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Crossing Over?

The Implications of Reform to the Traditional Public School Labor Market for Charter School Teachers

Abstract

In recent years, policymakers in many states have enacted reforms to teacher evaluation, tenure, and collective bargaining in the traditional public school sector. Despite the attention paid to these reforms by critics and supporters alike, the implications for such changes across the broader labor market for K-12 teachers are missing from debate. In this paper, we consider the potential for spillover reform effects on a large sector of public charter school teachers in Michigan. Using microdata from 2005-2016, we measure changes to rates of teacher transfer within and between sectors, as well as teacher exits from the profession, in both the traditional and charter school markets. We find evidence that, following the reforms, charter teachers overall were less likely to exit or transfer sectors relative to TPS teachers. However, there are some important differences within the set of charter teachers, suggesting differential policy-related responses.



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I. Introduction

Despite the large body of scholarship on student outcomes in charter schools, researchers have only recently begun to study teachers in the charter school sector. These studies suggest that teacher attrition is higher in public charter schools than in traditional public schools (TPS) (Cowen & Winters, 2013; Stuit & Smith, 2012), that charters in some locales are more likely to pay teachers for performance and attributes other than experience or education (Podgursky & Springer, 2007), and that charter schools typically operate without the constraints imposed by collective bargaining agreements (CBAs) (Hoxby, 2002; Malloy & Wohlstetter, 2003). The available evidence also indicates that teachers in charter schools differ dramatically from those in traditional public schools; they tend to be younger, more diverse, less experienced, have spent less time in their schools and in teaching overall, and they are less likely to hold certifications from traditional educator preparation programs (Stuit & Smith, 2012). Given the literature available, the clearest picture is one of little overlap between the charter school and TPS labor markets.

What might drive the relative separation of these labor markets? It is possible that some teachers are attracted to charter schools because they generally operate under fewer administrative regulations imposed by teachers' unions and their CBAs with districts (Hoxby, 2002; Malloy & Wohlstetter, 2003). For example, most charter schools do not need to abide by negotiated salary schedules and employment regulations that are dictated solely by seniority and degree attainment. This may enable charter schools to reward teachers based on merit or effort and to place teachers where they are needed most rather than where their seniority enables them to teach. In addition, charter school administrators may be more inclined to hire teachers from non-traditional teacher preparation programs. On the other hand, a certain subset of teachers may prefer the TPS sector because, among other reasons, the lack of CBA/union protections in charter schools can be viewed as an absence of teacher "voice," resulting in difficult working conditions where teachers in charter schools may face at-will dismissal, assignment to larger classes, or other "unwelcome" attributes of employment. If these conceptions of the overall teacher labor market are correct, then they help to explain why charter school and TPS teachers operate in parallel labor markets with little overlap in teacher supply.

However, the differences in working conditions between traditional public and charter schools may be narrowing. In recent years, many states have enacted significant reforms to the traditional public school teacher labor market. For example, between 2011 and 2013, lawmakers



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in 20 states proposed comprehensive restrictions on bargaining rights for teachers and ultimately enacted such laws in five of these states (Marianno, 2015). During the same period, lawmakers in 49 states proposed non-comprehensive laws restricting union protections, of which 44 were adopted (Marianno, 2015). As of 2015, 23 states required that teaching effectiveness be used in tenure decisions, as opposed to basing these decisions solely on experience (National Council on Teacher Quality, 2015). Seven states have enacted laws that allow districts to remove tenure protections from teachers if they do not meet performance standards, and three states have passed laws that effectively eliminate tenure and/or due process rights for permanent teachers (Thomsen, 2014). A small subset of states (e.g., Michigan, Wisconsin, and Indiana) have substantially removed basic collective bargaining rights from teachers’ unions and diminished teachers’ unions abilities to collect dues from members. Most recently, in *Janus v. ASFCME*, the Supreme Court removed the rights of public sector unions writ large to require employees to pay agency fees (*Janus v. ASFCME*, 2018). This decision has important implications for union power nationally, as it removes public sector unions’ rights to require employees to pay union dues, greatly decreasing the power of teachers’ unions.

Together, these reforms—considered to be “anti-teacher” or “anti-teachers’ union” by some (see Cowen, Brunner, Strunk, & Drake, 2017)—liberalized the TPS teacher labor market, making the conditions under which TPS teachers work more similar to those under which charter teachers work. In this changed labor market context, a de-regulated TPS labor market may be more appealing to charter teachers and the charter sector may become relatively more appealing to teachers who lose protections in the TPS sector, incentivizing greater crossover between the two markets. For example, traditional public schools now offer fewer protections for teachers who may have preferred this aspect of the TPS sector, which could make the charter sector relatively appealing. Similarly, under these reforms, the TPS sector may become relatively more merit-based, perhaps attracting some teachers who previously preferred the market-based management structure of charter schools.

This crossover hypothesis—that charter and TPS sectors in Michigan became more similar, and sector transfer might increase as a result—hinges upon the sectors becoming more

similar and thus more or less preferable to certain types of teachers. On the other hand, if the recent slate of reforms is truly viewed as “anti-teachers’ union” by TPS teachers who appreciate union protections, TPS teachers may be more likely to completely exit the profession. Theoretically, charter teachers may feel less challenged by the new statutes—as only one component of the reforms, teacher evaluation, directly applies to them—and happier to stay relative to their TPS counterparts. However, if the teachers interpret recent reforms broadly as “anti-teacher” regardless of which sector they work in, it is possible they would be less likely to transfer into the TPS sector as a result, or be motivated to exit the profession as well. More generally—and with perhaps the more fundamental implications for school choice policy—the potential narrowing of TPS-charter labor markets allows an important ex post, empirical consideration of what may draw teachers into the charter profession. If teachers in both sectors share a common professional orientation toward educating children, but are divided by their aversion to risk, reaction to employment rules, or preference for administrative structures, we might expect policy change that narrowed these labor markets to have differing implications for the two sectors. If, on the other hand, differences in such employment preferences do not tend to explain why some teachers sort into TPS and others into charter schools, we should expect to see little direct change in teacher sorting after the markets narrow.

In this study, we consider the recent substantial changes to the teacher labor market in Michigan, which primarily affected the TPS sector, but had implications for the charter sector as well. Michigan serves as an ideal case to study how these reforms may have impacted the charter sector for two primary reasons. First, Michigan has a robust charter sector (over 300 charter schools serving more than 140,000 students and employing over 7,000 teachers), ensuring a large enough charter sector to study attrition from and transfers between the charter and TPS labor markets. Second, the Michigan legislature enacted a set of reforms (described in greater detail below) in 2011 and 2012 that required new evaluation programs for both TPS and charter teachers, reduced the scope of collective bargaining in local TPS districts, and removed the requirement to become a union member or pay mandatory agency fees in order to be employed as a TPS teacher.

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Given these specifics of the Michigan context, it is particularly relevant to examine how labor market reforms of the kind being implemented across the country might affect the movement of teachers between the TPS and charter sectors. In particular, we ask: Following the reforms, are charter or TPS teachers more or less likely to transfer sectors or exit the profession? If so, what types of teachers appear to respond to the reforms?

In what follows, we review the extant literature that addresses charter school labor markets, focusing on a small subset of work that has already addressed crossover between the two sectors in contexts absent these types of reforms, as well as the literature on recruitment and retention. Then we provide a brief background on the slate of Michigan reforms. In the next section, we describe the data used in the study, and lay out our key analytic methods. We then present our results, and we conclude with a discussion of the implications of our findings for policymakers as they consider potential consequences of similar state actions.

II. Teaching in charter schools

Relative to an expansive body of work on TPS teachers, there is far less research on teacher labor markets in charter sectors. Charter teachers are less likely to be traditionally certified through a typical teacher education program (Stuit & Smith, 2012), and tend to come from more selective undergraduate institutions and majors (Baker & Dickerson, 2006; Burian-Fitzgerald & Harris, 2004; Podgursky, 2006). However, on the recruitment side, there is evidence that those who move to charter schools from traditional public schools are less qualified and less effective, especially those transferring to charters with high rates of non-white students (Carruthers, 2012). This work also indicates that charter schools experience greater teacher turnover than traditional public schools (Cowen & Winters, 2013; Newton, Rivero, Fuller, & Dauter, 2011; Stuit & Smith, 2012). Using a nationally representative sample of teachers, Stuit and Smith (2012) find that charter school teachers are significantly more likely to experience an involuntary exit from their school than teachers in traditional public schools. While tenure protections make it difficult to dismiss a teacher, such regulations generally do not protect charter teachers. Still, it is unclear whether charters are either attempting to or are better able to induce attrition among less effective teachers.

