GEORGIA MGP-CHURN RATE STUDY

Interim Report

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INTRODUCTION

The initial goal of this study was to investigate the relationship of teacher mean growth percentiles (MGPs) to a measure of classroom churn, which is an indicator related to the number of student transitions (into a class or out of a class) that take place in the course of a semester or a year. This is of potential interest since the degree of classroom churn presumably impacts on teachers' practices and, ultimately, on how much (relative) progress their students make – at least as determined by the results for those students who contribute to teachers' MGPs. In addition, the relationship of MGPs to a measure of classroom-level socio-economic disadvantage was also investigated. This report presents the study findings, discusses limitations and suggests the need for a follow-up study.

In the exposition below, the teacher serves as the unit of analysis. We carried out a pilot project using schools in districts that have 4 nine-week marking periods. Because data are available at four points, transitions were countable over the three intervening periods. Class student rosters at each transition allowed us to count entries and exits at each period.

Let i index periods ($i = 1 \ldots 3$) and

N = #students in class roster of the first period
E_i = #students entering the class during the period (not included in N)
X_i = #students exiting the class during the period
$T = N + \sum E_i$
$M = \sum X_i + \sum E_i$

Define the churn rate as:

$C = \frac{M}{T} =$ [Total # Transitions]/ [Total # Students appeared in class]

In this case C is an approximation to the actual level of churn, if churn is defined as the ratio of the total number of transitions to the total number of students who appeared in the class during the year[1]. Students who both entered and exited within a given period do not enter this calculation. (Note that if a transactional database were available, a finer grained analysis would be possible.)

[1] Note that this is only one of many ways to define "classroom churn". With this definition, the churn rate can exceed one because the numerator counts the number of transitions; therefore, a student who enters during one term and exits in another term contributes a count of two to the numerator. A rationale for this choice is that all transitions can bring disruption to a class and, moreover, such students do not contribute to the teacher's value-added score but have benefitted from the teacher's attention to their needs.

For our present purpose, the actual values of the churn rates are of less interest than the relative rankings of classes with respect to this indicator. We hypothesized that there would be a negative correlation between churn rates and MGPs. The size of these correlations and their variability within and between schools could inform a judgment of how well MGPs capture differences in effectiveness across teachers and schools that are not confounded with student background characteristics.

DATA

The Georgia Department of Education provided two sets of data for this study. The first is a record of high school students with classes subject to an End of Course Test (EOCT). These records also indicated whether class rosters were recorded at each of four nine-week sessions, or some other period such as semesters. The second dataset included student growth percentiles (SGP) in conjunction with teachers of the EOCT courses and an indicator as to whether a given SGP should be included in determining a teacher's MGP. A testing session field indicated whether students took the EOCT in fall, spring, or summer. This data also included student characteristics such as race, socio-economic status, and English language proficiency.

Teachers were included if they met the following conditions:

- Student enrollment was recorded for nine-week terms
- The teacher had rosters for all four terms
- Five or more SGPs were available for the teacher

For each of the 314 teachers from 120 schools who met these conditions, we computed the churn rate, MGP, and the proportion of students that were recorded as "economically disadvantaged".

VARIATION AMONG TEACHERS

From the sample including teachers with at least one student with an SGP (n=335), well over half had 50 or fewer contributing students. One teacher included in this analysis was recorded with over 250 students.

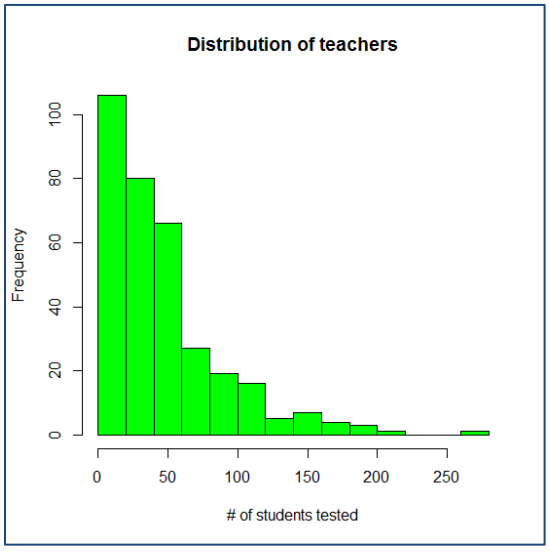

FIGURE 1 - THE DISTRIBUTION OF TEACHERS BY THE NUMBER OF STUDENTS THAT CONTRIBUTED TO THE MGP

Overall the number of teachers declined precipitously with increasing numbers of contributing students (Fig. 1). However, the distribution was relatively flat with roster sizes from 0 to about 30 (Fig, 2). Dropping teachers with fewer than five SGPs meant losing 21 teachers, or about 6% of the sample. After making this adjustment to the sample, the distribution of teachers by MGP remained close to normal with a mean MGP of about 48 (Fig. 3).

