

Working Paper:

Supporting Students at Any Cost? Examining the Dynamics of Teacher Out-of-Pocket Spending, Student Demographics, and Teacher Autonomy

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Nearly every public school teacher in the country regularly spends their own personal funds to purchase classroom supplies, with amounts ranging from tens of dollars to well over a thousand each year. Past descriptive work on the subject suggests that teachers are often attempting to support students in ways their pre-existing school budgets either can't or won't, indicating that higher teacher out-of-pocket spending may be a useful proxy to understand the degree of student need otherwise going unmet in our classrooms. In this report, I explore this link further by examining the relationship between teacher out-of-pocket spending, student race/ethnicity, and self-reported teacher autonomy over classroom instruction and materials, with data from the NCES Schools and Staffing Survey. I find that as the share of racial/ethnic minority students in a school increases, teacher spending also increases, and this relationship holds when accounting for factors like school urbanicity, teacher experience, and interactions with the share of students qualifying for free and reduced-price lunch. For example, teachers in schools with 75-100% racial/ethnic minority students spend about \$130 more per year than peer teachers in schools with 0-24% racial/ethnic minority students - an approximately 31% difference. Indeed, the results offer suggestive evidence that the link between student race/ethnicity and teacher spending is more influential than the well-studied link between student poverty and teacher spending. I also show that higher levels of teacher autonomy are negatively associated with teacher spending at a comparable magnitude, independent of student demographics - in other words, that higher levels of teacher autonomy over classroom supplies predicts substantially lower teacher spending. Altogether, these results offer additional evidence that teacher spending may represent a useful proxy for unmet student need, and that teachers in schools with greater shares of racial/ethnic minority students and lower autonomy may struggle the most to deliver the high-quality instruction they strive towards.

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I. Introduction and Context

The practice of teachers spending their own money on classroom materials is nearly universal. As of the 2014-2015 school year, approximately 94% of all public school teachers surveyed through the National Teacher and Principal Survey (NTPS) reported doing so, and this high prevalence holds true across school levels, school types, and time (Spiegelman, 2018). That said, while nearly all public school teachers spend money out-of-pocket to support their students in this way, the degree of that spending varies *considerably*. Of surveyed public school teachers who spent money out of pocket, 44% reported spending between \$1 and \$250 in the past year, while as much as 7% reported spending over \$1000, against a mean of \$479 and a median of \$297.

So why do teachers choose to spend more or less on their students? While there are a multitude of potential reasons, we have suggestive evidence that teachers are often attempting to cover classroom and student needs otherwise going unmet by their school budgets. For example, the National School Supply and Equipment Association conducted a small-scale survey (n=400) on teacher spending in which 90% of teachers reported spending personal funds to cover basic school supplies, and 85% also reported purchasing instructional materials (Cavanagh, 2013). These figures have steadily increased since 2000-2001, when the percentages were 75% and 56%, respectively. Horace Mann conducted similar surveys of teachers in 2013 (n=1,700) and 2015 (n=1,700), and found in both waves that about 50% of teachers planned projects and lessons that required general classroom supplies not covered by their school budget. In fact, 80% of teachers surveyed abandoned at least one planned project due to lack of school funding or available funds from other sources.¹

Prior studies reveal that teachers in higher-poverty schools tend to spend more of their own money, further suggesting that teacher spending may be some function of student need and budgetary capacity in a teacher's school. A report by the National Center for Education Statistics (NCES) revealed that 51% of teachers in the lowest poverty schools (as measured by student free and reduced price lunch eligibility) spent \$250 or more, while 63% of teachers in the highest poverty schools did (Spiegelman, 2018). These results are mirrored by analysis from the Education Policy Institute on the same data, reporting that teachers in low-poverty schools spent an average of \$434 per year, while their counterparts in high-poverty schools spent nearly 21% more at an average of \$523 (García, 2019). This dynamic reflects the possible reality that teachers in higher poverty schools

¹ At the time of writing, the author was unable to obtain the full survey methodology for these studies; these results should be taken with caution, though they remain some of the only data available describing the details of teacher spending behavior. That said, their basic statistics (e.g., average amount of teacher spending, occurrence of teacher spending) generally align with data from NCES in aggregate.

- schools shown to have similar per-pupil funding (Chingos & Blagg, 2017) but more intensive instructional needs (Barnum, 2019) and lower levels of teacher autonomy (Sparks & Malkus, 2015) - strive to meet students' needs out of their own pockets when formal budgets can't accommodate.

If teacher out-of-pocket spending is indeed a proxy for unmet student needs, we would expect it to also correlate strongly with other salient factors related to availability of school resources. Yet despite the growing evidence of, and public outcry about, racial inequities in school funding (EdBuild, 2019; Morgan & Amerikaner, 2018), no study to date has examined the relationship between teacher spending and student racial/ethnic demographics. Closer examination of these dynamics could then offer important and timely empirical insights on the degree of unmet need among racial/ethnic minority students as filtered through the lens of their teachers. In the following report, I conduct descriptive analyses using nationally representative survey data from NCES to address this open question in the literature and analyze: **Do teachers at schools with higher proportions of racial/ethnic minority students spend more money out of pocket than teachers at schools with lower proportions of racial/ethnic minority students?** I further examine whether this relationship is moderated by other factors likely related to teacher spending and student race/ethnicity demographics like teacher salary, teacher experience (Jones, 2015), teacher autonomy, teacher race/ethnicity, student poverty rates, and school urbanicity.

In sum, I find that there is a strong, positive relationship between student race/ethnicity and teacher spending. As the proportion of racial/ethnic minority students in a teacher's school increases, teacher spending also increases. To illustrate, my results indicate that, at schools with 75-100% racial/ethnic minority students, teachers are spending an average of \$130 (in 2019Q4 dollars) more per year than teachers at schools with 0-24% racial/ethnic minority students, and this trend is nearly linear as the proportion of racial/ethnic minority students increases. Given a sample average of \$425 in teacher spending per year, this is a substantial difference of about 31%. I further find that this general relationship remains consistent across a multitude of reasonable model specifications and the inclusion of various control variables, though with mixed rates of precision and statistical significance.

In supplementary analyses, I reveal that greater teacher autonomy over classroom supplies and instruction has a strong, negative relationship with teacher spending, reinforcing the idea that teachers may be responding to perceived budgetary inflexibility with their own dollars. For example, teachers in the top third of the sample in terms of reported autonomy (i.e., higher reported control over classroom instruction and supplies) spend \$113 less than teachers in the bottom third, even

after controlling for student race/ethnicity and poverty, school urbanicity, and teacher experience. Lastly, I find that the aforementioned relationship between student race/ethnicity and teacher spending remains similar in narrative after controlling for the observed relationship between teacher autonomy and teacher spending.

Taken together, the results suggest two broad insights. First, that student demographics – both student race/ethnicity *and* student poverty – seem to be important predictors of teacher spending. Even when controlling for a variety of important and salient covariates with strong relationships to teacher spending, the general trends between these student demographics and teacher spending persist in gesture. Moreover, it appears that while prior literature surfaced a strong relationship between student poverty and teacher spending, student race/ethnicity appears generally more influential on teacher spending than student poverty once the two are carefully considered together. Second, the overall set of results presented here are consistent with the narrative that teacher spending is a useful proxy for unmet student need. To the extent that student race/ethnicity, student poverty, and teacher autonomy over classroom instruction and supplies, are all plausibly related to the abstract concept of higher levels of student need going unmet, the consistent relationship between the aforementioned variables and teacher spending suggests that teacher spending can potentially serve as a useful proxy for this important – but often difficult to measure – concept. Especially in concert with new evidence supporting the notion of teachers as “front-line workers” well-informed of the actual needs in their classrooms (Keppler, Li, & Wu, 2020), school leaders and policymakers may be well-served in listening to teacher input when it comes to budgetary priorities.

The remainder of this report proceeds as follows: Section II reviews my data and analytic approach, Section III walks through selected results in sequence, and Section IV offers discussion and additional interpretation of the results.