There are a variety of additional factors that may partially explain higher attrition rates. For example, charter teacher pay is often lower and working conditions more tenuous than in the traditional sector (Bell-Weixler, Harris, & Barrett, 2017; Malloy & Wohlstetter, 2003; Stuit & Smith, 2012), although it is unclear whether workload overall differs or explains high attrition (Ni, 2012; Torres, 2016). Charter schools often operate in historically disadvantaged locales with

more demanding expectations (Miron & Applegate, 2007), and charters tend to serve more challenging student bodies than the average TPS (Bifulco & Ladd, 2006; Booker, Zimmer, & Buddin, 2005; Hoxby, Murarka, & Kang, 2009; Witte, Weimer, Shoher, & Schlomer, 2007). Thus, charter school teachers often work in environments that, as noted previously, tend to have higher rates of teacher exit. Evidence also suggests that charter teachers' higher exit rates could be due in part to better outside labor market opportunities, as they tend to come from more selective institutions and undergraduate majors (Stuit & Smith, 2012). Finally, recent work comparing TPS and charter teachers in Florida finds that, on average, charter teachers in particularly high poverty schools are significantly more effective (based on value-added estimates) than their peers in comparable TPS schools. These results are explained largely by higher returns to experience in the charter sector (Ozek, Carruthers, & Holden, 2018)

One unambiguous difference between the charter and TPS teacher labor markets in most states is the absence of CBAs governing administrator decision-making on the charter side. Since CBAs dictate nearly all aspects of employment in most traditional districts from compensation to layoff and dismissal policies (e.g. Strunk, 2011; Strunk et al., 2018), some have argued that greater administrative flexibility could lead to differences in the quality of teachers attracted to and retained in the charter and TPS environments (Cowen & Winters, 2013; Hoxby, 2002; Malloy & Wohlstetter, 2003). In particular, schools operating with greater flexibility in employment practices might benefit from the increased ability to remove ineffective teachers (Ballou & Podgursky, 1997).

On the other hand, research provides mixed evidence on the extent to which CBAs actually restrict flexibility in teacher assignment within the TPS sector. Several studies have found negative relationships between the restrictiveness of CBAs and traditional school district productivity (e.g., Hoxby, 1996; Moe, 2009; Strunk, 2011; Strunk & McEachin, 2011; Marianno & Strunk, in press). Only two studies have systematically examined whether unionization and collective bargaining impact student achievement in charter schools, and the results are mixed: Matsudaira and Patterson (2017) found that charter schools that unionized and adopted CBAs in California saw increases in student math achievement, whereas earlier work by Hart and

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Sojourner (2015), also in California, found the opposite result.¹ But other work has found that the impacts of CBAs depend on the specific provisions they contain (Koski & Horng, 2007; Lovenheim, 2009; Strunk & Grissom, 2010; Nicholson-Crotty, Grissom, & Nicholson-Crotty, 2012; Strunk, 2012). To our knowledge, thus far, there has been only one study evaluating whether there is a differential relationship between measured teacher quality and teacher attrition in the charter and traditional public sectors. In that work, Cowen and Winters (2013) find no evidence that charter schools in Florida are better at removing ineffective teachers (as measured by value-added models of effectiveness) than traditional public schools in the state.

The current study adds to this relatively thin research base by addressing an important question about teacher labor market crossover in the current era of teacher-related reforms. In particular, there is no evidence, to our knowledge, about how teacher labor market reforms primarily affecting the TPS sector might affect teacher employment decisions in the charter sector.

III. Michigan policy context: Charter schools and traditional public school labor market reforms

Teachers in Michigan's charter schools

Michigan began to authorize charter schools (a.k.a. public school academies) in 1993. Under the current law, there are no strict caps on the number of charter schools (as of 2015-16 there were 302 schools statewide, serving more than 140,000 students)² and the law allows the formation of new schools, conversions from other public schools, and cyber schools.³ There are multiple authorizers permitted in Michigan, including public universities, community colleges, local school boards, and intermediate school districts (essentially collections of local districts at the county or multi-county level). Approximately four out of every five charter schools are run

¹ Matsudaira and Patterson (2017) address potential reasons for opposing findings. They argue variation in results exists because while Hart and Sojourner (2015) analyze student math and ELA achievement together and weight their average test scores by the number of students tested in each cell, Matsudaira and Patterson (2017) separate subject scores and perform an unweighted analysis. Further, Matsudaira and Patterson (2017) acquire data on charter school unionization through direct contact with the schools.

² Charter school information found at https://www.michigan.gov/documents/numbsch_26940_7.pdf. To compute this number, we count charter schools of different levels (elementary, middle, high schools) or different campuses as different schools, even if run under the same organization, which causes us to use a higher count of individual charter schools than state-reported numbers.

³ See <http://www.publiccharters.org/get-the-facts/law-database/states/MI/> for a detailed summary of Michigan's charter school authorization laws. See http://www.michigan.gov/documents/PSAQA_54517_7.pdf for an additional overview.

through a contract between one of these authorizers and a for-profit education management organization (EMO), which is quite high relative to other states (Miron & Gulosino, 2013).

Although the state collects basic administrative and employment information about teachers within the state charter system, just as it does for TPS teachers, a comprehensive picture of the labor market for charter schools has yet to emerge.⁴ With a few exceptions (e.g. university faculty who teach in schools authorized by their home institution), the law requires charter teachers to be certified to teach in Michigan public schools. State law permits, but does not require, charter authorizers to collectively bargain with their teachers, and as of fall 2017, staff in fewer than ten of the more than 300 charter schools have voted to unionize (Higgins, 2017). Teachers may be hired directly by the authorizer or by the management organization contracting with the authorizer to run the school, and except for teachers in charters authorized and run by a local school district, charter teachers do not participate in the state’s public school employee retirement system.⁵ Michigan charter teachers are subject to the same state teacher evaluation laws described above, but do not receive tenure.⁶

In sum, while Michigan charter teachers share with their TPS counterparts the same general credentialing requirements and the same requirement for annual performance-based evaluation (since 2011, but later strengthened in 2016)⁷, other features of the labor market—the lack of collective bargaining, tenure, and a public retirement system—represent very different employment conditions.

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⁴ For the details that follow, see Michigan Revised School Act 451 of 1976 [http://www.legislature.mi.gov/\(S\(2xwsaoavcl4xykqj2l01mpwk\)\)/mileg.aspx?page=getObject&objectName=mcl-451-1976-1-6A&highlight=THE%20AND%20REVISED%20AND%20SCHOOL%20AND%20CODE](http://www.legislature.mi.gov/(S(2xwsaoavcl4xykqj2l01mpwk))/mileg.aspx?page=getObject&objectName=mcl-451-1976-1-6A&highlight=THE%20AND%20REVISED%20AND%20SCHOOL%20AND%20CODE)

⁵ Ibid.

⁶ Michigan Association of Public School Academies <http://www.charterschools.org/blog/2016/12/06/facts-michigan-charter-school-accountability>

⁷ While Public Acts 100-103 implemented a high stakes performance-based teacher evaluation system and tied promotion and layoff decisions to evaluation measures, it was not until 2016-17 that schools were required to use “rigorous, transparent, and fair” evaluation process and train all its teachers, administrators, evaluators, and observers on the observation tools (as legislated in Public Act 173 of 2015). See <https://www.legislature.mi.gov/documents/2015-2016/publicact/pdf/2015-PA-0173.pdf>

Reforms to the teacher labor market

Over the past seven years in Michigan, as in other states, a slate of reforms affecting the TPS teacher labor market has been implemented. These reforms have focused on three longstanding features of the TPS system: the absence of performance-based evaluation, strong

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employment protections under a tenure law, and wide-ranging CBAs governing nearly all aspects of teacher employment. In July 2011, the Michigan legislature implemented Public Acts 100, 101, 102, and 103 (State of Michigan, 2011), followed by Public Act 349 in December 2012 (State of Michigan, 2012). The first set of reforms (Public Acts 100-102) reduced employment protections by implementing a high-stakes performance-based teacher evaluation system and tying promotion and layoff decisions to evaluation outcomes. The key feature of this legislation was the inclusion of student achievement as a “significant” determinant of educator performance ratings, and the eventual dismissal of teachers with multiple (three) “ineffective” ratings.⁸

In addition, PA 102 prohibited districts from using seniority as the primary determinant of layoff decisions (as is the case under typical Last-in-First-Out (LIFO) layoff processes) and required districts instead to base layoff decisions on performance ratings stemming from the new evaluation system. Districts, though, are still allowed to use seniority to determine layoffs between teachers of similar performance ratings.

