Abstract Title Page

Title: Estimating Cause: Teacher Turnover and School Effectiveness in Michigan

Author(s):

Venessa Keesler, Michigan State University
rosevene@msu.edu

Barbara Schneider, Michigan State University
bschneid@msu.edu

Abstract Body

Background/context:

Teacher supply is a pressing educational policy issue for states. States must regularly address questions such as, "Do we have enough teachers to meet our needs? Do we have certain subjects that lack teachers?" Perhaps most importantly, however, states must address the extent to which their teacher supply issues relate to student achievement and school effectiveness.

While teacher supply can be considered from a labor market perspective, it is also important to consider the organizational nature of teacher labor force composition within each school. Ingersoll (2001) has argued that teacher turnover is an organizational feature of a school, and as thus, contributes to the culture of the school itself. Schools have distinct organizational conditions, which relate to teacher turnover and staffing problems, all of which affect performance (Ingersoll & Perda, 2009). A body of evidence suggests that the community of the school has important implications for school performance and effectiveness (Coleman & Hoffer, 1987; Rosenholtz, 1989; Bryk, Lee, & Smith, 1990). Following this research tradition, it becomes important to understand how teacher supply and demand is specific to each school, and how a school-specific supply and demand of teachers relates to other characteristics of that school.

In the teacher supply and demand literature, the bulk of the research actually focuses more heavily on calculating teacher supply than on estimating demand. The general formula for estimating supply, as outlined by NCES, is calculated as the sum of continuing teachers, teachers moving from school to school, new (first-time) teachers and re-entrants into the profession (Boe & Gilford, 1992). These supply calculations are focused on identifying all of the potential streams of teachers into the teaching force. However, since a substantial amount of the "supply" of teachers is derived from those who are retained from the previous year, an adequate estimation of supply demands strongly on the ability to model retention and attrition (Boe & Gilford, 1992). It is not surprising, then, that much of the teacher supply research focuses on teacher turnover, attrition and retention.

A key aspect of undersupply is teacher turnover, defined here as the rotation of teachers into and out of a school. This is slightly different than teacher attrition, which is more concerned with teachers leaving the profession entirely. Turnover or "churn" can be more localized to a specific school, and I argue that it is an organizational characteristic of the school itself that interacts with other key school characteristics. The local nature of teacher turnover can lead to localized teacher shortages, whereby schools that may already struggle with staffing are further challenged by a high turnover of teachers from year to year.

From an organizational perspective, however, attrition and turnover have similar effects on the schools in that both represent a decrease of staff that must be replaced (Ingersoll & Perda, 2009). Teacher turnover and attrition are important issues for states, districts and schools. Teacher attrition is costly to districts and schools; studies place the cost of hiring a new teacher at approximately $10,000 (Barnes, Crowe, & Schaefer, 2007; Milanowski & Odden, 2007; Reichardt, 2006). Teacher attrition disrupts school community and hinders school improvement efforts (Ingersoll, 2001). Finally, some evidence suggests that when qualified teachers leave, they are replaced by less qualified teachers (Reichardt, 2008). More than half of teacher turnover is migration from one school to another (Ingersoll, 2001).

One perspective in teacher supply research suggests that the teaching profession is plagued by abnormally high rates of turnover within schools, as well as high rates of attrition

from the profession entirely (Ingersoll, 2001). However, others have found that when comparing teachers to comparable fields, such as nurses, social workers and accountants, teacher turnover is not significantly higher (Harris & Adams, 2007). Stinebrickner (2002) found that exit rates are not lower in other professions, and that non-teachers change professions more but non-teachers also return to the workforce more quickly after an exit than teachers do. The crux of this argument appears to revolve primarily around pre-retirement attrition. Harris & Adams (2007) suggest that teacher attrition is lower, but that there are larger numbers of early retirements than in other professions. There is also some evidence to suggest that the distribution of teacher attrition is U-shaped, with high attrition among older and very young teachers (Grissmer & Kirby, 1997; Harris & Adams, 2007).