II. Data and Analytic Approach

To analyze the relationship between teacher spending and student race/ethnicity, I turn to the NCES Schools and Staffing Survey (SASS) as my primary data source, a product of the U.S. Department of Education Institute of Education Sciences. This nationally-representative survey examines a wide variety of educational dynamics in the United States and serves as the most robust source of data for self-reported out-of-pocket spending among teachers. I focus on the survey waves conducted in the 2007-2008 and 2011-2012 school years, as these were the only years where a question on teacher spending was included.² Moreover, I focus on full-time, traditional public school teachers who reported a non-zero base salary in the survey year, resulting in a final sample size of roughly 61,000 teachers total.³

The SASS, importantly, allows us to link individual teacher responses to a wide variety of relevant data. For this analysis, I use the following variables as specified below:

- **Teacher out-of-pocket spending:** Defined as the number of dollars a teacher reported spending on unreimbursed classroom expenses over the past academic year. When dealing with raw dollar amounts, I adjust for inflation to 2019Q4 dollars. In supplementary analyses, I also scale this variable by teacher school-related income (defined separately, below).
- **Student race/ethnicity:** Defined as the proportion of racial/ethnic minority students in the teacher's school, reported by the school system itself. For ease of analysis and interpretation, as well as to better account for potential nonlinearities, I examine this measure as a binary indicator ("two-group specification") for schools with 0-49% racial/ethnic minority students and 50-100%. This split moreover facilitates analyzing teacher spending patterns by schools that are majority-minority and not. I also examine (with reduced precision) results when using a four-group specification using 0-24%, 25-49%, 50-74%, and 75-100% groupings, as well.⁴

² While the NTPS, a revamp of the SASS, conducted in 2015-2016 also includes data on teacher spending, I was not able to access these data at this time. Note that descriptive analyses of these data indicate that teacher spending trends in 2015-2016 are largely similar to those in 2007-2008 and 2011-2012 (Spiegelman, 2018).

³ This then excludes teachers in non-traditional public schools (e.g., career and vocational schools) or charter schools.

⁴ Ideally, I would be able to examine disaggregated student race/ethnicity. However, the disaggregation of student race/ethnicity groups in these survey data began with the 2015-2016 NTPS, which I was not able to access at this time.

- **Student poverty:** Defined as the proportion of students in the school qualifying for Free or Reduced-Price Lunch (FRPL). I use the same grouping scheme for this variable as described for student race/ethnicity (two-group and four-group), for the same reasons.
- **Teacher’s base salary:** Defined as teacher’s reported base pay for the most recent academic year. Whenever dealing with this and all following income-related variables as raw dollar amounts, I adjust for inflation to 2019Q4 dollars.
- **Teacher’s school-related income:** Defined as teacher’s reported base pay, plus any school-provided bonuses, incentive pay, summer teaching pay, and summer non-teaching pay.
- **Teacher’s yearly income from all sources:** Defined as the sum of all reported income by teachers over the past year, inclusive of non-teaching positions outside of their school, but exclusive of any other household income or wealth (e.g., spouse’s income).
- **Teacher autonomy:** Teachers were asked several Likert-scale questions about their workplace and job, especially on topics related to their own sense of satisfaction and autonomy. I construct a simple averaged measure from the questions related to teachers’ control over instructional decisions and resources in their classroom (e.g., “To what extent do you agree with the following statement? Necessary materials such as textbooks, supplies, and copy machines are available as needed by the staff?”), and then split the sample into terciles (bottom third, middle third, top third) based on this index to indicate teachers with Low, Moderate, and High perceptions of their own autonomy. More information on the exact construction of this variable, and the survey components included, can be found in Appendix VIa.
- **Teacher experience:** Defined as a binary indicator for whether the teacher has three or fewer years of experience, including full- and part-time teaching experience in public and private schools (i.e., novice teacher or not by NCES’s definition).
- **School urbanicity:** Defined in four categories of City, Suburb, Town, and Rural, as is standard among NCES data.⁵

⁵ More detail on urbanicity classifications can be found from NCES here: https://nces.ed.gov/programs/edge/docs/LOCALE_CLASSIFICATIONS.pdf

My analytic approach focuses first on examining the basic relationship between teacher spending and student race, and I progressively introduce additional control measures and estimation strategies to examine whether that relationship persists as other salient confounding factors and covariates are introduced. Importantly, I am not attempting to derive any causality in my approach; I am instead descriptively exploring whether student race/ethnicity serves as a meaningful predictor of unmet budgetary need as proxied by teacher out-of-pocket spending. I approach this analysis primarily using a regression framework, setting teacher spending as the outcome while varying the regressors in the equation. In all specifications, I include a year fixed-effect to account for time-varying trends across the two survey years. Moreover, all regressions are adjusted to account for the survey and sampling methodology underlying the SASS data.⁶ Further details on individual models are described throughout the results section.

Lastly, a complete pre-analysis plan and full replication code can be found at the following GitHub repository: https://github.com/brhkim/teacher_spending_analysis. All analyses as described below were defined in the pre-analysis plan with only minor deviations, driven by data constraints, precision issues, or interpretability concerns, after initial diagnostic analyses on the restricted SASS data itself.

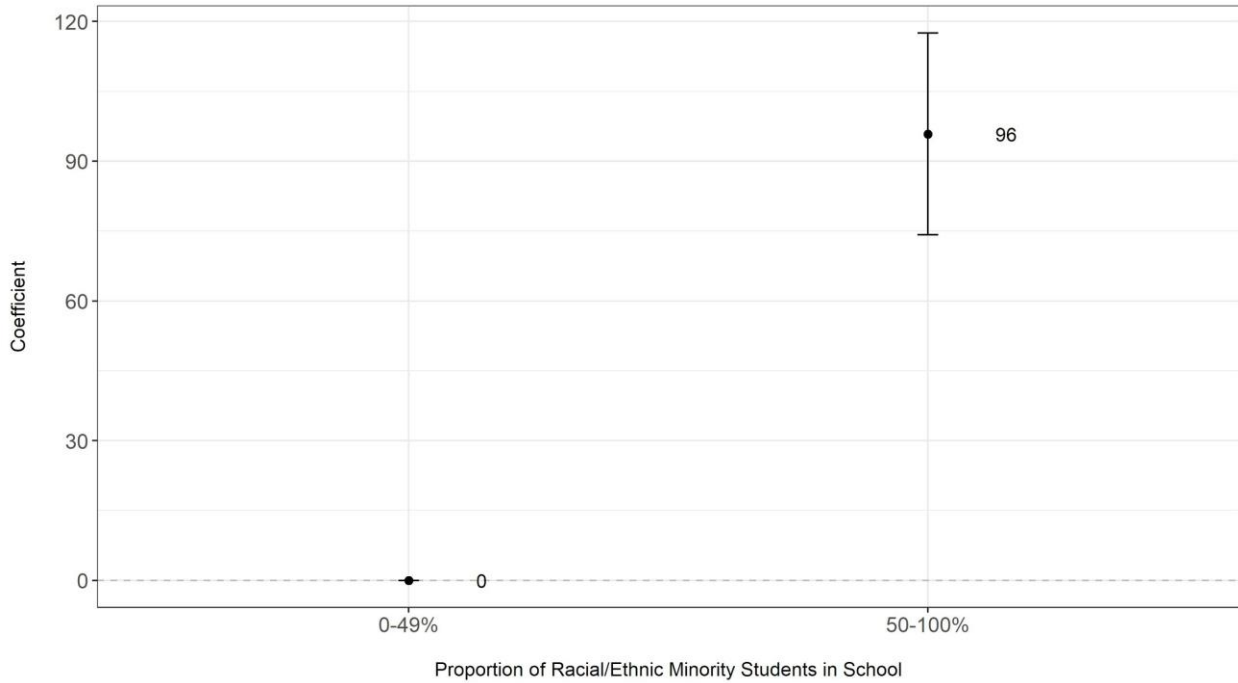
⁶ To be explicit: I ensure that all responses are properly weighted according to the provided sampling weights, and I ensure that all the standard errors reported here are adjusted with the Balanced Repeated Replication technique using the replicate weights directly provided by NCES. These adjustments are all per direct recommendations by NCES in their data manuals for the SASS.