To further aid districts’ ability to use the new evaluation system to remove ineffective teachers, Public Acts 100 and 101 increased the pre-tenure probationary period from four to five years and required that evidence of teacher effectiveness be the dominant factor in awarding tenure. With that change, teachers are now required to be rated effective or higher in three consecutive probationary years before receiving tenure (State of Michigan, 2011). Despite these laws calling for immediate implementation of teacher evaluation beginning in the 2011-12 school year, the rigor and transparency of the teacher evaluation process varied substantially across districts. In 2015, Public Act 173 further clarified the requirements for evaluations to ensure a more “rigorous, transparent, and fair” process, and it was not until 2016-17 that school districts and charter schools were required to train all teachers, administrators, evaluators, and

⁸ In November 2015, the state passed subsequent legislation to allow individual districts wide discretion in the implementation of this policy over time, with student achievement remaining an important feature.

observers on the observation tools (State of Michigan, 2015). Thus, the impact of the evaluation component of the 2011-2012 suite of reforms may have differed depending on how immediately and rigorously evaluations were conducted.

At the same time, additional reforms were aimed at collective bargaining and teacher unionization, and these changes “radically altered the landscape of bargaining for public school employers and the unions representing their teachers,” according to Michigan administrative law judge Julia Stern.⁹ PA 103 prohibited CBAs bargained after that date from governing evaluation, teacher transfer, and reassignment (which is traditionally based on seniority rather than performance or local need), performance-based compensation, classroom observations, the length of the school year, and discipline (State of Michigan, 2011). Fifteen months later, in December 2012, the state passed Public Act 349, which prohibited districts from requiring teachers to pay agency fees (funds designated for union activities related to the organization’s professional purposes) as a condition of employment, shifting the state from agency shop to Right-to-Work status (State of Michigan, 2012).

IV. Data and estimation strategy

To study how the 2011 reforms may have affected teacher labor markets (namely, teacher attrition and transfers) and, in particular, the charter labor market, we use detailed administrative data on the universe of Michigan public school employees from the 2005-06 through 2016-17 school years.¹⁰ These employee records include teacher demographic characteristics such as age, gender, race/ethnicity, years of experience, school and district location, and other measures common to rich administrative individual-level data.

Charter school and TPS teachers in the state differ in terms of observable characteristics, so we primarily use these two groups for comparison purposes without making strict assumptions that would permit causal inference. In addition, to compensate for the differences between these groups and manage some constraints in the data, we restrict the sample in several ways and test the robustness of our results to multiple restrictions. We describe these restrictions, and present the sample sizes, both in terms of the number of teachers and number of teacher-by-year observations after each of these successive restrictions, in Appendix A and Appendix Table A.

⁹ See Michigan Association of School Boards Bargaining Toolkit https://www.masb.org/Portals/0/Member_Center/Labor_Relations/Bargaining_Toolkit.pdf accessed 5/9/17

¹⁰ Our analysis is only for 2005-06 through 2014-15, but we use the 2015-16 and 2016-17 school years to create our outcome variables.

We focus on two main samples: one state-wide sample, and one in which we restrict the sample to areas with relatively high charter concentration. For this alternative sample, we restrict the sample to the teacher-year observations for teachers located in Intermediate School Districts (ISDs) in the top quintile of charter density in the year prior to reform. The ISD-level charter density is calculated as the proportion of 2010 teachers within a given ISD who taught in charter schools in 2010, the last pre-reform year. Charter teachers comprise 7% or more of their ISD teaching force in the top quintile of charter density when using this constant, 2010 measure. This restriction narrows our analysis to geographic labor markets with theoretically more meaningful inter-sector competition.

Although limiting analysis to the top quintile of charter density drastically reduces the number of observations ($n = 236,888$), doing so yields an analytical sample in which movement between the sectors may be more prevalent. Summary statistics for both analytical samples can be found in Table 1. The sample narrowed to the top quintile of charter density is generally representative of the statewide analytical sample, though teachers are more likely to be located in urban areas, to work in lower-income schools, and to be black.

Table 1
Comparison of population and analytical samples: average teacher and school characteristics by sample and group

	Analytical Sample - State				Analytical Sample - Top Quintile			
	All	TPS	Charter	Difference	All	TPS	Charter	Difference
Age	38.0	38.3	35.5	-2.8	38.4	39.1	35.5	-3.6
Years of Experience	7.7	8.1	4.1	-4.0	7.6	8.3	4.1	-4.2
% Female	74.6%	73.9%	79.8%	5.8%	75.2%	74.3%	79.3%	5.0%
% Male	25.4%	26.1%	20.2%	-5.8%	24.8%	25.7%	20.7%	-5.0%
% Urban	24.8%	21.6%	51.8%	30.2%	35.5%	31.1%	55.2%	24.1%
% Suburban	42.5%	43.7%	32.6%	-11.0%	43.7%	46.4%	31.4%	-15.0%
% Other	32.7%	34.7%	15.6%	-19.2%	20.8%	22.5%	13.3%	-9.1%
School Enrollment	693.6	709.7	558.3	-151.5	705.6	733.2	582.0	-151.2
School % FRL	43.5%	40.9%	65.2%	24.3%	50.6%	46.5%	69.2%	22.7%
% White	90.7%	92.1%	79.2%	-13.0%	84.1%	86.2%	74.6%	-11.6%
% Black	6.5%	5.3%	16.6%	11.2%	12.4%	10.6%	20.5%	9.9%
% Hispanic	1.1%	1.0%	1.4%	0.3%	1.4%	1.3%	1.6%	0.3%
% Other Race	1.7%	1.5%	2.9%	1.4%	2.2%	1.9%	3.3%	1.4%
Master's Degree or Higher	51.3%	54.5%	24.5%	-30.0%	50.9%	56.6%	25.7%	-30.9%
Observations	591,238	528,162	63,076		236,888	193,583	43,305	

Note: Analytical Sample - State consists of observations for all teachers in Michigan charter or traditional public schools from the 2005-06 to 2014-15 academic years. This sample excludes teachers older than 70 or younger than 21, teachers eligible for Michigan's Early Retirement Incentive in 2009, teachers with inconsistent/incomplete exit data, and teachers with 16 or more years of experience (see Appendix A). "Analytical Sample - Top Quintile" restricts this to only include teachers employed within ISDs in the top quintile of charter density in 2010. FRL = eligible for free- or reduced-price lunch.

In Appendix Table B, we present basic descriptive statistics for TPS and charter school teachers for two time periods: 1) before the reforms (six school years beginning 2005-2010), and after the reforms (four school years beginning 2011-2014). This table is produced using the statewide analytic sample (see row 7 of Appendix Table A). Appendix Table B clearly indicates that both prior to and following the 2011 reforms, charter and TPS teachers differ in many ways. Even after our sample restrictions, charter school teachers tend to be younger, less experienced, and less likely to have a master's degree or higher. Charter teachers are also more likely to be female, more likely to be black (and less likely to be white), and more likely to serve in urban communities. Some of these charter-TPS gaps widened following the reforms, indicating that charter and TPS teachers became more different in some respects. For example, the gap between the proportion of TPS and charter school teachers serving in urban school districts widened following the reforms. Also of note, while the proportion of free and reduced priced eligible students in TPS schools, on average, jumped by over 9 percentage points, that same group but within charter schools experienced more than a 12 percentage point increase. In other ways, the gaps closed. Although, on average, TPS schools shrank by about 26 students between pre- and post-reform years, the average charter school enrollment grew by over 50 students. Thus, the gap between average charter and TPS student enrollment counts decreased by over 40%.

Table 2 indicates the unadjusted exit rates and sector transfer rates over time for charter and TPS teachers, overall, and by subgroup of teacher. The overall sector transfer rates are consistently low for TPS teachers (well below 1% in any year). Similarly, exit rates for TPS teachers were consistently lower than the same rate for their charter school peers.

Some notable differences occur for teachers from certain demographic backgrounds. For example, Black TPS teachers have higher transfer rates and exit rates than their white TPS peers. Less experienced TPS teachers (those in their first five years of teaching) were more likely to exit than their more experienced TPS peers. Additionally, while exit rates differed very little among TPS teachers with and without a higher degree, more educated charter school teachers often experienced higher exit rates.