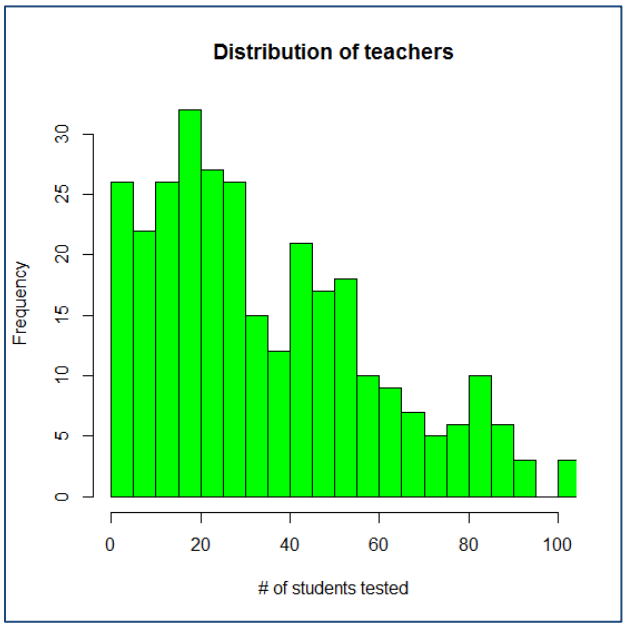

FIGURE 2 - THE DISTRIBUTION OF TEACHERS BY THE NUMBER OF STUDENTS THAT CONTRIBUTED TO THE MGP

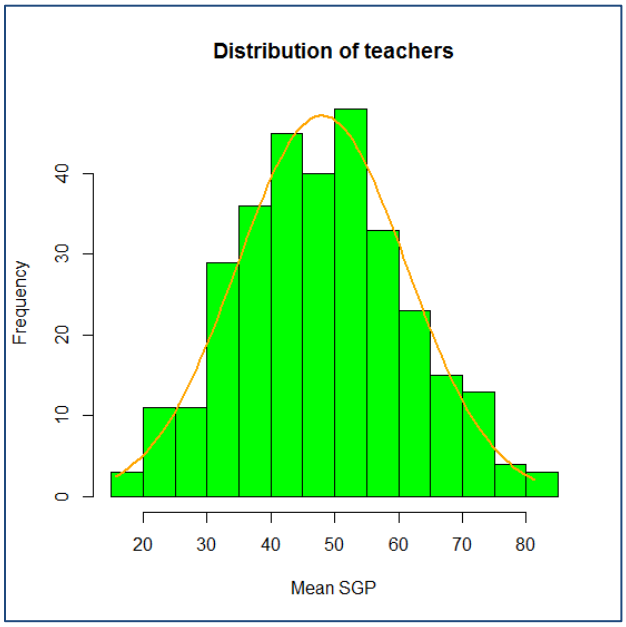

FIGURE 3 - DISTRIBUTION OF SAMPLED TEACHERS BY MGP WITH A FITTED NORMAL CURVE

In the distribution of teachers by churn there are two primary modes (Fig. 4). The smaller of the two occurs at churn rates near zero, the larger mode occurs at just above 1.0. Because churn was computed in the same fashion for all teachers regardless of the type of course schedule, the large group of teachers with churn slightly higher than one is composed mostly of those teachers with semester-long classes, who replace all of their students half-way through the school year. This supposition is confirmed by examining which teachers had students that took the EOCT during the winter. If students took an EOCT in winter then they were most likely enrolled in semester-long courses. As Figure 5 shows, teachers with churn estimates greater than 1.0 were much more likely to have students that tested in winter.