In general, teachers appear to leave the teaching force for a number of reasons: salary (Dolton & van der Klaauw, 1999; Shen, 1997; Loeb, Darling-Hammond, & Luczak, 2005); a feeling of a lack of empowerment or influence (Shen, 1997); and family factors, such as childbearing, especially for female teachers (Stinebrickner, 1998; 2002). There is debate about whether salary or organizational factors are more important: Stinebrickner (1998) finds that salary considerations are more important than organizational characteristics, while Hanushek, Kain, & Rivkin (2004) find that teacher attrition is related more to being in schools with lower-achieving and minority students than to salary considerations.

From the perspective of school organizational characteristics, the type of schools that tend to have high turnover are: those with high rates of student poverty (Shen, 1997; Smith & Ingersoll, 2004; Hanushek et al., 2004); small schools (Stockard & Lehman, 2004; Ingersoll, 2001); schools with high numbers of minority students (Carroll, Reichardt, & Guarino, 2000; Hanushek et al, 2004); charter schools (Smith & Ingersoll, 2004); those with a high proportion of inexperienced teachers (Shen, 1997); private schools (Smith & Ingersoll, 2004; Ingersoll, 2001; Whitener et al., 1997; Arnold, Choy & Bobbitt, 1993) and urban schools (Lankford et al, 2002). These characteristics can all be considered part of the "working conditions" that play a role in supply and demand in labor market theory (Guarino, Santibanez, & Daley, 2006). Several analyses found that working conditions, particularly large class size, facilities problems, multi-track schools, and a lack of textbooks, are more important than salary when determining teacher attrition (Loeb, Darling-Hammond, & Luczak, 2005; Futernick, 2007; Hanushek, Kain & Rivkin, 2004).

Purpose / objective / research question / focus of study:

The purpose of this paper is investigate issues related to within-school teacher supply and school-specific teacher turnover within the state of Michigan using state administrative data on Michigan's teaching force. This paper 1) investigates the key predictors of teacher turnover and mobility, 2) develops a profile of schools that are likely to experience higher rates of teacher turnover, and most importantly, 3) investigates the effect of high teacher turnover as measured by student achievement and school AYP status. Using propensity scores, this analysis seeks to isolate the potential treatment effect of lowering teacher turnover in schools that are plagued by high teacher turnover levels.

Teacher supply is defined here as specifically the within-school number of FTEs in each subject area in a given year. Teacher turnover, or "churn," is the rate at which teachers leave each school, but does not reference whether or not teachers leave the profession. Teacher attrition and retention refers to teachers leaving the teaching profession, or "stopping out" and returning at a later point.

There are two important limitations that it is important to acknowledge. The first is that these analyses do not address issues related to teacher quality, although there is a growing body of evidence that suggests that the quality of a teacher is significantly related to student performance and growth (Rivkin, Hanushek, & Kain, 2000; Sanders & Rivers, 1996, Clofelter, Ladd, & Vigden, 2007). One reason is that there are not adequate measures of teacher "quality" in the dataset, even if such a set of agreed-upon measures existed. While there is information regarding teacher licensure, this is not a good proxy for quality. Thirty-seven percent of teachers (46, 162 teachers) have professional licenses, 20% (24,385) have provisional licenses, and 25% have 18/30 hour continuing licenses (30,164). Clearly, these are not meaningful distinctions with regards to quality, as there are sure to be variations in quality among the tens of thousands of teachers who hold the same license. Secondly, this supply calculation does not explicitly include compensation levels, as suggested by some teacher supply and demand models. In Michigan, data on teacher compensation are not available at the present time (Pantal, Podgursky, Ehlert, Hull, & Schneider, 2008).

Setting:
This research is conducted using the Registry of Educational Personnel (REP) database, an administrative longitudinal database collected and maintained by the state of Michigan.

Population / Participants / Subjects:
The entire teaching force in the state of Michigan is included in this analysis. One key benefit of this dataset is that it contains the whole universe of teachers, which reduces the uncertainty inherent when conducting inferential statistics on a sample of the population.