In Table 3, we present descriptive statistics for charter school teachers and TPS teachers separately, by the type of mobility that a teacher exhibited in any particular year. Each observation in these tables represents a teacher in a given year, so teachers can be represented in multiple columns. All teacher-by-year observations are in the column to the far right for each sector. On the far left, again by sector, we describe the set of teacher-year observations for teachers that are least mobile (remaining in sector), and then as we move to the right we see teachers who transfer sectors followed by teachers exiting the profession. As with Table 1, the sample used for this table is the statewide analytic sample in row 7 of Appendix Table A.

Table 2
Unadjusted exit and transfer rates, by sector and subgroup

Charter Teacher Exit Rates							
	All Teachers	White	Black	1-5 Years Exp.	6+ Years Exp.	Bachelor's or Less	Master's or Higher
2005	11.3%	11.0%	12.4%	11.8%	8.3%	10.8%	13.2%
2006	12.1%	12.5%	10.4%	12.7%	9.5%	11.6%	14.1%
2007	10.9%	10.9%	11.1%	11.2%	9.7%	10.1%	14.1%
2008	8.5%	8.5%	8.6%	8.9%	7.1%	8.1%	9.9%
2009	10.4%	10.4%	10.4%	10.5%	10.0%	9.9%	11.9%
2010	9.4%	9.4%	9.5%	9.5%	9.1%	8.8%	11.3%
2011	11.5%	11.8%	9.6%	12.0%	10.2%	11.4%	11.9%
2012	10.8%	11.1%	9.3%	11.3%	9.7%	10.8%	10.9%
2013	12.3%	12.3%	12.8%	13.7%	9.4%	12.5%	12.0%
2014	13.8%	13.6%	14.7%	15.0%	11.3%	13.6%	14.3%
TPS Teacher Exit Rates							
	All Teachers	White	Black	1-5 Years Exp.	6+ Years Exp.	Bachelor's or Less	Master's or Higher
2005	4.0%	3.8%	7.4%	4.7%	3.5%	4.2%	3.8%
2006	4.2%	4.0%	7.2%	5.1%	3.6%	4.2%	4.2%
2007	4.4%	4.2%	7.1%	5.2%	3.9%	4.5%	4.3%
2008	3.6%	3.3%	8.6%	4.6%	3.2%	3.9%	3.4%
2009	4.0%	3.8%	8.9%	4.9%	3.7%	4.2%	3.9%
2010	3.8%	3.6%	8.1%	5.4%	3.1%	4.5%	3.3%
2011	5.1%	4.8%	11.4%	6.7%	4.5%	5.9%	4.5%
2012	5.4%	5.3%	8.2%	7.0%	4.8%	6.2%	4.9%
2013	5.7%	5.5%	9.8%	7.2%	5.0%	6.1%	5.3%
2014	6.0%	5.9%	9.1%	8.1%	5.1%	7.0%	5.2%
Charter to TPS Transfer Rates							
	All Teachers	White	Black	1-5 Years Exp.	6+ Years Exp.	Bachelor's or Less	Master's or Higher
2005	8.4%	8.0%	9.9%	8.8%	6.3%	9.0%	6.1%
2006	6.2%	6.0%	6.9%	6.5%	4.6%	6.1%	6.4%
2007	7.0%	7.1%	6.8%	7.3%	5.8%	7.3%	6.1%
2008	5.4%	5.5%	5.2%	5.7%	4.6%	5.5%	5.4%
2009	8.4%	7.8%	10.9%	8.7%	7.2%	8.3%	8.6%
2010	5.8%	5.0%	9.5%	5.5%	6.6%	5.5%	6.8%
2011	7.4%	7.1%	9.2%	7.4%	7.4%	7.2%	8.0%
2012	8.6%	8.3%	10.2%	9.6%	6.4%	8.7%	8.2%
2013	9.1%	8.6%	12.1%	9.8%	7.8%	8.8%	10.0%
2014	8.1%	8.0%	9.0%	8.7%	6.9%	8.1%	8.3%
TPS to Charter Transfer Rates							
	All Teachers	White	Black	1-5 Years Exp.	6+ Years Exp.	Bachelor's or Less	Master's or Higher
2005	0.4%	0.3%	1.9%	0.7%	0.2%	0.6%	0.2%
2006	0.4%	0.2%	2.5%	0.6%	0.2%	0.5%	0.3%
2007	0.3%	0.2%	1.6%	0.6%	0.2%	0.4%	0.2%
2008	0.4%	0.3%	2.4%	0.7%	0.3%	0.6%	0.3%
2009	0.4%	0.2%	2.5%	0.6%	0.2%	0.5%	0.3%
2010	0.3%	0.2%	1.7%	0.7%	0.2%	0.5%	0.2%
2011	0.5%	0.4%	2.1%	1.1%	0.2%	0.8%	0.3%
2012	0.6%	0.4%	3.7%	1.2%	0.4%	0.8%	0.4%
2013	0.6%	0.5%	2.5%	1.2%	0.4%	0.9%	0.4%
2014	0.5%	0.4%	2.8%	1.2%	0.3%	0.8%	0.3%

Note: From statewide sample.

Table 3
 Characteristics of Michigan TPS and charter teachers by mobility type

	Traditional Public Schools				Charter Schools			
	Stay in Sector	Inter-Sector Transfer	Indefinite Exit	All Teachers	Stay in Sector	Inter-Sector Transfer	Indefinite Exit	All Teachers
Age	38.2	37.4	41.4	38.3	35.5	33.8	36.5	35.5
Years of Experience	8.2	5.3	7.4	8.1	4.2	3.9	3.7	4.1
% Female	74.0%	71.2%	73.5%	73.9%	80.5%	77.2%	76.3%	79.8%
% Male	26.0%	28.8%	26.5%	26.1%	19.5%	22.8%	23.7%	20.2%
% Urban	21.1%	42.7%	29.5%	21.6%	50.9%	57.9%	54.1%	51.8%
% Suburban	44.1%	34.0%	37.1%	43.7%	33.2%	28.7%	31.6%	32.6%
% Other Locale	34.9%	23.3%	33.4%	34.7%	15.9%	13.4%	14.4%	15.6%
School Enrollment	710.9	626.0	692.8	709.7	563.7	525.0	541.4	558.3
School % FRL	40.5%	60.2%	47.3%	40.9%	64.3%	72.1%	67.5%	65.2%
% White	92.6%	66.8%	84.8%	92.1%	79.8%	75.1%	77.1%	79.2%
% Black	5.0%	28.2%	9.7%	5.3%	16.3%	19.8%	16.0%	16.6%
% Hispanic	1.0%	2.0%	1.3%	1.0%	1.3%	2.1%	1.6%	1.4%
% Other Race	1.4%	3.0%	4.2%	1.5%	2.6%	3.1%	5.3%	2.9%
Master's Degree or Higher	54.7%	35.7%	50.7%	54.5%	24.1%	25.0%	26.9%	24.5%
Observations	501,644	2,312	24,206	528,162	51,224	4,771	7,081	63,076

Note: The numbers and proportions above represent the populations of teachers within their respective sector-year group from the 2005-06 to 2014-15 academic years. Observations are for the statewide analytical sample (n = 591,238). This sample excludes teachers older than 70 or younger than 21, teachers eligible for Michigan's Early Retirement Incentive in 2009, teachers with inconsistent/incomplete exit data, and teachers with 16 or more years of experience.

Table 3 provides descriptive evidence about the kinds of teachers who remain in their sector, transfer sectors, or exit the Michigan public school teaching force indefinitely. In both sectors, teachers who indefinitely exit tend to be older than those who remain in sector or transfer sector. Teachers who indefinitely exit also tend to be less experienced than those who stay, though the relationship between transfer rates and teaching experience depends on sector. Exiters from the charter sector are more likely to have a master's degree or higher, relative to all charter teachers. In the TPS sector, those who remain in sector are most likely to have advanced degrees, followed by indefinite exiters and those who transfer sectors. In both the TPS and charter sector, sector transfers (and to a lesser extent, exiters) are disproportionately likely to be urban and working in schools with higher percent FRL. Similarly, no matter what sector teachers are in, those who transfer sectors are disproportionately likely to be black. In the TPS sector, but not charter schools, exiters are also disproportionately black.