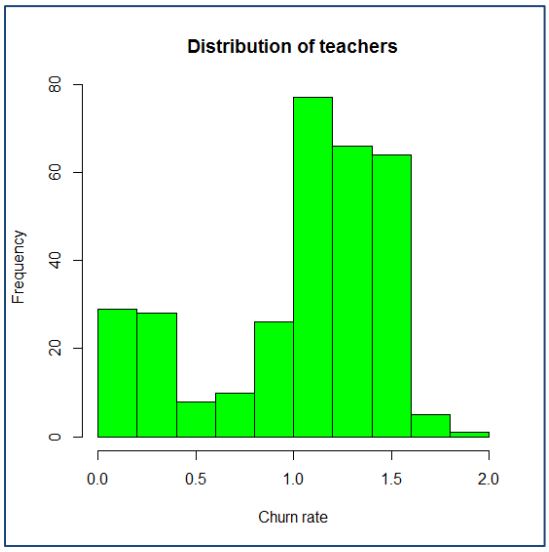

FIGURE 4 - DISTRIBUTION OF SAMPLED TEACHERS BY CHURN ESTIMATE

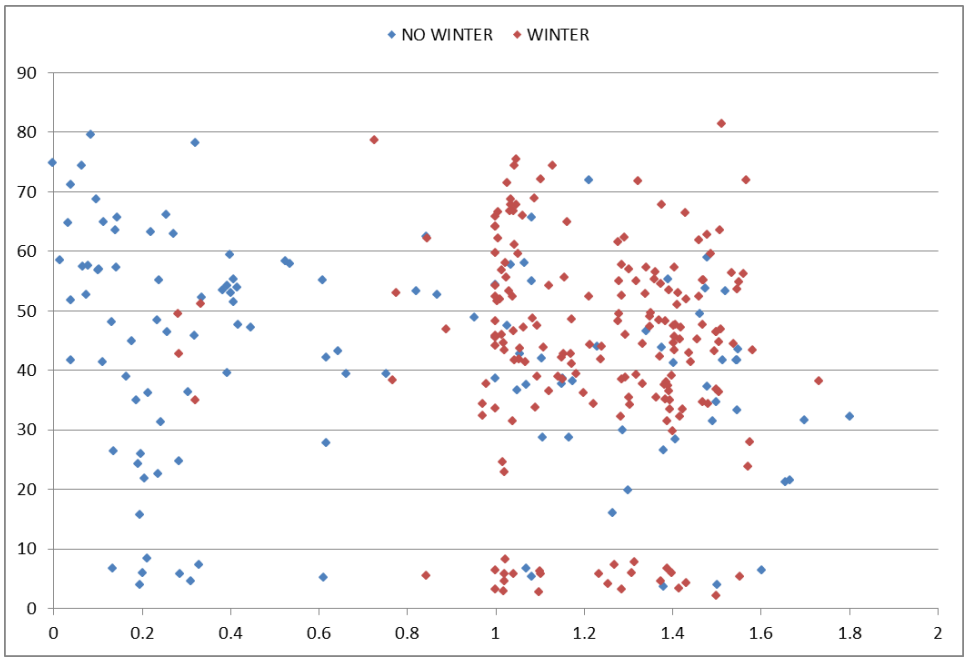

FIGURE 5 - TEACHER MGPS BY CHURN RATES, SHOWING WHETHER EOCT WAS ADMINISTERED IN WINTER

At both the 0.0 and 1.0 modes the distribution remains flat as churn increases, but then suddenly drops off when it has increased by about 0.5, suggesting that there may be some constraint that prevents many churn rates from exceeding that amount.

MODELS

As hypothesized, churn and MGP were negatively correlated, $r = -0.19\ (\text{Pearson's}\ r, \text{weighted})$. When teachers' MGPs are regressed on churn rates, the weighted model estimates are displayed in Table 1. The regression weights are equal to the inverse of the estimated conditional variance for each teacher in the sample. The conditional variances were obtained by first computing the log of each of the squared residuals. Conditional means for this vector were derived by fitting a LOESS smooth line for the transformed residuals on the predictor variable, in this case the churn rate. The value of the conditional variance estimates were then computed as $e^{\hat{q}}$ where $\hat{q}$ is equal to the LOESS-fitted value for each case in the sample.

TABLE 1 - WEIGHTED REGRESSION OF TEACHERS' MGP ON CHURN

	Estimate	St. Error	t –value	p - value
Intercept	53.6	1.81	29.7	<0.001
Churn coefficient	-5.5	1.61	-3.4	<0.001

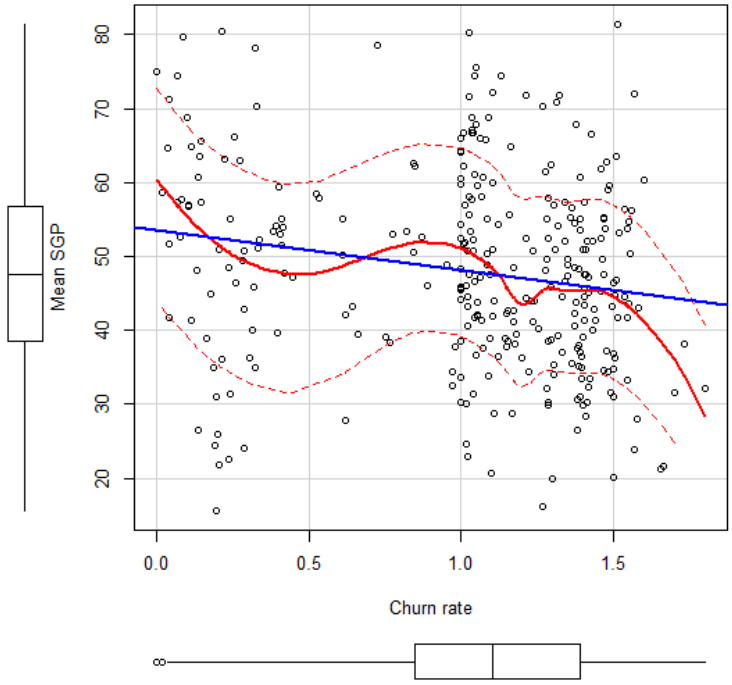

FIGURE 6 - TEACHERS' MGPS PLOTTED ON CHURN RATES WITH THE WEIGHTED REGRESSION LINE IN BLUE AND LOESS SMOOTH LINE IN RED

However, as suggested by the LOESS curve in Figure 6, the difference between teachers with year-long classes and those with semester-long classes obscures the actual character of the relationship between churn and MGP. Accordingly, we then analyzed the two groups of teachers separately[2].

YEAR-LONG VERSUS SEMESTER-LONG CLASSES

When treated separately, a stronger negative correlation (Pearson's $r = -0.36$) was obtained for the year-long classes along with a steeper slope($b = -9.7$). In Figure 7 one can see that there are relatively few teachers in this group with churn rates greater than 0.5. Among teachers with students who tested in winter a small group had churn estimates that were smaller than 1.0. Because of their paucity and distorting influence on the overall model, these cases were excluded in the analyses reported here. As with the year-long class teachers, when this group was treated separately, the slope of the regression coefficient was more strongly negative. However, there was no improvement in the amount of variance accounted for in the model. The two models are compared in Table 2.