Intervention / Program / Practice:
It is not feasible or ethical to undertake a randomized control trial with the whole population of Michigan schools, whereby some schools were assigned to have high rates of turnover and others were assigned to have low rates of turnover. However, it is possible to use a quasi-experimental design, such as a propensity score match, to estimate the effect of the treatment, decreasing teacher turnover.

Research Design:
Using a method to estimate teacher supply and demand developed to help the state of Michigan identify areas of teacher undersupply, teacher supply is generated by summing the number of FTEs within each subject within each school (Keesler, Wyse & Jones, 2008). This calculation provides an accurate depiction of the actual quantity of FTEs who are assigned to a particular school in a given year. However, these current supply calculations do not account for potential teacher attrition; by summing the FTEs taught in a given year and then comparing them with estimated demand, supply may be overestiamted by assuming that it will stay relatively constant. If a school has a particularly high attrition rate, then the number of FTEs will most likely not stay constant, which suggests that each subject-area supply calculation may need to be weighted by school- and subject-specific attrition rates. Therefore, school-specific attrition rates or "churn" are estimated using the longitudinal nature of the available administrative data, which takes into account the fact that turnover is a more localized factor, not necessarily an aggregate one. This is a departure from how other researchers tend to look at attrition (Ingersoll, 2001; Murnane, Singer, & Willett, 1998). Ingersoll and Perda (2009) disaggregate the data and looks

at shortages in specific fields. It is important to underscore that this proposed dissertation work looks at this for specific schools and specific fields, and within science, for specific endorsement-level supply/demand matches (i.e. physics endorsements for physics courses).

To examine the predictors of teacher turnover, a multilevel model is estimated, with teachers nested within schools. The outcome is the predicted probability of an individual leaving a given school. Individual level predictors include demographics, subject assignment and license type. School-level predictors include school demographics, and more importantly, the school-specific turnover rate, in order to investigate whether or not the school's level of turnover is related to individual teacher decisions to leave. Regression analyses are conducted on key predictors of school-level turnover rates, in order to isolate the factors that are most correlated with teacher turnover in a given school. The end result is a profile of both the types of schools that are likely to have high turnover rates, as well as the type of teacher that is likely to leave a given school and how school-level organizational characteristics may interact with that decision.

If teacher turnover is an integral part of the organizational culture and is related to student achievement as hypothesized, then decreasing teacher turnover should increase student achievement. To evaluate this empirically, a propensity score matching approach will be used again. First, the predicted probability of having low turnover will be estimated (with the cut-off for "low turnover" estimated based on the distribution of turnover rates for all schools). Then, schools will be matched on their propensity for low turnover. Finally, using a multinomial logit predicting membership in each of the quadrants above, the effect of low turnover will be estimated by comparing quadrant membership among schools that have equal probabilities of having high turnover but different actual turnover rates. In other words, for schools who look similar on all characteristics but who have low rates of turnover or high rates of turnover, what would the potential effect be of lowering the turnover rate in a given school in terms of both undersupply and AYP status?

Data Collection and Analysis:

The data in the REP are collected annually, in order to comply with federal regulations. Therefore, there is no new data collection necessary.

Findings / Results:

In related work the topic of teacher supply, undersupply was calculated using a demand formula generated for the state of Michigan by myself and a research team. The formula is:

$$D_i = (ax_i/y)/z \quad (1)$$

where

D_i = number of teachers needed to meet graduation requirements in a subject area
a = proportion of years that the student body is required to take in a given subject
x_i = student enrollment
y = class size
z = number of periods taught per FTE per day[††]

There appears to be an association between schools that are undersupplied and failing AYP. While many schools that are undersupplied are able to meet their AYP requirements, there

[††] See Keesler, Wyse & Jones, 2008, on the IES website (http://ies.ed.gov/ncee/edlabs/regions/midwest/pdf/techbrief/tr_00508.pdf). As this formula and the resulting undersupply calculations are not the key focus of this paper, I will limit my discussion of it here.