Our analysis is based on an approach similar to a comparative interrupted time series (CITS), with two "treatment" groups hypothesized to be affected by the reforms differently. The CITS framework compares changes in outcomes (specifically indefinite exit or sector-transfer) after the 2011 reforms for teachers in the two sectors. CITS, an interrupted time series with a

non-equivalent comparison group, has been used to estimate the impacts of school accountability policies (Dee & Jacob, 2011; Wong, Cook, & Steiner, 2011), school turnaround reforms (Strunk, Marsh, Hashim, & Bush, 2016; Strunk, Marsh, Hashim, Bush, & Weinstein, 2016), educational programs such as Reading First (Somers, Zhu, Jacob, & Bloom, 2013), and employment programs such as Jobs-Plus (Bloom & Riccio, 2005). CITS is similar to a difference-in-differences (DD) approach, but assesses whether the treatment group deviates more than the comparison group from its baseline trend, whereas DD assesses whether the treatment group deviates more than the comparison group from its baseline mean (Somers et al., 2013). CITS controls for differences in the baseline mean and trends between two groups, rather than assuming parallel baseline trends (as in DD). In other words, CITS accounts not only for differences in the levels between treatment and comparison groups, but also for differences in their natural growth rates (Somers et al., 2013). This is particularly important given that our two groups (teachers in charter schools and teachers in TPS schools) likely had differential pre-trends in attrition and transfer.

In a more typical CITS application, causal inference requires that deviations from prior trends in the comparison group serve as a valid counterfactual for what would have happened in the treatment group in the absence of the policy change. In our scenario, we do not have a clear treatment-comparison contrast, but rather two groups potentially affected by reform. In essence, our approach estimates post-reform differences in deviations from each group's pre-reform exit or transfer trends.

We are interested in three outcomes, j , for a teacher i in school year t : 1) remaining within sector; 2) transferring between the two public school sectors; or 3) exiting the profession indefinitely. Our definition of remaining in sector includes two types of teachers: those who never leave their sector, and those who take one or more breaks from teaching during our time period but then return to the same sector. Our definition of sector transfer includes two types of teachers: those who immediately transfer into the other sector, and those who take a break from teaching, and when they return, do so in the other sector. Our definition of exit only includes teachers who leave the profession and never return to teaching in a Michigan public school within our observable data (by the end of 2016-17). Thus we estimate Equation 1, a CITS model similar to Dee and Jacob (2011) but modified to provide multinomial predictions of the probability that teacher i elects outcome j after school year t :

$$\mu_{ijt} = \beta_0 + \beta_1 Charter_{it} + \beta_2 Year_t + \beta_3 Post_t + \beta_4 Years_Since_Reform_t + \beta_5 (Charter_{it} \times Year_t) + \beta_6 (Charter_{it} \times Post_t) + \beta_7 (Charter_{it} \times Years_Since_Reform_t) + \beta_8 urban_{dit} + \beta_9 closure_{sit} + \beta_{10} num_openings_{cit+1} + \mathbf{X}_{it}\boldsymbol{\beta} + \mathbf{Y}_{st}\boldsymbol{\gamma} + \mathbf{C}_{kt}\boldsymbol{\delta} + \varepsilon_{it}, \quad (1)$$

$Year_t$ is a time-trend variable starting with 0 for the first year in the analytic dataset, 2005-06, $Post_t$ is an indicator variable equal to 1 for any time period including and following the 2011 policy changes (i.e. in 2011-12 and later) and 0 for each earlier time period, and $Years_Since_Reform_t$ is a time trend variable defined such that it equals zero in all periods prior to and including the year of the policy-change (through 2011-12), one in 2012-13, two in 2013-14, and three in 2014-2015. Thus, the total policy-related change by the end of the study period (2014-15) for TPS teachers is the sum of $(\widehat{\beta}_3 + 3 \times \widehat{\beta}_4)$, where $\widehat{\beta}_3$ can be interpreted as an immediate shift in the rate (level) of a given outcome, and $\widehat{\beta}_4$ can be interpreted as a change in slope (the trend over time of the outcome) starting in the second outcome year.

$Charter_{it}$ indicates whether teacher i was serving in a charter school in year t . Using interactions with other variables, $Charter_{it}$ allows us to estimate a separate shift in the level and change in trend for teachers in the charter sector. Thus, the total policy-related change in behavior within the charter sector after four years is the sum of $(\widehat{\beta}_3 + 3 \times \widehat{\beta}_4)$ and $(\widehat{\beta}_6 + 3 \times \widehat{\beta}_7)$. The term β_5 indicates whether there was a statistically significant difference between the treatment and comparison groups' baseline trends, which is likely to be the case when comparing charter to TPS teachers. Controlling for this is one benefit of the CITS approach over a simple DD.

We control for the urbanicity of the district d that teacher i taught in in year t by including an indicator, $urban_{dit}$ based on the U.S. Department of Education's Common Core of Data. To account for new schools opening near where a teacher currently works, which may be associated with the likelihood that a teacher transfers, we include $num_openings_{cit+1}$, the number of schools that open in the following year ($t+1$) in the Intermediate School District (ISD), c , that teacher i worked in during year t . We also account for school closures (which should be positively associated with teacher exits or transfers), by including an indicator, $closure_{sit}$, for whether the school s that teacher i taught in during year t had no teachers working in it the following year, and thus was assumed to be closed. To account for demographic characteristics of schools that might influence teacher attrition rates, we include the vector \mathbf{Y}_{st} , which includes the proportion of free and reduced price eligible students in school s in year t , the school proportion of students with special education needs, the proportion of non-white, non-Asian students in the school, and the size of the school as measured by student enrollment.

Given that the timing of these reforms also followed the Great Recession, which theoretically affected certain areas differentially, we include C_{kt} to account for a pair of economic factors which may impact a teacher's labor decisions. Using data from the American Community Survey collected by the U.S. Census Bureau, we include in our analysis both median income and unemployment for county k in year t . We use time variant measures of income and

unemployment to control for local economic conditions which may be associated with a teacher's likelihood to transfer or exit. For cases in which these indicators were missing, we included an indicator of missing data to avoid dropping these observations from the analysis.

X_{it} is a vector of teacher-level demographic characteristics including teaching experience, experience squared, and indicators for female, black, Hispanic, and other non-white races, and whether the teacher has a master's degree or higher. In a subset of models, we also include interactions between some of these key teacher characteristics and the variables of interest, *Trend*, *Post*, *Years_Since_Reform*, *Charter*Trend*, *Charter*Post*, and *Charter*Years_Since_Reform*, to determine which types of teachers within these sectors appear to be driving any changes in mobility. The idiosyncratic random error term is indicated by ϵ_{it} . Standard errors are clustered at the ISD level to account for nesting of teachers within geographic regions that also roughly define local labor markets.

V. Results

Multinomial probit regressions: Marginal effects

Table 4 presents the marginal effects of primary interest resulting from Equation (1) for our primary three outcomes: staying in sector, switching sectors, or leaving Michigan public schools (TPS or charter) indefinitely. For full results see Appendix Table C. We present the results in three sets of two columns. Each set comprises an outcome—remaining in sector, transferring sector, or exiting the profession—while columns within a set are representative of our statewide analytical sample and top quintile of charter density, respectively. The CITS approach allows us to estimate whether charter school teachers and TPS teachers transferred or exited at differential rates in post-reform years relative to pre-reform rates.

Representing post-reform changes in that behavior for TPS teachers, *Post* indicates the immediate change following the reform (during the 2011-12 school year) and *Years_Since_Reform* indicates the change in trend in future years. The total change for TPS teachers after four years is the sum of *Post* + 3 years**Years_Since_Reform*.

*Charter*Post* indicates whether there was a differential change in teacher mobility in the charter sector relative to the TPS sector immediately following the reform (in the 2011-12 school year), and *Charter*Years_Since_Reform* indicates whether there was a differential change in the trend of teacher mobility in charter schools relative to TPS schools in future years. The total change four years after the reform for charter teachers, relative to TPS teachers, is the sum of *Charter*Post* + 3 years * (*Charter*Years_Since_Reform*). Adding this to *Post* + 3 years**Years_Since_Reform* gives the overall change, after three years, for Charter teachers.