III. Results

IIIa. Teacher Spending and Student Race/Ethnicity

To begin, I first explore the most basic relationship between our two primary variables of interest, teacher spending (in 2019Q4 dollars) and student race/ethnicity demographics (two-group specification), and progressively complicate the model afterwards. Figure 1 below displays the results of this simple regression as a “coefficient plot,” where each point represents a regression coefficient estimate for the corresponding race/ethnicity group on the x-axis, and its height on the y-axis represents the size of that coefficient estimate (in dollars, noted also by the numeric label adjacent to each point). The extruding lines then represent the 95% confidence intervals for each coefficient estimate point. Because this is a regression and the student race/ethnicity variable is only a two-category variable, the 0-49% group is mechanically set to zero, and the 50-100% group’s coefficient estimate is *relative* to the 0-49% group - thus, the 0-49% group is not actually spending \$0 on their students, but their level of spending is taken as the baseline for the purposes of this analysis. To interpret the graph, we observe that teachers in schools with 50-100% racial/ethnic minority students spend an average of \$96 more than teachers in the 0-49% group, and this result is highly statistically significant. With a mean of \$425 in spending across all in-sample teachers, this difference is substantively large at 23%.

Figure 1. Teacher Spending in 2019Q4 Dollars and Student Race/Ethnicity - Two Group Specification (n = 61,000)

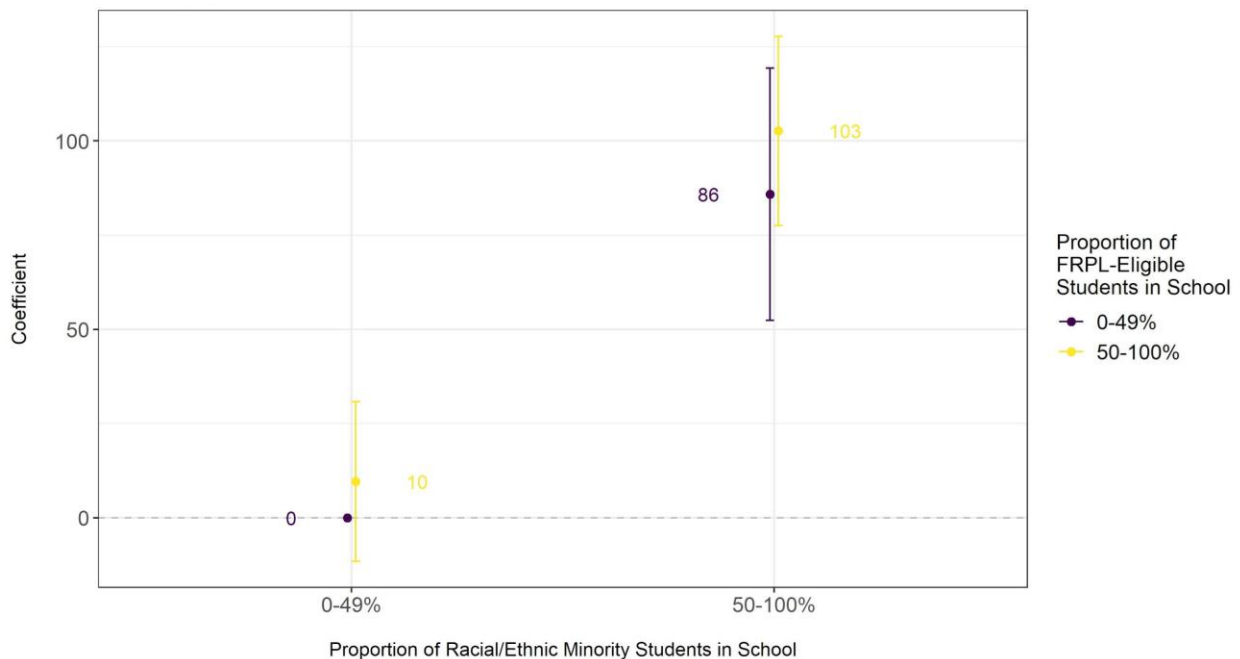


Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

That said, it may be valuable for us to consider additional covariates related to both teacher spending and student race/ethnicity as well. Again, I am not attempting to derive causality between student race/ethnicity and teacher spending, but these analyses could offer helpful insights about the extent to which related variables influence the relationship observed above. To begin, we know from prior research there also exists a strong relationship between student poverty and teacher spending. Because we know that student poverty and student race/ethnicity often trend together, simply controlling for both at once may artificially deflate our estimates on either variable. Instead, I opt to create an exhaustive interaction term of the two variables. This has the effect of looking at how higher student poverty relates to teacher spending *within* each student race/ethnicity group, and vice versa. We can think of this as essentially disaggregating each of the points displayed in Figure 1 into two new points, one to represent each underlying student FRPL eligibility group. Figure 2 displays the results of this new regression specification, mirroring the format of Figure 1. The reference group mechanically set to zero is now teachers in schools with 0-49% racial/ethnic minority students *and* 0-49% FRPL-eligible students. Moving from left to right, we see that teachers in

schools with 0-49% racial/ethnic minority students and 50-100% FRPL-eligible students spend roughly the same amount as our reference group, as the difference between the two is small at \$10 and not statistically significant. Then, we observe that teachers in schools with 50-100% racial/ethnic minority students and 0-49% FRPL-eligible students are spending \$86 more out of pocket than the reference group. Finally, teachers in schools with 50-100% racial/ethnic minority students and 50-100% FRPL-eligible students spend the most with an estimate of \$103 over the reference group.

Figure 2. Teacher Spending in 2019Q4 Dollars and Student Race/Ethnicity Interacted with Student FRPL Eligibility Rates - Two Group Specification (n = 60,400)



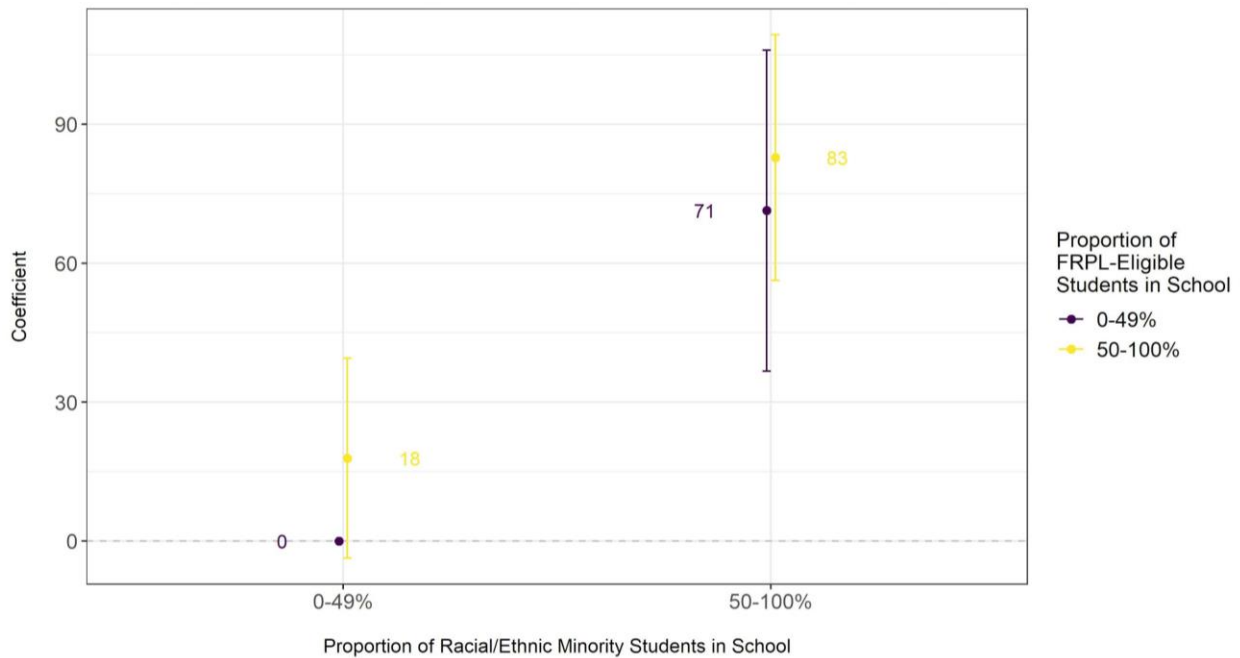
Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

This figure reveals two interesting trends. First, student race/ethnicity seems to matter substantially more for teacher spending than student FRPL eligibility in this specification: differences across student racial/ethnic minority groups are large and statistically significant when holding student FRPL rate constant, while differences across student FRPL groups are small and not statistically significant when holding student racial/ethnic minority group constant (e.g., that \$86 is not significantly different from \$103, nor \$0 from \$10). That said, FRPL-eligibility still seems to

matter to some extent, even if non-significant. We will see that the general contours of these results hold across nearly all following specifications I introduce.

