, public employment—especially employment in public schools, represents a dependable and even perhaps comparably well-paying method of employment (Streams and Toma 2008). Such an appeal may even extend, or even especially extend, to individuals with no desire to leave the region to seek other opportunities. To the extent that principal positions represent the only realistic form of career advancement within that sector, our results indicate that women in these poorer and more isolated areas have even fewer professional options than do their male counterparts.

Unfortunately, this analysis can only serve to point to a problem rather than suggest a potential solution. If these patterns were simply a matter of developing a formal process (perhaps statewide) for identifying future principals, such programs may alleviate (though not necessarily eliminate) the dependence on supervising principals for leadership potential. What we see here, however, suggests that such formal management training programs would only be successful if coupled by efforts to lower barriers to women at the hiring stage as well. Future iterations of this paper will consider yearly probabilities of the promotion to a principalship and these results—while almost have to hold given the aggregate data here—have the chief advantage over this analysis in that we will be able to directly account for teacher experience. But even now our models account for initial hiring age, which suggests that if our results are explained away by differences in yearly experience, then the gender-based differences we observe here are driven by women who take time away from the classroom after their initial hire. This in turn implies that women who pause their teaching careers to raise children may be harming their potential for promotion.

Figure 1: Appalachian and Non-Appalachian Districts in Kentucky

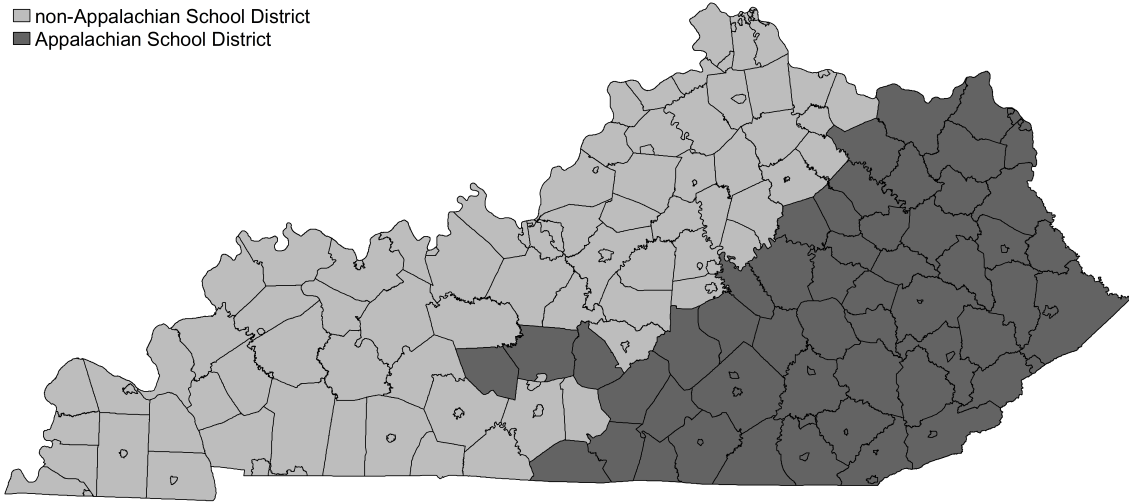


Table 1: Descriptive Statistics of Analytical Sample

	mean	sd	min	max
Teacher sits for the KYPT	0.11	0.31	0.00	1.00
Teacher becomes a school principal	0.04	0.20	0.00	1.00
Teacher's characteristics at initial placement				
Teacher is male	0.22	0.41	0.00	1.00
Teacher is non-white	0.03	0.17	0.00	1.00
Teacher's age	28.97	6.74	21.00	80.00
Teacher is certified in math or science	0.19	0.40	0.00	1.00
School year of teacher's first year	1995.56	5.29	1987.00	2004.00
Initial placement district's characteristics				
Appalachian district	0.34	0.47	0.00	1.00
Total district enrollment	14043.94	25269.28	130.00	99544.00
Percent district enrollment non-white	9.94	12.00	0.00	76.32
County per capita income (in \$1k R2000)	20.80	5.36	8.95	35.29
County population density	32.29	50.04	2.07	181.72
Observations (unique teachers)		19,254		

Table 2: Logistic regression results
Dependent Variable: Teacher becomes a school principal

	OR (SE)
Initial employment in Appalachian district	0.705* (0.141)
Teacher is male	4.111*** (0.419)
Initial employment in Appalachian district x Teacher is male	1.756*** (0.282)
Teacher is non-white	1.813** (0.436)
Teacher's age at initial employment	0.946*** (0.007)
Teacher is certified in math or science	1.023 (0.094)
Logged total district enrollment	0.952 (0.059)
Percent district enrollment non-white	0.992 (0.006)
County per capita income (in \$1k R2000)	0.953** (0.019)
County population density	1.004* (0.002)
Constant	0.637 (0.385)
Year and region indicators	Yes
Observations (unique teachers)	19,254

Exponentiated coefficients; Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

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Table 3: Predicted probabilities of becoming a principal by gender and district Appalachian status

	Male	Female
Appalachian District	.134	.022
Non-Appalachian District	.084	.023

Figure 2: Predicted probabilities of becoming a principal by gender and district Appalachian status