appears to be a pattern with respect to schools that are undersupplied and failing AYP. Schools that are undersupplied in all or any one of the four key areas and failing AYP are more likely to be high poverty, high minority, Title I, and/or located in urban areas. Failing to meet AYP targets could be more a function of the demographic profile of the schools than whether a school is undersupplied or not. Although the number of schools that are undersupplied is relatively small, the number of students affected by undersupply is not insignificant. For example, 72,798 students attend the 61 schools that are undersupplied in mathematics and ELA. Moreover, looking at the characteristics of undersupplied schools can help to target resources or potential interventions more effectively. Twenty-five percent (223) of schools are undersupplied in math, seven percent (64) are undersupplied in English/language arts, five percent (41) are undersupplied in science, and four percent (39) are undersupplied in social studies (see Table 1). Fifty-two schools are undersupplied in both math and ELA, which represents 6% of the total. A smaller number (9) are undersupplied in all core areas.

Figures 1 and 2 in Appendix B show the relationship between being undersupplied in FTEs in mathematics and ELA and the percent of the students meeting AYP targets for urban, high minority, and high poverty schools. These figures show that most of these schools are not making AYP targets and that if schools are undersupplied in FTEs it is very unlikely that the schools with these characteristics will meet AYP. For ELA, there are only five schools that are undersupplied in FTEs that are also able to meet AYP. There is only one school that is undersupplied in FTEs meeting the AYP targets for mathematics that are urban, high poverty, and high minority. Schools with these characteristics that are scoring just above the cut score are likely to have difficulty meeting AYP requirements in the future when the cut scores are raised. What is unclear, however, is the extent to which the undersupply conditions outlined above are related to teacher turnover and mobility—are schools undersupplied because of a constant "revolving door" of teachers? The additional analyses outlined here will investigate that relationship further.

Results from a separate report completed and under review by the state of Michigan find that schools with high proportions of inexperienced teachers (those with provisional licenses) are less likely to pass AYP. All of this suggests that a critical element in the relationship between undersupply and school effectiveness lies in teacher turnover, or the "churn rate" of schools. The analyses outlined here will expand on the preliminary results and provide a more complete picture of the relationship between undersupply, "churn," and school effectiveness.

Conclusions:

Preliminary results clearly suggest that the composition of a school's workforce is related to the school's AYP performance. The evidence also strongly suggests that a key element in this is teacher mobility, which is a malleable factor that a state or district could potentially target resources toward remedying. Given these two elements, the proposed analysis is positioned to provide important policy-relevant information that is actionable for policymakers and that can potentially be utilized to improve school effectiveness.

Appendix A. References

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Appendix B. Tables and Figures

Table 1: Percentage of Schools with an Undersupply of FTEs by MMC Subject Areas
(N=886 schools)

	Percent of Schools with No Undersupply of FTEs	Percent of Schools with Undersupply of FTEs	Percent of the Total High School Population Affected by the Undersupply[1,2]
Core Subjects			
Math	75% (663)	25% (223)	50% (268,031)
English Language Arts	93% (822)	7% (64)	15% (80,794)
Science	95% (845)	5% (41)	10% (51,378)
Social Studies	96% (847)	4% (39)	8% (45,049)
Undersupply of FTEs in Subjects			
Math and ELA	94% (834)	6% (52)	13% (70,619)
All core subjects	99% (877)	1% (9)	2% (12,182)

[1] Total number of students (n= 531,443) is taken from the sum of enrollments of the 886 schools in our analysis
[2] Percentages refer to the percent of students in schools that are undersupplied in the various areas

Figure 1: Undersupply of FTEs in Mathematics versus Percent above Cut Score for MEAP Mathematics Test for urban, high poverty, and high minority schools