For example, Figure 3 displays the results of the same regression as Figure 2, but accounting for teacher experience and school urbanicity - two variables which may also be related to teacher spending and student demographics. The point estimates for the 50-100% racial/ethnic minority group shift slightly downward: from \$86 to \$71 for the 0-49% FRPL-eligible group, and from \$103 to \$83 for the 50-100% FRPL-eligible group. But the narrative of the results remains the same, indicating that this is not necessarily a story driven by early-career teachers more commonly spending their own money (e.g., teachers who have not yet attained tenure, per Jones, 2015) being concentrated in higher-poverty and majority-minority schools, nor factors related specifically to the urbanicity of their school.

Figure 3. Teacher Spending in 2019Q4 Dollars and Student Race/Ethnicity Interacted with Student FRPL Eligibility Rates - Two Group Specification, also Accounting for Teacher Experience and School Urbanicity (n = 60,400)

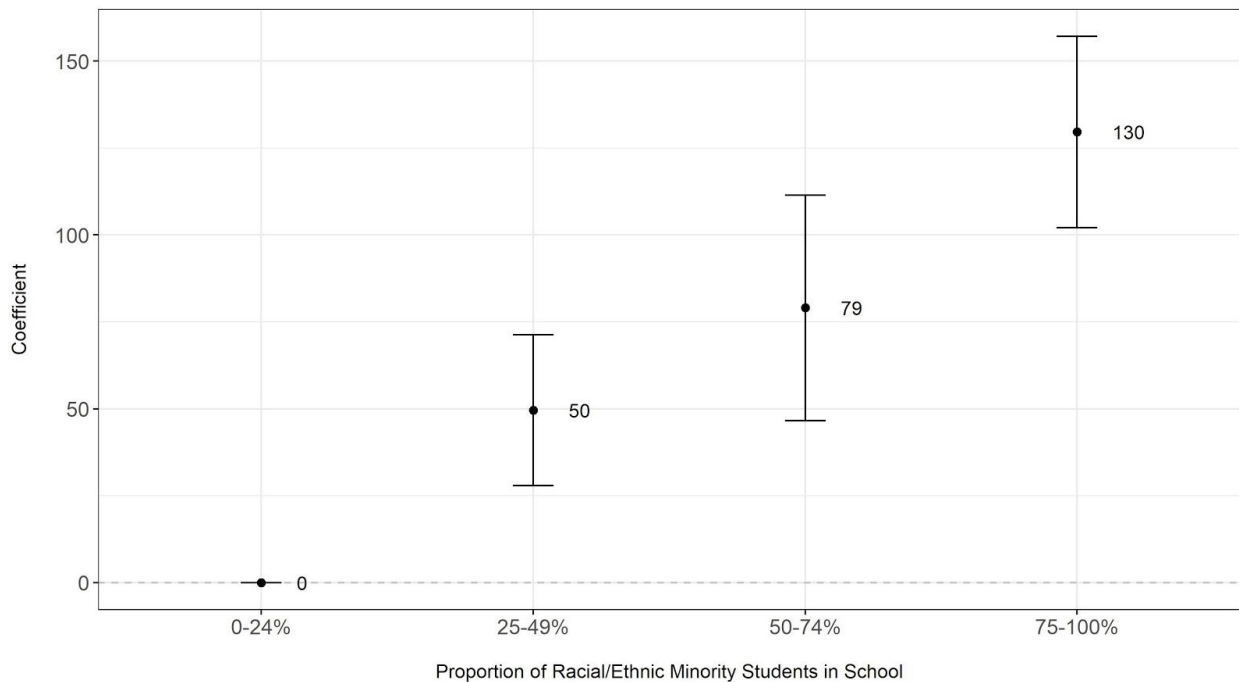


Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

Figure 4 parallels Figure 1 with a simple regression of student race/ethnicity on teacher spending but splitting the student race/ethnicity variable into four groups, rather than two. This approach offers us a more granular look at the variation in spending by student race/ethnicity, without committing to strong assumptions about the functional form of the relationship between the two variables (as would be required to model student race/ethnicity proportion as a continuous, linear regressor). That said, what we gain in granularity, we lose in precision - as the number of teachers in each group are split, the statistical precision of each estimate necessarily decreases. This, too, will be a trend to consider as we review the results of all following specifications.

In this case, the reference group for each coefficient estimate is the group of teachers in schools with 0-24% racial/ethnic minority students. Teacher spending seems to increase regularly as the proportion of racial/ethnic minority students in the teacher’s school increases, up to \$130 more than the reference group for teachers in the 75-100% group. Again, on a sample average of \$425 across teachers, this is markedly higher at an increase of 31%.

Figure 4. Teacher Spending in 2019Q4 Dollars and Student Race/Ethnicity - Four Group Specification (n = 61,000)