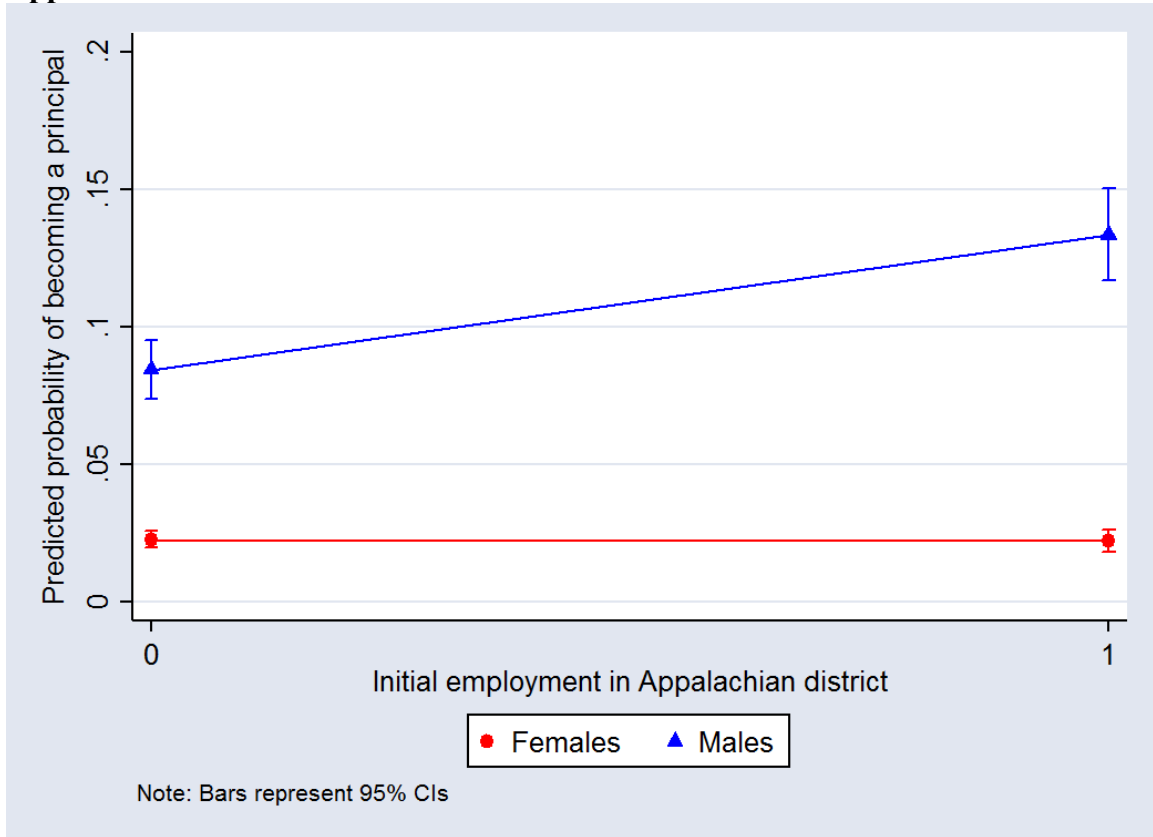


Table 4: Logistic Regression Results
Dependent Variable: Teacher sits for the KYPT assessment

	OR (SE)
Initial employment in Appalachian district	0.809* (0.100)
Teacher is male	3.921*** (0.252)
Initial employment in Appalachian district x Teacher is male	1.224** (0.123)
Teacher is non-white	2.296*** (0.327)
Teacher's age at initial employment	0.953*** (0.004)
Teacher is certified in math or science	1.092 (0.065)
Logged total district enrollment	0.951 (0.036)
Percent district enrollment non-white	0.995 (0.004)
County per capita income (in \$1k R2000)	0.978* (0.012)
County population density	1.002 (0.001)
Constant	0.662 (0.240)
Year and region indicators	Yes
Observations (unique teachers)	19,254

Exponentiated coefficients; Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Preliminary: Please Do Not Cite Without Author Permission

Table 5: Predicted probabilities of sitting for the KYPT assessment by gender and district Appalachian status

	Male	Female
Appalachian District	.288	.0817
Non-Appalachian District	.216	.0685

Figure 3: Predicted probabilities of sitting for the KYPT assessment by gender and district Appalachian status



Table 6: Logistic regression results
Dependent Variable: Teacher becomes a school principal (Subsample of only KYPT assessment takers)

	(1) OR (SE)	(2) OR (SE)
Initial employment in Appalachian district	0.726 (0.191)	0.737 (0.194)
Teacher is male	1.504 ^{***} (0.195)	1.525 ^{***} (0.199)
Initial employment in Appalachian district x Teacher is male	1.728 ^{***} (0.348)	1.716 ^{***} (0.346)
Teacher is non-white	1.061 (0.305)	1.124 (0.324)
Teacher's age at initial employment	0.976 ^{**} (0.010)	0.975 ^{**} (0.010)
Teacher is certified in math or science	0.900 (0.104)	0.875 (0.102)
Logged total district enrollment	0.983 (0.076)	0.977 (0.077)
Percent district enrollment non-white	0.991 (0.008)	0.991 (0.008)
County per capita income (in \$1k R2000)	0.969 (0.024)	0.968 (0.025)
County population density	1.005 [*] (0.003)	1.005 [*] (0.003)
Teacher takes KYPT assessment multiple times		0.906 (0.139)
Natural log of teacher's KYPT assessment score		14.852 ^{***} (12.450)
Constant	4.359 [*] (3.375)	0.000 ^{***} (0.000)

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Year and region indicators	Yes	Yes
Observations	2,120	2,120

Exponentiated coefficients; Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

Preliminary: Please Do Not Cite Without Author Permission

Table 7: Predicted probabilities of becoming a principal conditional on sitting for the KYPT assessment by gender and district Appalachian status

	Male	Female
Appalachian District	.451	.254
Non-Appalachian District	.392	.308

Figure 4: Predicted probabilities of becoming a principal conditional on sitting for the KYPT assessment by gender and district Appalachian status



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