TABLE 2 - COMPARISON BETWEEN REGRESSIONS OF MGP ON CHURN BETWEEN SEMESTER- AND YEAR-LONG CLASSES

	Intercept	Coefficient	r^2	df
Semester	63.0	-11.808	0.03	165
Year-long	54.0	-9.691	0.13	119

[2] Teachers were classified as having semester classes if they had some students who were recorded as taking the EOCT associated with that teacher during the winter. This assumes that all year-long classes would be tested only during the spring. The legitimacy of this inference was supported by the fact that nearly all teachers classified for semester classes had churn rates greater than 1. It was also highly consistent with a classification scheme that identified teachers who had students take EOCTs both in winter and spring as semester class teachers.

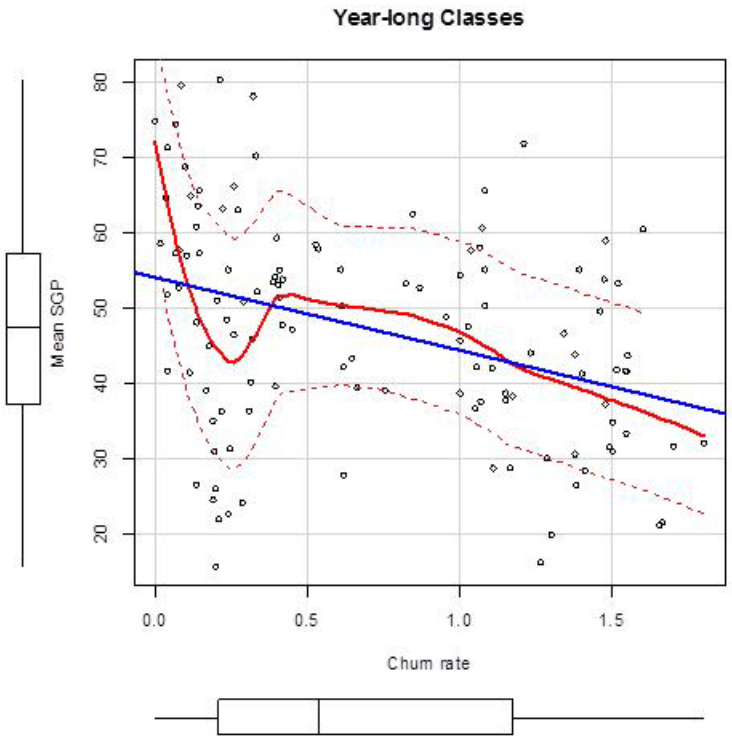

FIGURE 7 - MGP PLOTTED ON CHURN RATE FOR TEACHERS WITH YEAR-LONG CLASSES

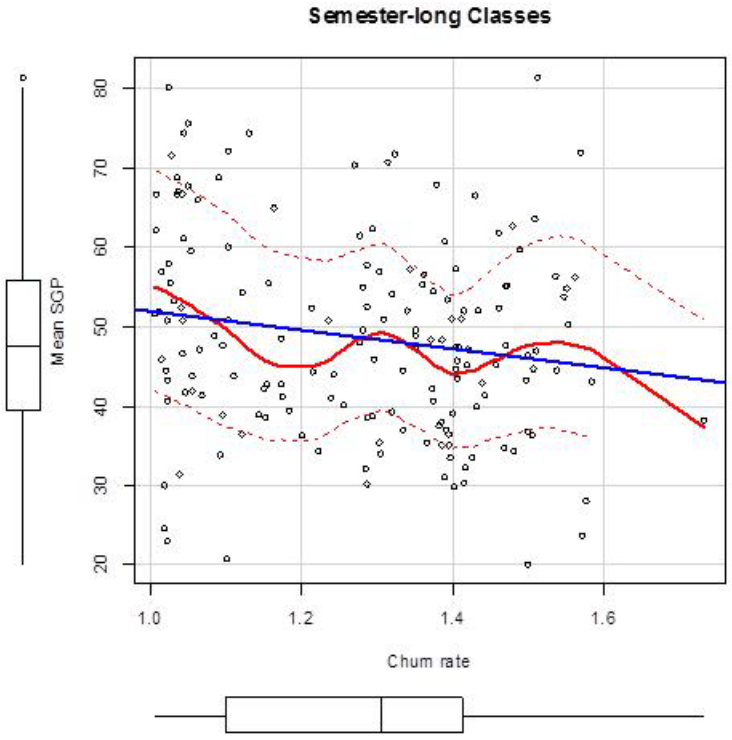

FIGURE 8 - MGP PLOTTED ON CHURN RATE FOR TEACHERS WITH SEMESTER-LONG CLASSES AND CHURN > 1

ECONOMIC DISADVANTAGE

At this point, an obvious question arises: Does the use of churn rates to evaluate the operating characteristics of MGPs add relevant information beyond the variables known to be related to student's academic outcomes? Accordingly, this study also examined a measure of student socio-economic status. In the data provided by the Georgia Department of Education that included individual EOCT SGPs, a dichotomous indicator of student economic disadvantage was available. For each teacher in the sample, we computed the percentage of students that contributed to the MGP, who were recorded as economically disadvantaged.