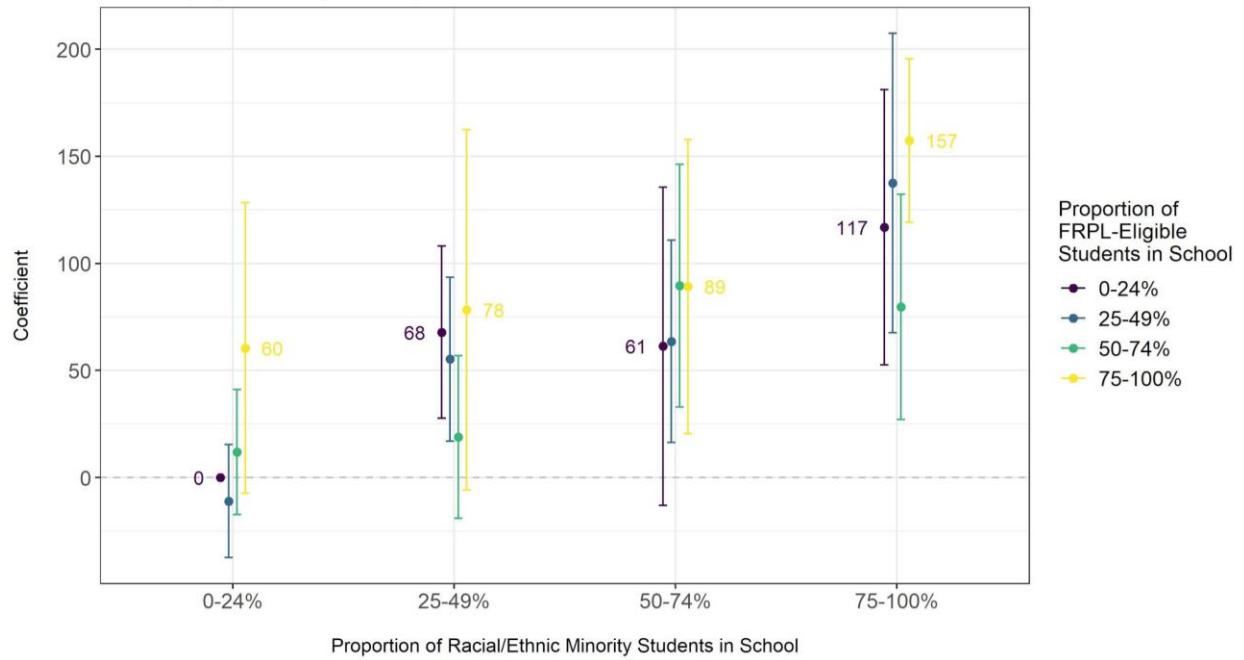


Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

Figure 5 parallels Figure 2, in that it further disaggregates the results of Figure 4 into constituent student FRPL groups by interacting each of the four student race/ethnicity groups with four student FRPL eligibility groups. In this case, the reference group are now teachers in schools with 0-24% racial/ethnic minority students and 0-24% FRPL-eligible students. There are many results to take in here, so it is helpful to walk through a few salient insights. If you look at the four points grouped on the left side of the graph, these points represent teachers in schools with 0-24% racial/ethnic minority students - with a separate point for each FRPL eligibility group (0-24%, 25-49%, 50-74%, and 75-100%). By looking at trends within this group from left-to-right, we hold student race/ethnicity status constant as FRPL eligibility rates increase. Among this group of four points, we see that as the proportion of FRPL-eligible students in a teacher's school increases, so too does teacher out of pocket spending. However, this relationship is fairly noisy - all the error bars cross the \$0 line, indicating that these results may well be the result of random statistical chance. Even so, note how this trend persists (albeit weakly and noisily) regardless of which race/ethnicity grouping we look within along the x-axis. This is suggestive evidence that as student FRPL eligibility rates increase in general, teacher spending does too - even holding constant highly correlated student race/ethnicity. The imprecision of these estimates mean we should take results with a grain of salt, though the consistency of this narrative across specifications offers at least some credence.

Similarly, if we examine how results change for all four points of the *same color* across the x-axis, we are in effect holding student FRPL eligibility rate constant while looking at how student race/ethnicity trends with teacher spending. Thus, looking only at the darkest violet points to examine all teachers in schools with 0-24% FRPL-eligible students, we see that teacher out of pocket spending starts at \$0 (mechanically) for teachers in schools with 0-24% racial/ethnic minority students, but increases somewhat steadily to \$117 for teachers in schools with 75-100% racial/ethnic minority students. This general trend, too, persists regardless of which FRPL group (color) we focus on, indicating that student race/ethnicity matters even as we hold constant student FRPL rates. Indeed, this trend seems generally stronger and more consistent than the trend within student race/ethnicity groups and across student FRPL eligibility, suggesting again that student race/ethnicity may be a primary driver of higher teacher spending. To put a fine point on it, teachers in schools with the highest proportions of racial/ethnic minority students and FRPL-eligible students (the right-most yellow point) are spending \$157 more out of pocket per year on average than their peers in schools with the lowest proportions of these students. This a *drastic* difference given the sample spending mean of \$425, a difference in the neighborhood of 37%.

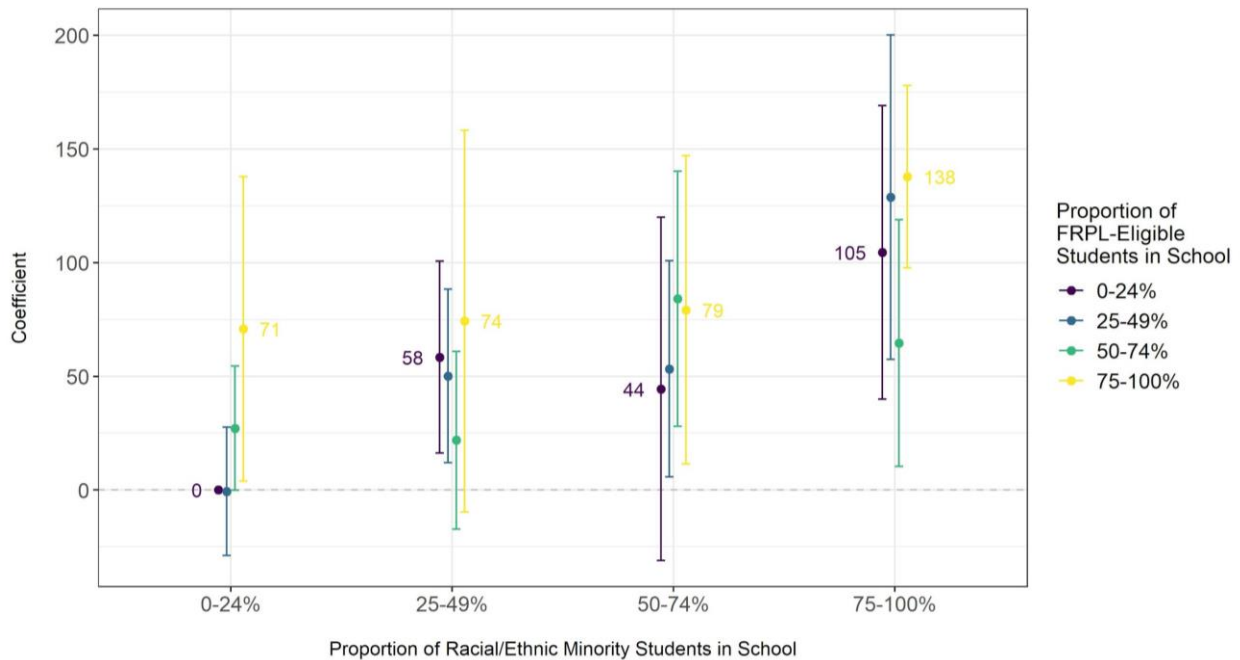
Figure 5. Teacher Spending in 2019Q4 Dollars and Student Race/Ethnicity Interacted with Student FRPL Rates - Four Group Specification (n = 60,400)



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), "Public School Teachers," 2007-2008 and 2011-2012.

Figure 6 reintroduces teacher experience and urbanicity as controls to the same regression posed in Figure 5. The results, again, become noisier as we progressively increase the dimensionality of our sample with these added control variables. Moreover, the point estimates shift downward in the groups with higher racial/ethnic minority students - for example, the 75-100% racial/ethnic minority and 75-100% FRPL-eligible group shift from \$157 in Figure 5 to \$138 in Figure 6. But the general trends remain: both student FRPL and student race/ethnicity seem to have generally positive relationships with teaching spending, even independent of one another.

Figure 6. Teacher Spending in 2019Q4 Dollars and Student Race/Ethnicity Interacted with Student FRPL Eligibility Rates - Four Group Specification, also Accounting for Teacher Experience and School Urbanicity (n = 60,400)



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

While examining teacher spending in terms of absolute levels (i.e., dollars) provides valuable insight into the general dynamics of teacher spending and student demographics, it is also worthwhile to consider whether the degree of teacher spending also scales at all with teacher income. We might be interested in teacher spending relative to their income for two primary reasons. First, even if teacher spending is a reflection of unmet student need, it is still likely