Table 4

 CITS Multinomial ~~probit~~ regression predicting staying in sector, switching sector, or exiting profession

	Average Marginal Effects: Multinomial Probit Regression					
	Stay in Sector		Transfer Sectors		Exit	
	Statewide	Q5	Statewide	Q5	Statewide	Q5
Post	-0.024** (0.003)	-0.033** (0.008)	0.009** (0.001)	0.015** (0.002)	0.015** (0.003)	0.018** (0.006)
Years Since Reform	-0.006** (0.002)	-0.006 (0.005)	0.002** (0.000)	0.003** (0.001)	0.003* (0.001)	0.003 (0.004)
Charter * Post	0.035** (0.004)	0.041** (0.005)	-0.014** (0.001)	-0.019** (0.002)	-0.022** (0.003)	-0.022** (0.005)
Charter * Years Since Reform	0.011** (0.001)	0.013** (0.003)	-0.005** (0.000)	-0.008** (0.001)	-0.006** (0.001)	-0.005 (0.003)
Policy-Related Change After 4 Years						
After 4 Years, TPS	-0.040** (0.003)	-0.050** (0.007)	0.015** (0.001)	0.023** (0.002)	0.025** (0.002)	0.028** (0.007)
After 4 Years, Charter	0.028** (0.006)	0.030** (0.005)	-0.014** (0.001)	-0.021** (0.002)	-0.014** (0.005)	-0.008* (0.004)
Observations	591,238	236,888	591,238	236,888	591,238	236,888

Note: Marginal effects calculated using predicted probabilities for a multinomial ~~probit~~. Individual controls include race, gender, an indicator for the possession of a master's degree or higher, age, and experience. School controls include enrollment, % FRL, and % special education. Higher level controls include school openings, closures, charter density in ISD, county-level median income (in thousands \$US), and unemployment. Four-year effect calculated as (Post + (3*Years Since Reform)). Standard errors clustered at ISD level. ** p < .01, * p < .05

In Table 4, we provide these sums, representing the total changes for each group, after four years.

The results in Table 4 suggest statistically significant behavioral shifts in both sectors following the reforms. Immediately post-reform, teachers in traditional public schools were approximately 2.4 percentage points less likely to remain in sector (and about 3.3 percentage points less likely in the Q5 sample) while being slightly more likely to either transfer sectors or exit Michigan public schools entirely. The magnitude of these shifts in behavior were larger in the top quintile of charter density than in the state as a whole, which aligns with our theory that places with a larger proportional charter sector are likely to have more movement between the sectors. In the first post-reform year, relative to these TPS shifts, charter teachers were 3.5 percentage points more likely to remain in their sector (4.1 percentage points in the Q5 sample) and generally less likely than TPS teachers to either transfer or exit (although the charter-TPS differential change in exit rates lost some statistical significance). Thus, the overall combined post-reform difference in the first year (indicated by the sum of *Post* and *Charter*Post*) was about a 1.1 percentage point increase in the likelihood that a charter teacher remains in sector (0.8 percentage points in the Q5 sample), a 0.5 percentage point decline in the likelihood of transfer from charter to TPS (a 0.4 percentage point decline in Q5), and a 0.7 percentage point

decline in likelihood of exit from the charter sector (a 0.4 percentage point decline in Q5). There is a clear indication that more of the policy-related changes in behavior were on the TPS side, which bore the full force of reform.

The effect sizes just described pertain to the level shift in mobility in the first year following the reform). The coefficients on *Years Since Reform* indicate changes in trends following the reform. Changes in the trends of these same outcomes are smaller and occasionally insignificant (statistically and/or substantively). Per year, TPS teachers exhibited a decreasing likelihood of remaining in sector on the magnitude of about 0.6 percentage points (same, but not statistically significant, in the Q5 sample). For charter teachers, the total change in trend (*Years Since Reform* + *Charter* * *Years Since Reform*) was positive. The changes in the trend of transfer and exit rates were smaller in magnitude, and in the opposite direction as the changes in the trend of the rate of staying in sector.

To estimate the total policy-related change for these two groups of teachers, we calculate the TPS change after four years, as well as the charter change after four years in the bottom panel of Table 4. Corresponding to the results mentioned above, we find that the four-year difference for TPS teachers is a 4 percentage point decline in the likelihood of staying in sector (5 percentage points in the Q5 sample), with statistically significant increases in the likelihood of both transferring sectors and exiting Michigan public schools altogether. For charter teachers, the behavioral change after four years was about a 2.8 percentage point increase in the likelihood of staying in sector (3.0 percentage points in the Q5 sample), with declines in both exits and sector transfers. Thus, the overall finding is that the reforms were generally associated with movements out of TPS and into charter schools.

Changes by subgroup

In addition to understanding the overall changes in exit rates and sector transfer rates for charter and TPS teachers following the reform, we also seek to understand if there are heterogeneous responses by teacher characteristics. To assess whether different kinds of teachers in the two sectors reacted differently to the reforms, we estimate similar CITS models, but add variables interacting our key variables (*Trend*, *Post*, *Years_Since_Reform*, *Charter*Trend*, *Charter*Post*, and *Charter*Years_Since_Reform*) with some key teacher demographic variables (indicators for race, degree attainment, and early career defined as five or fewer years of teaching experience). Each subgroup is analyzed in separate models, with interactions only included for the subgroup under investigation. These analyses allow us to investigate whether labor market effects may be borne to a greater or lesser extent by some types of teachers relative to others.

We provide the results of these interaction models in Table 5. This table presents only the calculated four-year effects for the various subgroups. Additional results are in Appendix Tables D-F.

Table 5
 CITS multinomial probit regression predicting staying in sector, switching sector, or exiting profession: Average marginal effects after four years, by teacher type

	Stay in Sector		Transfer Sectors		Exit	
	Statewide	Q5	Statewide	Q5	Statewide	Q5
Race						
White TPS	-0.043** (0.004)	-0.069** (0.004)	0.018** (0.002)	0.035** (0.005)	0.027** (0.003)	0.034** (0.004)
White Charter	0.036** (0.005)	0.035** (0.006)	-0.016** (0.002)	-0.018** (0.002)	-0.020** (0.004)	-0.017** (0.005)
Black TPS	0.009 (0.012)	0.016 (0.014)	0.001 (0.001)	0.003 (0.002)	-0.010 (0.012)	-0.019 (0.015)
Black Charter	-0.031* (0.014)	-0.022** (0.007)	a (0.008)	-0.010* (0.004)	0.032** (0.007)	0.032** (0.004)
Teacher Experience						
1-5 Years TPS	-0.019** (0.004)	-0.030** (0.006)	0.002 (0.002)	0.016** (0.003)	0.017** (0.004)	0.014** (0.005)
1-5 Years Charter	-0.057** (0.006)	-0.054** (0.002)	0.010** (0.002)	0.014** (0.002)	0.047** (0.005)	0.041 (0.003)
6+ TPS	-0.035** (0.006)	-0.032** (0.010)	0.009** (0.003)	0.008** (0.002)	0.025** (0.004)	0.024* (0.011)
6+ Charter	0.073** (0.011)	0.085** (0.018)	-0.030** (0.004)	-0.048** (0.006)	-0.043** (0.008)	-0.037** (0.013)
Education Level						
Less than master's, TPS	-0.045** (0.004)	-0.071** (0.004)	0.018** (0.002)	0.038** (0.002)	0.026** (0.003)	0.033 (0.004)
Less than master's, Charter	0.023* (0.010)	0.014 (0.010)	-0.011** (0.002)	-0.011** (0.002)	-0.012 (0.008)	-0.002 (0.009)
Master's Plus, TPS	-0.024** (0.006)	-0.017 (0.010)	0.001 (0.002)	-0.003 (0.002)	0.023** (0.005)	0.019 (0.011)
Master's Plus, Charter	-0.022 (0.012)	-0.013 (0.012)	0.001 (0.005)	-0.004 (0.004)	0.021** (0.008)	0.017 (0.009)
Observations	591,238	236,888	591,238	236,888	591,238	236,888

Note: Marginal effects calculated using predicted probabilities for a multinomial probit.

Individual controls include race, gender, an indicator for the possession of a master's degree or higher, age, and experience. School controls include enrollment, % FRL, and % special education. Higher level controls include school openings, closures, charter density in ISD, county-level median income (in thousands \$US), and unemployment. An "a" indicates the estimate is <0.001. Four-year effect calculated as (Post + (3*Years Since Reform)). Standard errors clustered at ISD level. ** p < .01, * p < .05

“These results suggest that black teachers choose to exit teaching entirely as opposed to transferring to traditional public schools... (and) that the teaching force in charter schools in particular is becoming even more predominantly white since these reforms.”

The first subgroup analysis tests whether teachers of different racial/ethnic groups may have responded to these reforms differently. We test, specifically, whether post-reform changes in mobility were different for white and black teachers, though indicators for Hispanic teachers or those identified as another race were included in the analysis. We focus only on white and black teachers as they make up 97.3% of our sample, and all other groups are quite small (e.g. Hispanic teachers make up only 1.1% of our sample). Table 5 shows the total policy-related change, after four years, for black and white teachers in each sector. The full results are in Appendix Table D.