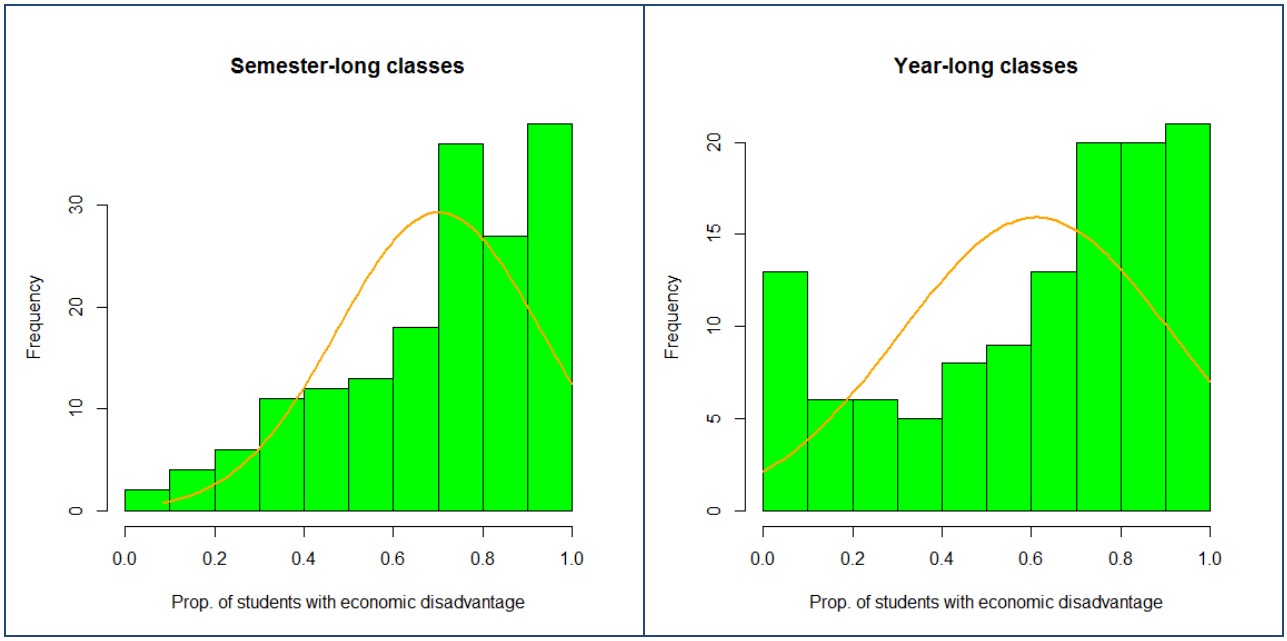

FIGURE 9 - DISTRIBUTION OF TEACHERS BY PERCENTAGE OF STUDENTS WITH ECONOMIC DISADVANTAGE GROUPED BY COURSE LENGTH

Overall, teachers with high rates (75% or more) of economically disadvantaged students were quite common. This was true for both class types. However, among teachers with year-long classes, there was a substantial group with very low proportions of economically disadvantaged students.

As would be expected, the proportions of economic disadvantage were negatively correlated with MGPs. The regression coefficients and correlations when using proportion with economic disadvantage as a predictor of MGP were comparable in size to those found when predicting with churn rate.

TABLE 3 - COMPARISON OF REGRESSIONS OF MGP ON ECONOMIC DISADVANTAGE BETWEEN SEMESTER-LONG AND YEAR-LONG CLASSES

Model	Context	Intercept	Coefficient	SE of Coeff.	R^2	df
Unweighted	Semester	60.2	-16.5	4.08	0.091	165
Weighted	Semester	60.2	-16.8	4.10	0.092	165
Unweighted	Year-long	53.5	-10.8	4.28	0.051	119
Weighted	Year-long	55.0	-13.01	4.25	0.073	119

The LOESS lines suggest that a straight line may be a more appropriate model for semester-long classes than for year-long classes. Note that, for both types, there is considerable variability in MGPs for classes with high proportions of students with economic disadvantage (i.e. 80% and above).