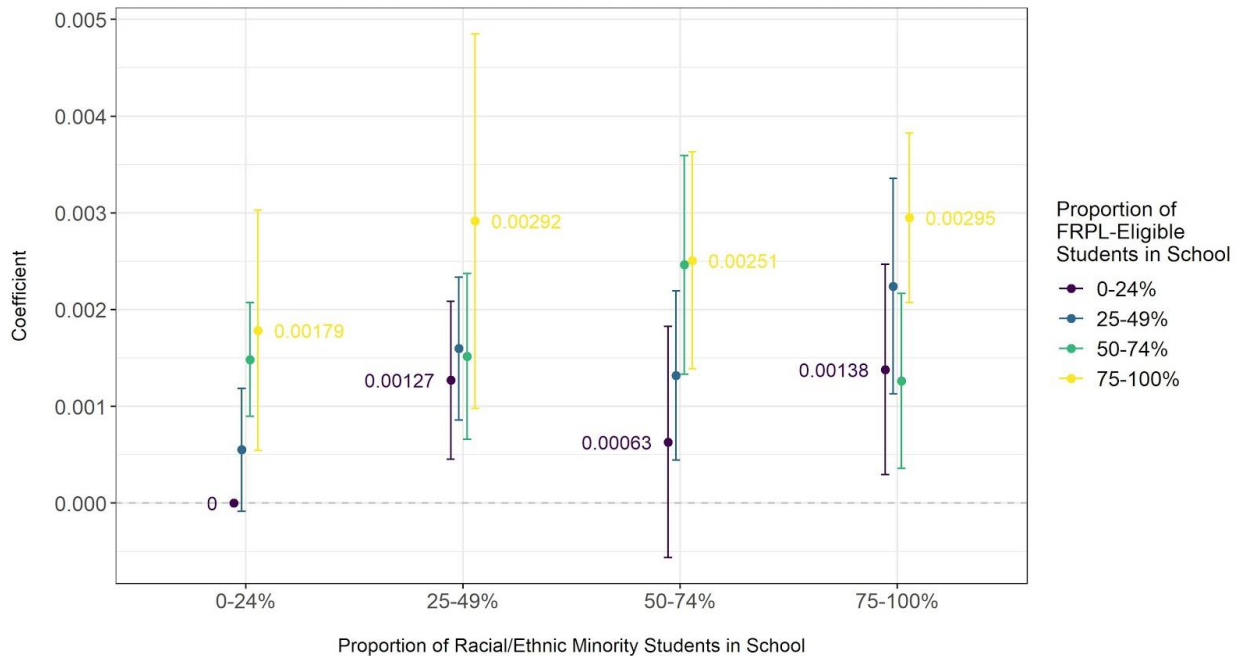
constrained by the teacher's own income: teachers who are being paid less may be spending less, but that may be an imperfect reflection (i.e., an underestimate) of the underlying unmet student need because they simply can't afford to actually meet that need. Thus, their lower absolute spending may not actually reflect lower student need. Second, and conversely, teachers who are being paid more may be more willing to spend greater sums of money on their students, even as the nature of students' unmet need remains constant (e.g., paying for higher-quality supplies). Thus, their higher absolute spending may not actually reflect higher student need.

I attempt to account for this dynamic by changing the outcome of my regression model from absolute spending, to spending as a proportion of the teacher's school-related income. That said, I find that the following results do not change in any meaningful way whether I use school-related income, reported base salary, or all-source income as the denominator.⁷ If it is the case that teachers are generally spending a higher proportion of their income in certain schools, and a lower proportion of their income in others, then this would provide some evidence that teachers choose their level of out-of-pocket spending almost independently of their own absolute income - spending whatever they need to in order to meet student need, in other words. But if we see a relatively flat relationship across schools, this would suggest that teachers' spending is at least partially constrained by their own incomes. Put another way, this analysis helps us assess the degree to which teacher spending is subject to a "ceiling" effect.

Figure 7 parallels Figure 6, but with spending proportional to teacher school-related income. Results here are more mixed. We see similar contours and trends compared with Figure 6, in that looking within student race/ethnicity groups but across student FRPL eligibility groups reveals a generally positive relationship between student FRPL eligibility and teacher spending as a proportion of their school-related income. Likewise, looking within student FRPL eligibility groups but across student race/ethnicity groups reveals a generally positive relationship between student race/ethnicity and teacher spending here as well. That said, the trends are far noisier and seemingly less meaningful. These results indicate that teachers' own income is moderately related to how much they actually spend; in other words, their spending may indeed be constrained by their income. As a reference for magnitudes, the median school-related income for the sample is about \$54,000, meaning a 0.001 difference in spending proportional to income is about \$54.

⁷ Results for these additional specifications are available upon request. In general, there is little difference for most teachers in the data across these three earnings variables, which would explain why results of regressions using these variables as outcomes are also largely indistinguishable.

Figure 7. Teacher Spending as a Proportion of School-Related Income and Student Race/Ethnicity Interacted with Student FRPL Eligibility Rates - Four Group Specification, also Accounting for Teacher Experience and School Urbanicity (n = 60,400)



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

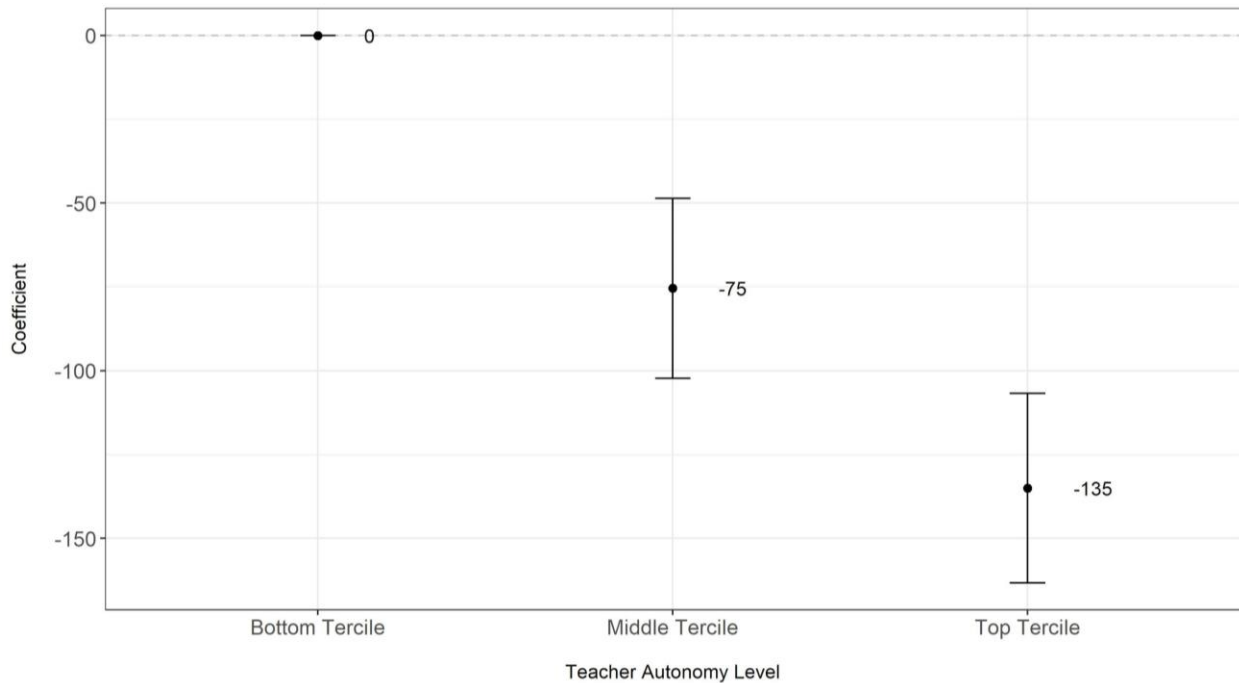
IIIb. Teacher Spending and Teacher Autonomy

I now move to examine to what extent teacher autonomy may play a role in teacher spending. Greater levels of teacher autonomy over classroom supplies and instruction would suggest that teachers are more able to meet student needs *within* their school-based budgetary constraints. In other words, they would not need to pay out of pocket for materials if they can instead pay for those materials using more flexible school budgets. Thus, if teacher spending is indeed a reflection of *unmet* student need, teacher autonomy should have a negative relationship with teacher spending. For the following analyses, I revert to the outcome of absolute teacher spending in 2019Q4 dollars, given the more mixed and imprecise findings on teacher spending proportional to income, above.

I begin this exploration with Figure 8 below, which shows the results of a simple regression including only teacher autonomy and school-year fixed effects as regressors. In this regression, teachers in the bottom tercile of reported autonomy serve as the reference group for the other coefficients. Thus, these results indicate that teachers in the middle tercile spend \$75 less than

teachers in the bottom tercile, while teachers in the top tercile spend \$135 less than teachers in the bottom tercile. Importantly, the difference between teachers in the middle and top tercile is statistically significant. Put together, we observe a strong, statistically significant, negative relationship between teacher autonomy and teacher spending. In other words, that teachers with more autonomy spend less money out of pocket on their students.