Because white teachers comprise the majority of the state’s teaching population, the estimated effects for white teachers generally mirror the overall results in Table 5. White TPS teachers are less likely to remain in sector, more likely to transfer, and more likely to exit, while white teachers in charter schools exhibit the opposite patterns. While four-year results for black TPS teachers were insignificant across the board, black charter teachers show behaviors that do not align with charter trends overall. Four years after the reforms, black charter teachers were approximately 3.1 percentage points less likely to remain in their sector (2.2 percentage points less likely in the Q5 sample). They were also significantly more likely to exit, with statistically significant increases of 3.2 percentage points in both samples. However, they were not significantly

more or less likely to transfer into the TPS sector. Together, these results suggest that black teachers choose to exit teaching entirely as opposed to transferring to traditional public schools. Given that 16 percent of charter teachers statewide are black (higher in charter-dense ISDs), this notable increase in attrition could have relevant implications for teacher supply going into the charter sector. These results indicate that the teaching force in charter schools in particular is becoming even more predominantly white since these reforms.

The second test for heterogeneous shifts in mobility compares the results for early career teachers (those with five or fewer years of teaching experience) to their more experienced

peers.¹¹ The results indicate that, while TPS teachers of all experience levels are less likely to stay in-sector post-reforms, more experienced teachers (those in their sixth or greater year of teaching) are substantially less likely to stay in sector (3.5 versus 1.9 percentage points). For charter school teachers in the post-reform years, we find that novice teachers in their first five years of teaching are 5.7 percentage points less likely to stay in sector, whereas experienced charter teachers (6+ years) are 7.3 percentage points *more* likely to stay in sector. In the Q5 sample, there is less variation between the two groups of teachers, but there is an even greater discrepancy in the effects of the reform on charter teachers by experience for teachers in geographies with the greatest charter concentrations (Q5).

Additional results are in Appendix Table E.

In the third panel, we separate teachers by whether or not they have any post-baccalaureate degree (master's or higher). TPS teachers both with and without advanced degrees were less likely to remain in-sector and more likely to exit following the reforms, but sector transfers post-reform were primarily driven by teachers without masters' degrees or higher. Charter teachers with less than a master's degree mirror overall trends of charter teachers in that they are relatively more likely to remain in sector. However, the change in the likelihood of remaining in the charter sector, for charter teachers with a master's degree or higher, was not statistically distinguishable from zero. Additional results can be found in Appendix Table F.

Multinomial probit regressions: Predicted probabilities

To facilitate interpretation of these results, we graph the predicted probabilities of exiting or transferring sectors for different teacher types, by year in Figures 1-8. These predicted probabilities for transfer and exit are estimated from our CITS models using the full state sample. Figures 1 and 2 are estimated using the model without interactions by teacher type, and represent the overall likelihood of sector transfer or exit, respectively, in the charter and TPS sectors.

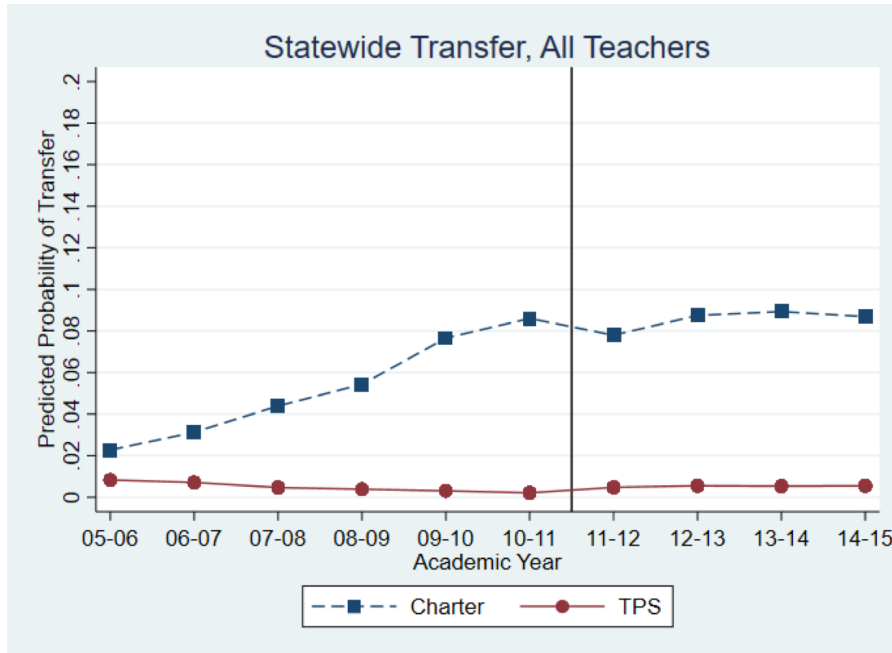
In Figure 1, we show the predicted probabilities of sector transfer for all teachers in the state, by sector. The figure shows that sector transfer rates were on the rise in the charter sector,

“TPS teachers both with and without advanced degrees were less likely to remain in-sector and more likely to exit following the reforms.”

¹¹ We also tested alternative definitions of early career teachers, including models which isolated first year teachers and models which separated teachers with 6 or more years of experience into several experience groups. Results presented here are robust to these alternative specifications.

prior to the reforms. This was followed by an initial decrease immediately following the reforms in the likelihood of transfer among charter teachers. The opposite trend – although much more muted, existed in the TPS sector, with a very slight decline prior to reform, and an immediate, but slight, increase immediately following the reforms. Following the reforms, trends in transfers appear to level off in both sectors.

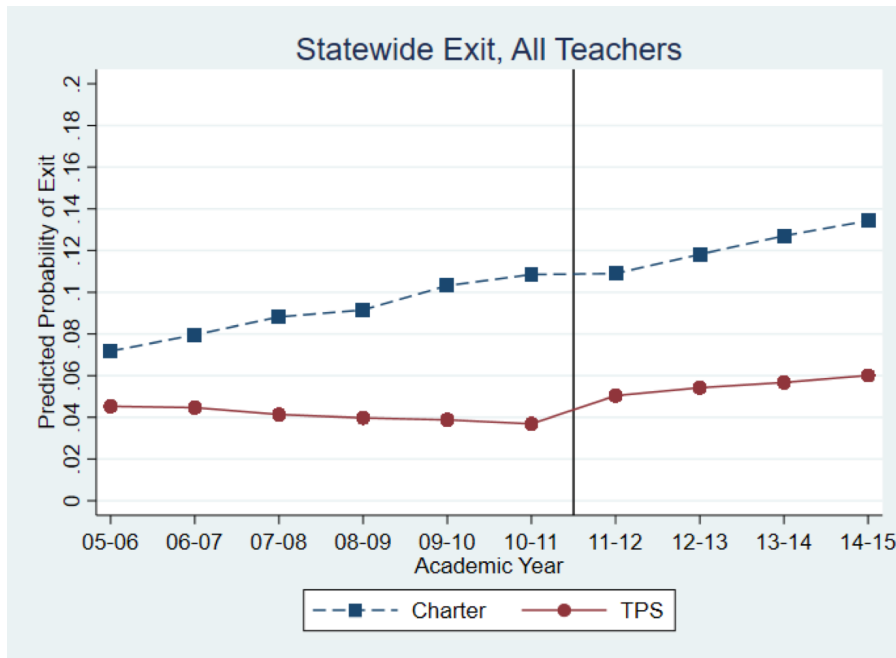
Figure 1
Statewide transfer rates, all teachers



Note. Figure represents predicted probabilities of sector transfer separately by sector and by year, calculated via the multinomial probit model presented in Table 4. Predicted probabilities obtained from the statewide sample.

For the same population, Figure 2 is a visualization of predicted probabilities of exit. Prior to the reforms, we see an increase in exit rates for charter teachers over time and a decrease in exit rates for TPS teachers over time. Immediately following the reforms, there is an increase in the likelihood of exit among TPS teachers, with an additional increase in trend, though minor. On the charter side, there does not appear to be any clear deviation in trend throughout the panel, including the year of reform. Thus, in terms of exits, charter teachers experienced less behavioral change relative to changes in the TPS sector.