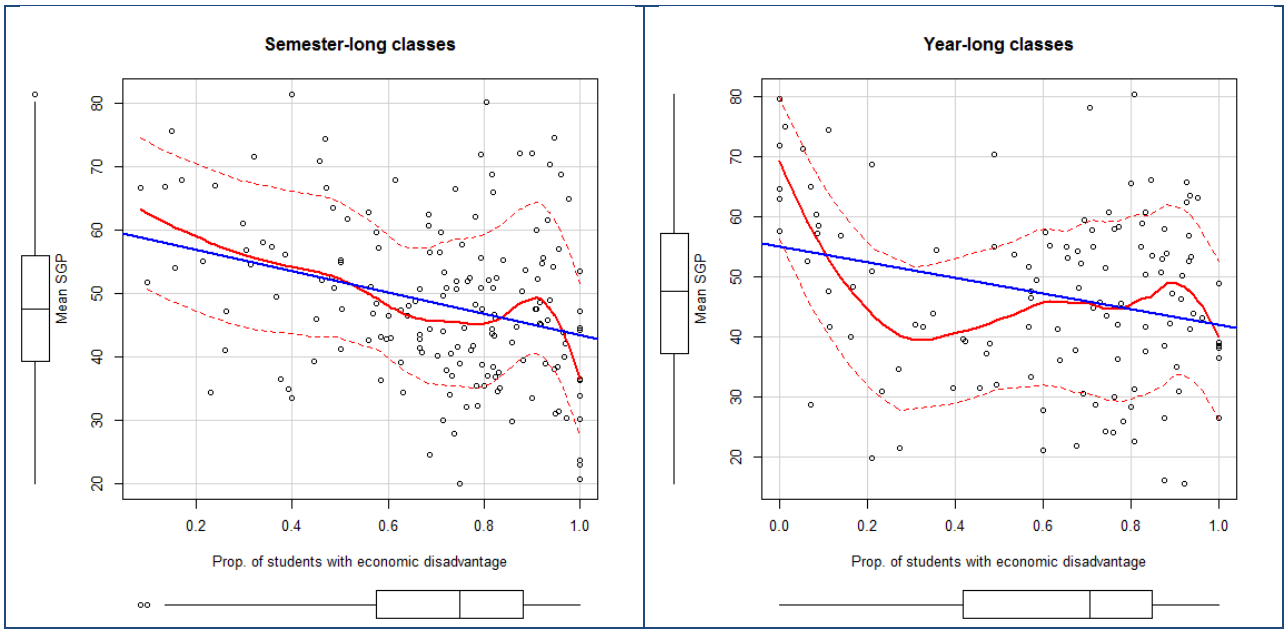

FIGURE 10 - MGPS PLOTTED AGAINST STUDENT ECONOMIC DISADVANTAGE, GROUPED BY COURSE LENGTH. LOESS CURVES IN RED AND WEIGHTED REGRESSION LINES IN BLUE.

Evidently, the utility of the churn rate indicator is dependent on it containing information that is different from other explanatory variables. If economic disadvantage and churn rate are highly correlated, then using churn rate would not contribute to a judgment of the validity of MGPs for teacher evaluations beyond what is known for student socio-economic status. In Figure 11 churn rate is plotted against the percentage of students that are economically disadvantaged. For both semester-long and year-long course teachers, the regression lines are relatively flat and the correlations are quite low (Pearson's $r = 0.08$ for semester and $r = 0.07$ for year-long).

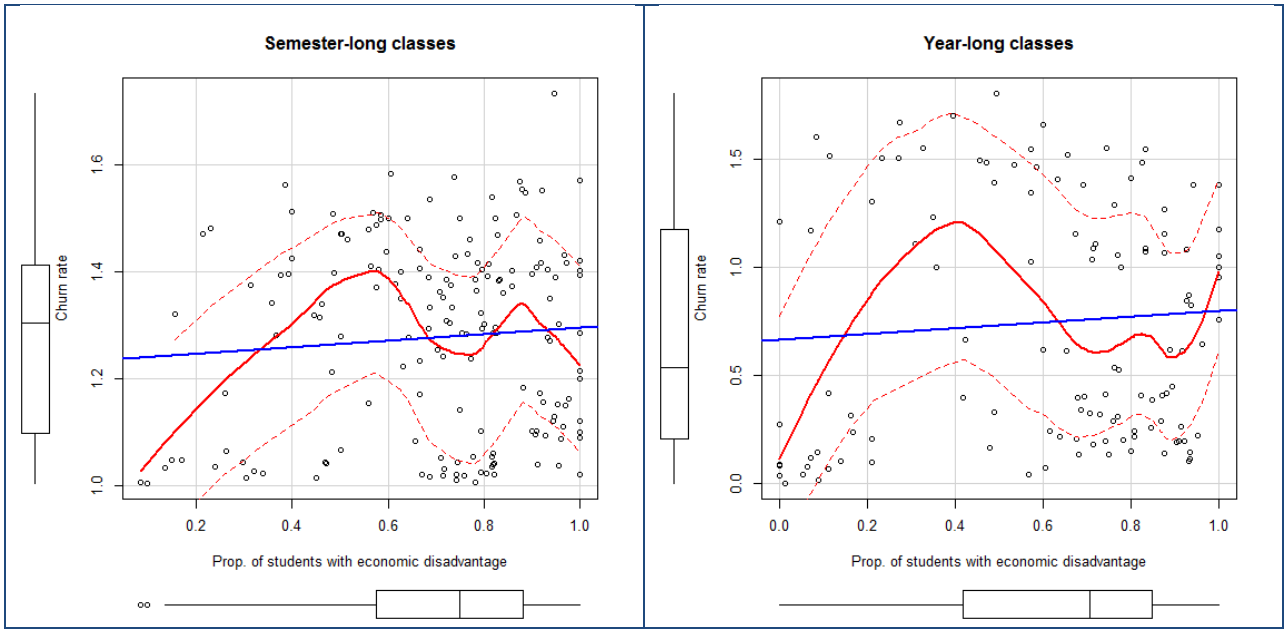

FIGURE 11 - PLOTS OF CHURN RATE AGAINST % ECONOMICALLY DISADVANTAGED, GROUPED BY COURSE LENGTH. LOESS CURVES IN RED AND WEIGHTED REGRESSION LINES IN BLUE.

TABLE 4 - COMPARISON BETWEEN REGRESSIONS OF CHURN RATE ON ECONOMIC DISADVANTAGE BETWEEN SEMESTER- AND YEAR-LONG CLASSES

Model	Context	Intercept	Coefficient	SE of Coeff.	R^2	df
Unweighted	Semester	1.2	0.057	0.061	0.005	165
Weighted	Semester	1.2	0.060	0.061	0.006	165
Unweighted	Year-long	0.65	0.097	0.165	0.003	119
Weighted	Year-long	0.66	0.133	0.166	0.005	119

The low correlations show there is very little relationship between churn rate and economic disadvantage in this data set. Also, as depicted in Figure 11, there is a relatively large cluster of teachers that have both low levels of churn and high proportions of economically disadvantaged students. This finding supports the inclusion of churn rates with this measure of economic disadvantage in examining the operating characteristics of MGPs.