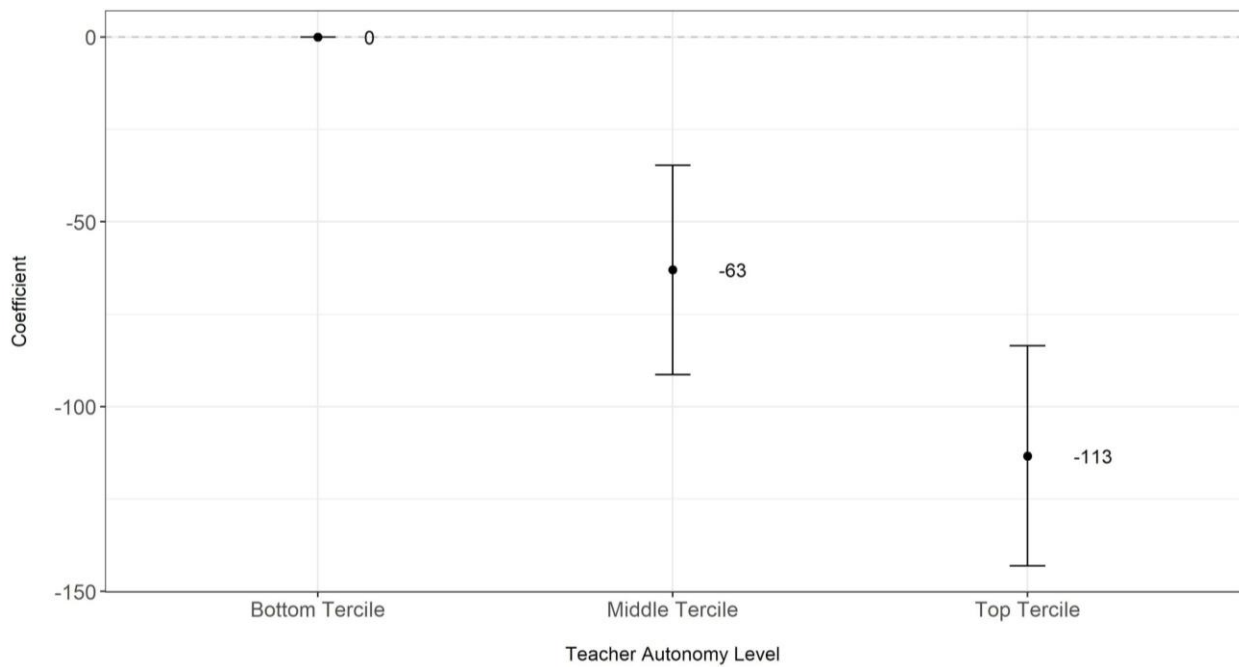
Figure 8. Teacher Spending in 2019Q4 Dollars and Teacher Autonomy - No Demographic Controls (n = 61,000)



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

In Figure 9 below, I further add the interacted student race/ethnicity and student FRPL-eligibility groups into the regression, alongside teacher experience and school urbanicity, to explore whether the relationship displayed in Figure 8 persists after considering these factors. Interestingly, the relationship is nearly identical; the point estimates are slightly reduced in magnitude, but the trends and insights remain the same.

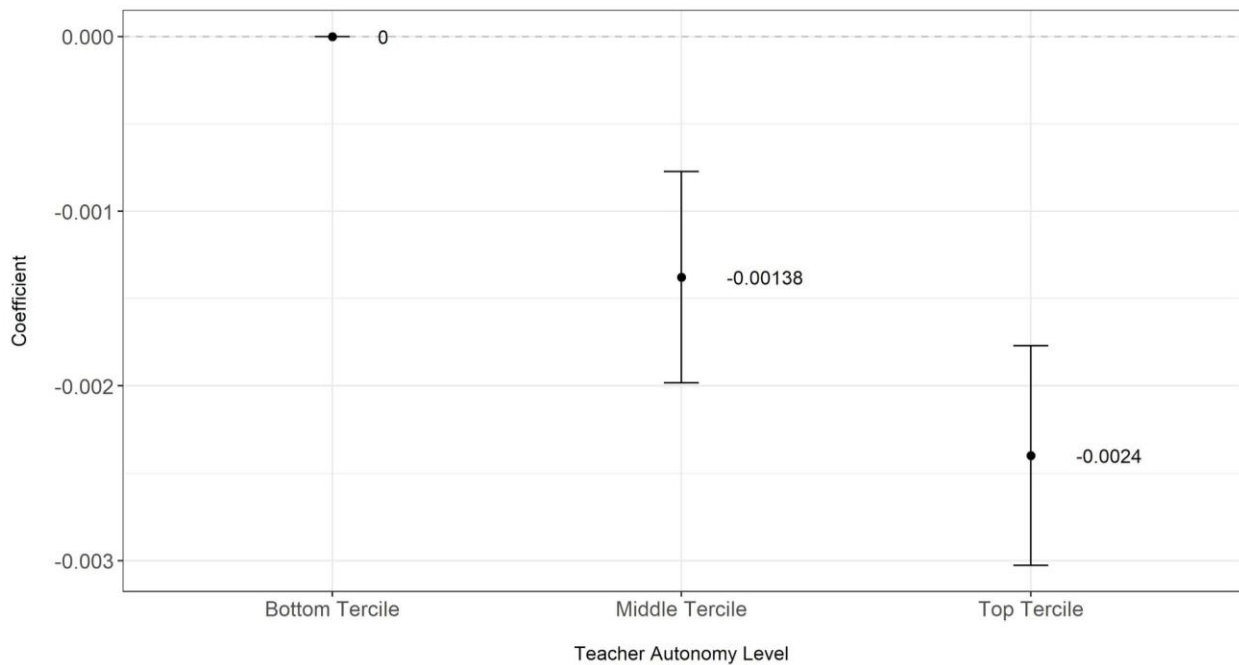
Figure 9. Teacher Spending in 2019Q4 Dollars and Teacher Autonomy - Accounting for Student Race/Ethnicity (Four group), Student FRPL Eligibility (Four group), Teacher Experience, and School Urbanicity (n = 60,400)



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), "Public School Teachers," 2007-2008 and 2011-2012.

Figure 10 below examines the exact same regression specification as Figure 9 but with spending *proportional to teacher school-related income* set as the outcome. Doing will mirror the spirit of Figure 7 and similarly allows us to examine whether the relationship between teacher spending and autonomy is also related to, or constrained by, their income. Again, the median school-related income for the sample is about \$54,000, meaning a 0.001 difference in spending proportional to income is around \$54. What we observe below is nearly identical to Figure 9, suggesting that teachers in lower autonomy schools are indeed willing to spend greater shares of their income on their students - even after controlling for interacted student demographics, teacher experience, and school urbanicity. By corollary, this may suggest that the spending driven by low autonomy circumstances is generally less constrained by teacher income.

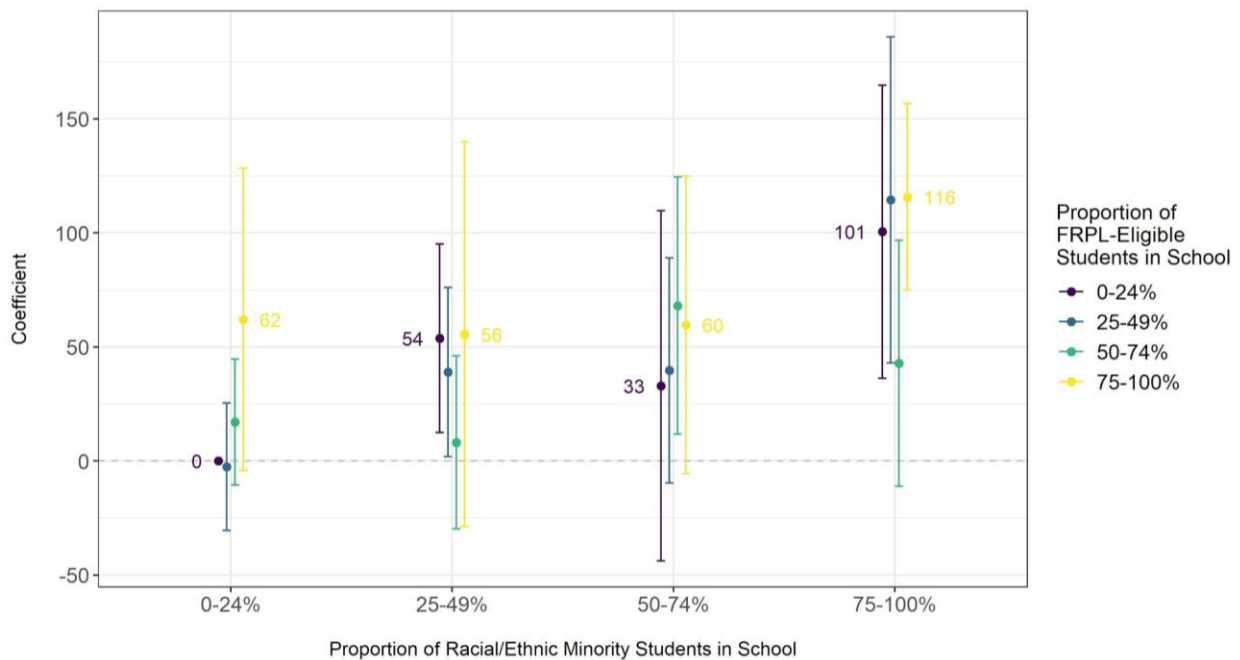
Figure 10. Teacher Spending as a Proportion of School-Related Income and Teacher Autonomy - Accounting for Student Race/Ethnicity (Four group), Student FRPL Eligibility (Four group), Teacher Experience, and School Urbanicity (n = 60,400)



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), "Public School Teachers," 2007-2008 and 2011-2012.