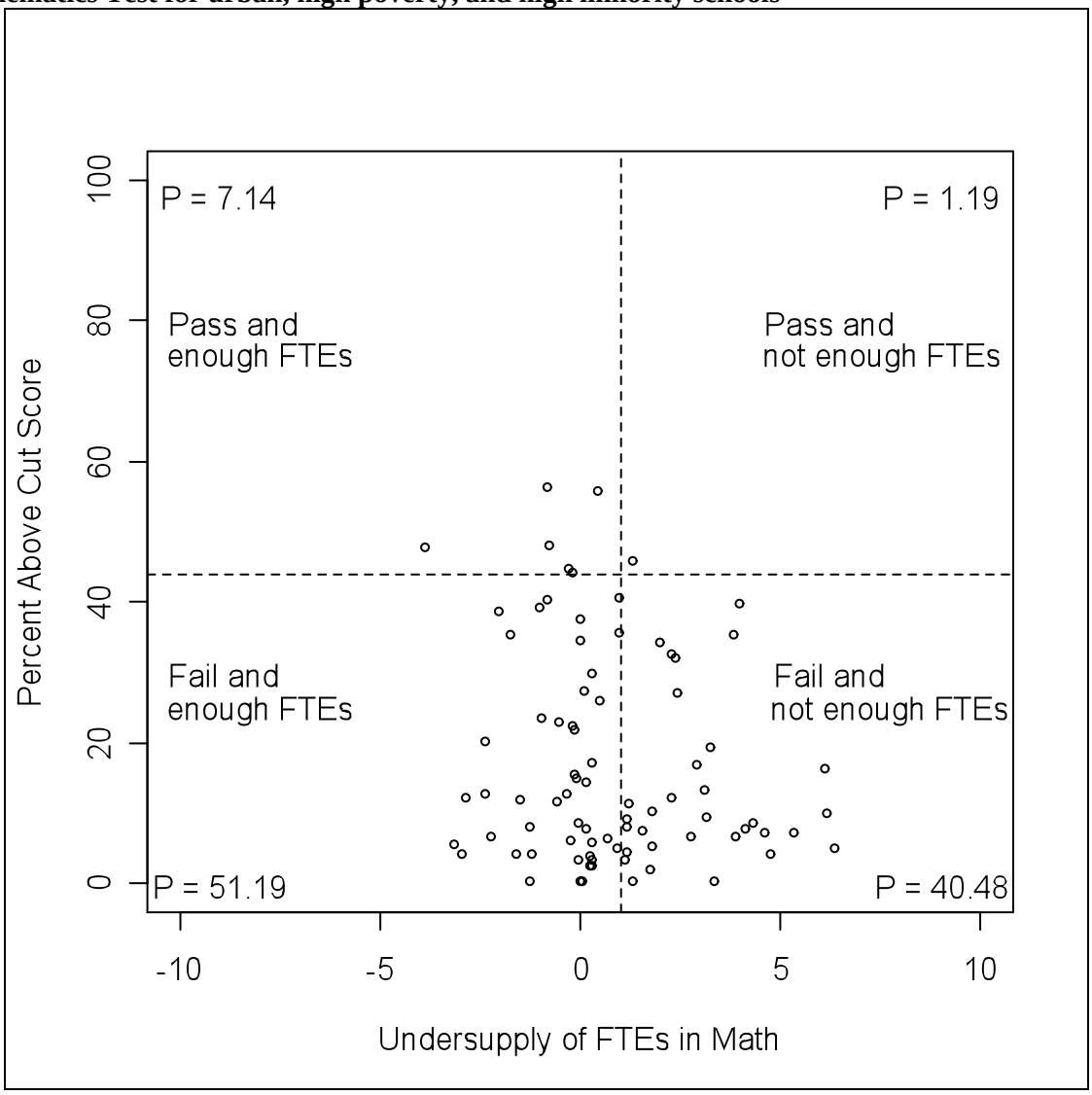

Figure 2: Undersupply of FTEs in ELA versus Percent above Cut Score for MEAP Reading Test for urban, high poverty, and high minority schools