CHURN COMBINED WITH ECONOMIC DISADVANTAGE

The multiple regression models were fit after centering churn rates and the proportions of economically disadvantaged students. For both course types, the negative relationships between MGPs and economic disadvantage and between MGPs and churn rates remained relatively strong in comparison to the relationships between churn rates and economic disadvantage. The year-long group is divided into two very distinct groups by churn rate and two somewhat less distinct groups by economic status while the semester group is split only on churn rates.

TABLE 5 - COMPARISON OF MGP REGRESSIONS ON CHURN AND ECONOMIC DISADVANTAGE BETWEEN SEMESTER- AND YEAR-LONG CLASSES

Model	Condition	Intercept	Churn	% Low-SES	R^2	p
Unweighted	Semester	48.5	-10.9	-15.9	0.11	4.55e-05
Weighted	Semester	48.4	-13.1	-16.3	0.12	1.77e-05
Unweighted	Year-long	46.9	-9.1	-9.9	0.17	1.881e-05
Weighted	Year-long	46.9	-9.1	-11.9	0.19	4.44e-06

When the combined model is compared to the models using churn rate or economic disadvantage alone to predict MGP, the proportion of variance that is accounted for is nearly the sum of that found for the other two models. However, there is a striking difference between the two types of classes, with economic disadvantage being a stronger predictor for the semester-long classes but churn rate stronger for the year-long classes. As Table 6 makes clear, the combined model for the year-long classes is considerably stronger than the one for the semester classes.

TABLE 6 - MULTIPLE R^2 FOR EACH OF THE MODELS AND CONDITIONS

	Semester-long	Year-long
Churn	.03	.13
% Economically disadvantaged	.092	.07
Churn & % Economically disadvantaged	.12	.19

SUMMARY

These analyses indicate an inverse relationship between teachers' MGPs on the one hand, and class churn rates and economic disadvantage on the other. In the case of semester-long classes a 0.5 standard deviation increase in both churn rates and economic disadvantage is associated with a reduction in MGP by 3.0 percentile points. In year-long classes, the 0.5 standard deviation increase in both churn and economic disadvantage is associated with a 4.3 percentile point drop in MGP.

Overall these findings suggest that it should be worthwhile to further explore the relationships among MGPs, churn rates and economic disadvantage (see Figs 12 and 13). However the results should be considered very preliminary in light of the paucity of available data with sufficient detail on class transitions. Not only are the sample sizes somewhat small, but also the scarcity of schools with four recording periods suggests that teachers included in the analysis may differ from a sample selected at random from the entire state school system. At the least, a larger and more representative sample of high schools, along with more refined transaction data for measuring churn rates, will offer a stronger foundation for evaluating the appropriateness of employing MGPs as indicators of teachers' efficacy.

Note: Were data with the characteristics noted above made available, it should be reasonably easy to conduct analyses parallel to those described here. In addition, we would investigate another statistic of possible interest; namely, the ratio of the number of students contributing to the teacher's MGP to T, the total number of students present in the class at some point during the course. It has also been suggested that we rescale the churn statistic so that it is bounded by unity. This can be done though it is not likely to alter the findings.