Figure 11 is based on the same regression specification as Figure 9 (returning to the outcome of teacher spending in inflation-adjusted dollars), but reporting the coefficients on the student demographic group variables instead. This figure can be effectively thought of as identical to Figure 6, but with teacher autonomy added as a control. In other words, I explore whether the relationship we observed between student demographics and teacher spending persists even while the relationship between teacher autonomy and teacher spending is taken into account. Again, the broad trends of the analysis remain roughly the same with reduced precision, though the magnitudes of each point estimate are slightly decreased across the board.

Figure 11. Teacher Spending in 2019Q4 Dollars and Student Race/Ethnicity Interacted with Student FRPL Eligibility Rates - Four Group Specification, also Accounting for Teacher Autonomy, Teacher Experience, and School Urbanicity (n = 60,400)



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey (SASS), “Public School Teachers,” 2007-2008 and 2011-2012.

IV. Discussion

Given the wide range of results and specifications above, I return to consider my primary research question to focus my discussion: Do teachers at schools with higher proportions of racial/ethnic minority students spend more money out of pocket than teachers who don't? In each of the regressions shown above examining only student race/ethnicity, the relationship is clear and stark in the affirmative, with the differences between teachers in schools with the highest and lowest proportions of racial/ethnic minority students ranging from 23-31% depending on the number of race/ethnicity groups used (i.e., Figure 1 versus Figure 4). When we progressively incorporate the important covariates of student poverty, teacher experience, school urbanicity, and teacher autonomy to explore whether related variables may be driving the relationship between student race/ethnicity and teacher spending, the precision and significance of many estimates are reduced, but the general trends largely reaffirm our initial conclusion to the posed research question. These other variables clearly matter but are not sufficient to explain all of the relationship between student race/ethnicity and teacher spending. Depending on specification, race/ethnicity appears to be a more important influence on teacher spending than even student poverty, but the noisiness of estimates precludes us from making strong conclusions on that front.

Importantly, my analysis uses a somewhat coarse *school-level* measure of student demographics in conjunction with a *teacher-level* measure of student spending. We have strong evidence that de facto segregation persists within schools, especially along lines of advanced course-taking opportunities (Goldhaber, Lavery, & Theobald, 2015; Green & Waldman, 2018), meaning that these school-level measures are not necessarily indicative of the students a given teacher actually serves and is supporting with their own out-of-pocket spending. In other words, my estimates here may be an imperfect measure of unmet student need for their own students, though this limitation is exceptionally difficult to overcome with any existing data sources. I would hypothesize that the trends displayed here would likely be *stronger* if we instead examined whether teachers with higher proportions of racial/ethnic minority students *in their classes* spend more out of pocket, though I leave that investigation to future study. A similarly important detail to remember is that my measure of race/ethnicity for students is also fairly coarse, grouping together all Hispanic, non-white students together. This means that, for example, schools with high concentrations of predominantly Eastern Asian students (commonly found to have academic outcomes equaling or even higher than non-Hispanic white students), who may have commensurately lower unmet need, are suppressing results for racial/ethnic minorities who generally struggle from higher levels of disadvantage across

schooling structures (e.g., Black, Latinx, Native American). In other words, an examination of teacher spending and the proportion of *historically disadvantaged* racial/ethnic minority students would likely reveal an even stronger relationship. This question may be better answered with the modern NTPS as it is made available (though these data would still not address the first issue of mismatch between school-level and classroom-level measurement).

Finally, I separately observe that teacher autonomy has a strong and negative relationship with teacher spending, consistent with the narrative that teacher spending serves as a proxy for *unmet* student needs that cannot be accommodated through provided school budgets. That this relationship persists even after all other control variables are added offer strong evidence to support this hypothesis further. Whether this is reflective of provided school budgets being *insufficient* (i.e., teachers are *allowed* to buy what students need, but lack the funds to cover all students) versus being *too inflexible* (i.e., teachers don't have the flexibility to purchase what they deem as necessary for students, even if the provided funds would otherwise be sufficient) is not explainable through these data but serves as an interesting question for potential future study.

Altogether, these results suggest that there exists substantially higher unmet student need occurring in schools with higher proportions of racial/ethnic minority students. This result aligns closely with recent literature and important investigations into racial inequities in school funding, which imply more generally that funding and resources at these schools are lower than necessary to ensure student success. These results indicate that teachers serving populations of students experiencing disadvantage are spending the most out of pocket while teaching these students - and given already high levels of stress and burnout among teachers, this dynamic should raise alarm for policymakers attempting to reduce eventual teacher turnover. Moreover, as policymakers and school leaders consider what avenues they can take to better support the needs of students in their classrooms, these results indicate that teachers may be valuable partners in marshalling funding where, and how, it is most needed.

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VI. Appendix

VIa. Teacher Autonomy Index

I operationalize my measure of autonomy as an index of four survey response components that were most conceptually related to classroom instruction autonomy and autonomy over classroom materials:

- To what extent do you agree or disagree with each of the following statements? (Strongly Agree/Agree/Disagree/Strongly Disagree): Necessary materials such as textbooks, supplies, and copy machines are available as needed by the staff.
- How much actual control do you have IN YOUR CLASSROOM at this school over the following areas of your planning and teaching? (No/Minor/Moderate/A great deal): Selecting textbooks and other instructional materials
- How much actual control do you have IN YOUR CLASSROOM at this school over the following areas of your planning and teaching? (No/Minor/Moderate/A great deal): Selecting content, topics, and skills to be taught
- How much actual control do you have IN YOUR CLASSROOM at this school over the following areas of your planning and teaching? (No/Minor/Moderate/A great deal): Selecting teaching techniques

First, I assess how well these measures relate to one another using Cronbach's Alpha and obtain an index score of 0.63; this value generally indicates an acceptable level of conceptual cohesion, especially as this is a fairly concise index and Cronbach's Alpha can inflate artificially as more components are added.

Second, I construct three separate specifications for teacher autonomy. The first specification mirrors the methodology used by NCES (Sparks & Malkus, 2015) to construct their broader measure of teacher autonomy in the SASS data: create a categorical variable in which teachers who respond with a 4 (great deal/strongly agree) to all questions are "High Autonomy," teachers who respond with an average answer of 3 or higher (moderate/agree) are "Moderate Autonomy," and all remaining teachers as "Low Autonomy." I find that less than 1% of the sample qualifies as "High Autonomy" in this measure, while the rest of the sample is split roughly evenly between Moderate and Low. The second specification is more data-driven, in that I generate an average response of the four questions (adjusted such that higher values for all questions indicate greater autonomy, conceptually) and simply split the sample into those teachers who were above the

average in the sample on this index, and teachers who were below the average. This is almost *identical* in practice to taking the first specification and flattening the High and Moderate autonomy groups. The third specification begins with the same approach, but instead splits the sample into tercile groups. I opt for this latter approach as my main specification, because it captures the *intention* of the first approach (split into three distinct groups) but preserves a greater level of variation in the sample by design.