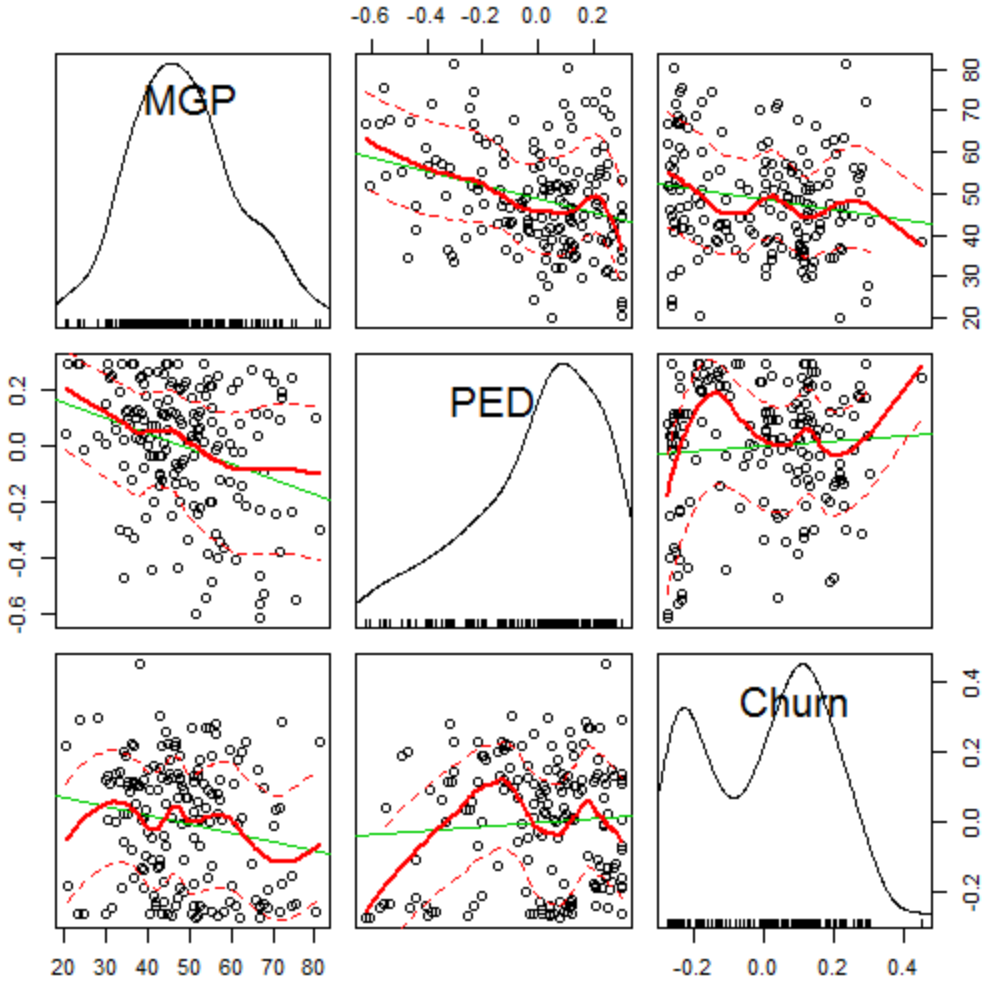

FIGURE 12 - SCATTERPLOT MATRIX FOR MGP, PROPORTION OF STUDENTS WITH ECONOMIC DISADVANTAGE (PED), AND CHURN FOR TEACHERS WITH SEMESTER-LONG CLASSES INCLUDING LOESS CURVES IN RED AND UNWEIGHTED REGRESSION LINES IN GREEN.

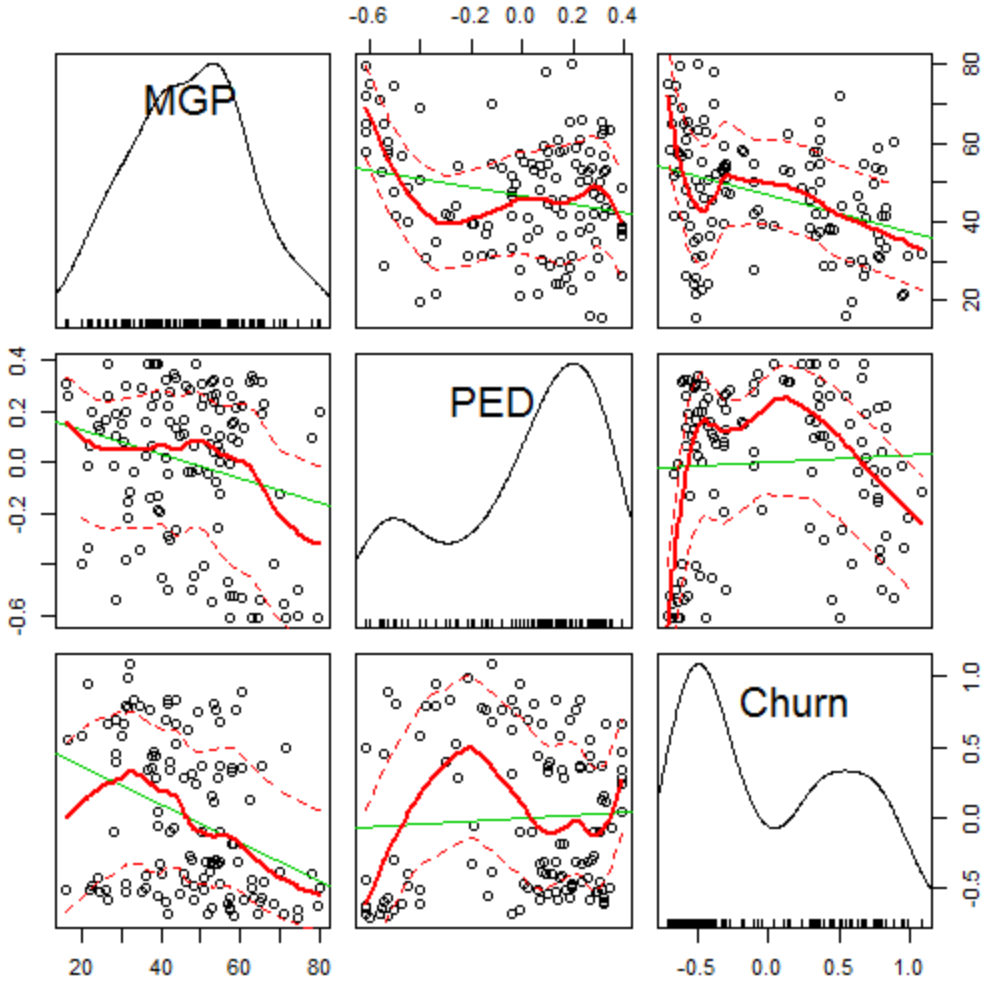

FIGURE 13 - SCATTERPLOT MATRIX FOR MGP, PROPORTION OF STUDENTS WITH ECONOMIC DISADVANTAGE (PED), AND CHURN FOR TEACHERS WITH YEAR-LONG CLASSES INCLUDING LOESS CURVES IN RED AND UNWEIGHTED REGRESSION LINES IN GREEN.