Figure 2
Statewide exit rates, all teachers



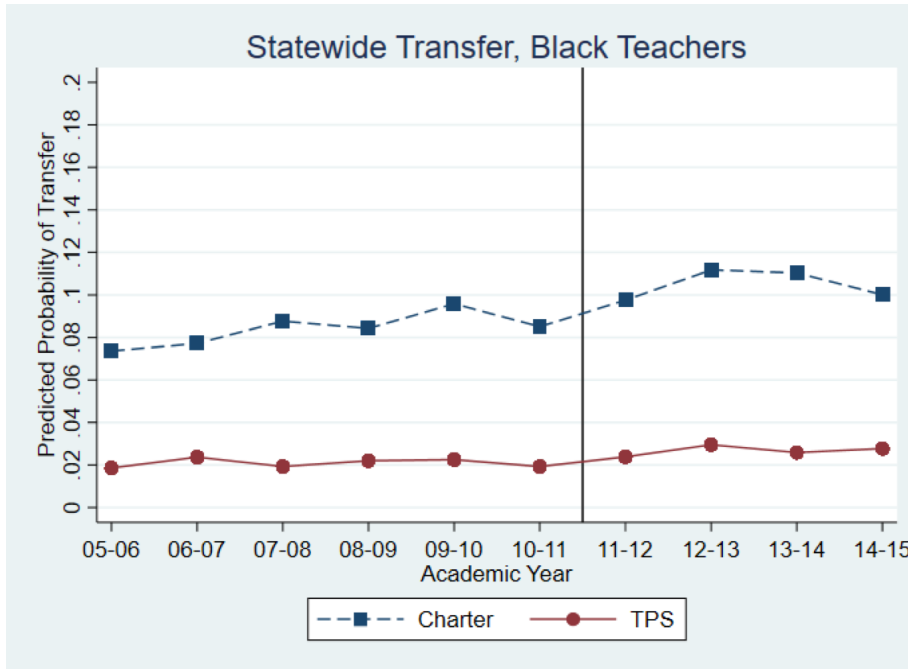
Note. Figure represents predicted probabilities of permanent exit separately by sector and by year, calculated via the multinomial probit model presented in Table 4. Predicted probabilities obtained from the statewide sample.

For comparison, raw exit rates can be found in Table 3. Note, particularly for transfers, predicted probabilities may not completely align with raw exit rates. There exist two main reasons these predicted probability figures differ from the raw rates found in Table 3. The raw rates do not account for observable differences between charter and TPS teachers, so the charter-TPS differences are confounded by other compositional differences (charter teachers are more likely to be Black, less experienced, working in urban areas, etc.).

In addition, the predicted probabilities assume a linear pre-trend for charter teachers and a linear pre-trend for TPS teachers, each conditional on all other observable characteristics, so the predicted probabilities tend to be more linear than the raw rates. It is important to note, however, that the raw rates and predicted probabilities become much more similar once we analyze the figures for specific groups. For example, found in Table 3, the raw rates for black teachers much more closely resemble Figures 3-4, the predicted probabilities for black teachers. This further illustrates that the reason for the differences in the overall graphs is due to compositional effects.

Figure 3

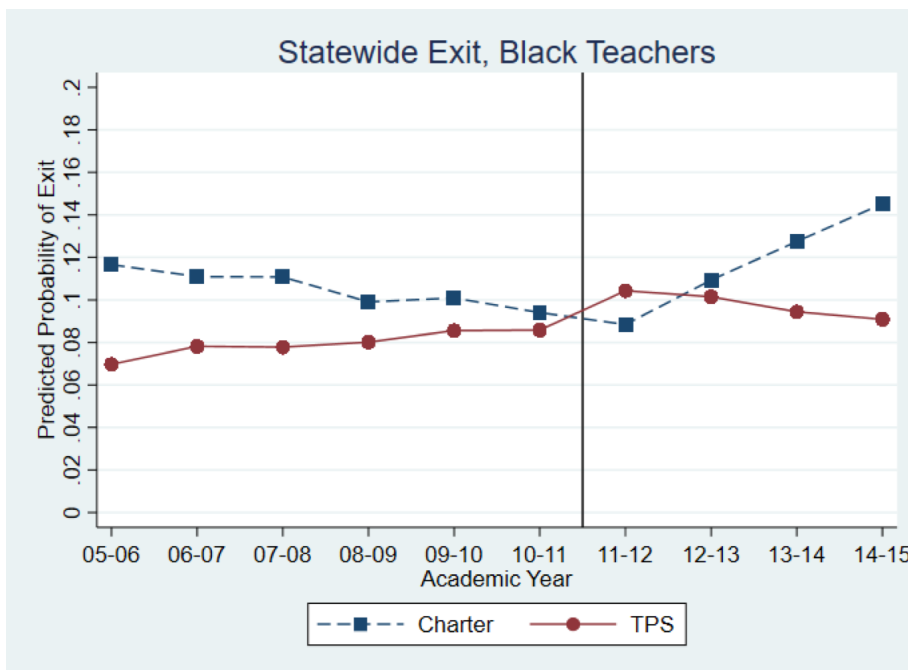
Statewide transfer rates, black teachers



Note. Figure represents predicted probabilities of sector transfer for black teachers separately by sector and by year, calculated via the multinomial probit model presented in Table 5. Predicted probabilities obtained from the statewide sample.

Figure 4

Statewide exit rates, black teachers



Note. Figure represents predicted probabilities of permanent exit for black teachers separately by sector and by year, calculated via the multinomial probit model presented in Table 5. Predicted probabilities obtained from the statewide sample.

We also investigate probabilities of exit and transfers among subgroups of teachers. Starting with Figure 3, analogous to sector transfer numbers in Table 3, we see the predicted probabilities of transfer among black TPS and charter teachers. As discussed previously, the results here are largely similar to the raw numbers. In both sectors, black teachers are more likely to transfer to their counter-sector in the first year following the reform (although this jump is much smaller in the TPS sector), with these trends generally levelling off afterwards.

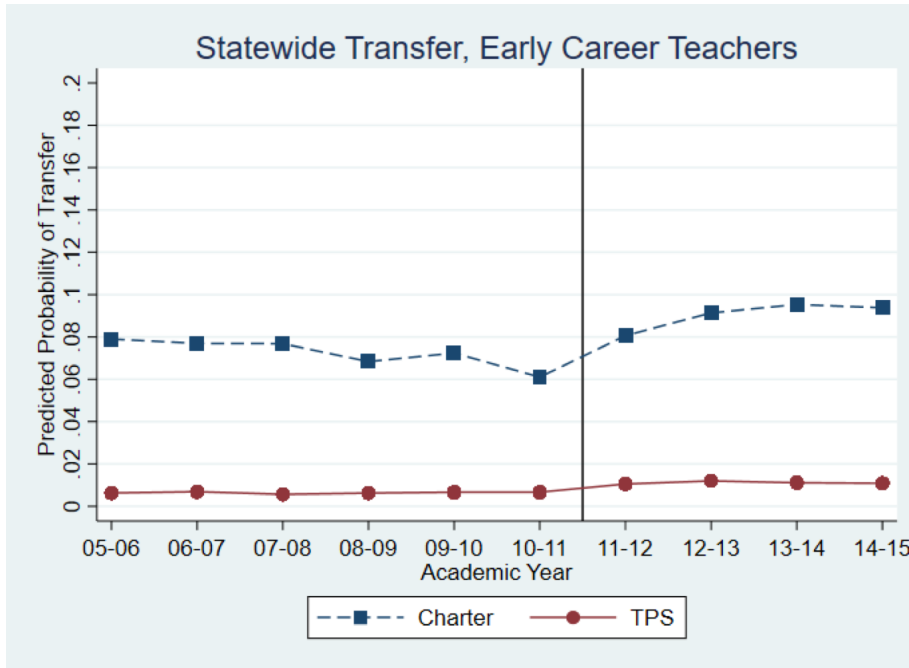
“Early career teachers in both sectors have marginally higher rates of exit than teachers statewide.”

In Figure 4, the predicted probability of exit among black teachers statewide, we see information that is again largely reflective of the raw descriptive data found in Table 3. Within the TPS sector, black teachers appear to exit at significantly higher rates post-reform relative to the year prior, composed of a large increase initially, followed by a slight return toward prior levels. For charter teachers, there was also an increase in exit rates, but timed quite differently. While there seems to be little change in the level of exit immediately following the reforms, the trend in exits appears to increase drastically in future years. The predicted probabilities of transfer and exit for white teachers (not shown) closely mirror those in Figures 1 and 2, as expected, because Michigan’s public school teachers are overwhelmingly white (over 90% of TPS teachers and over 80% of charter teachers are white).

Figures 5 and 6 show transfer and exit predicted probabilities for early career charter and TPS teachers. This set of relatively less experienced teachers exhibited higher rates of sector transfer and exit across the sample, so they are an important subgroup for understanding how policies such as Michigan’s labor market reforms might affect teacher mobility.

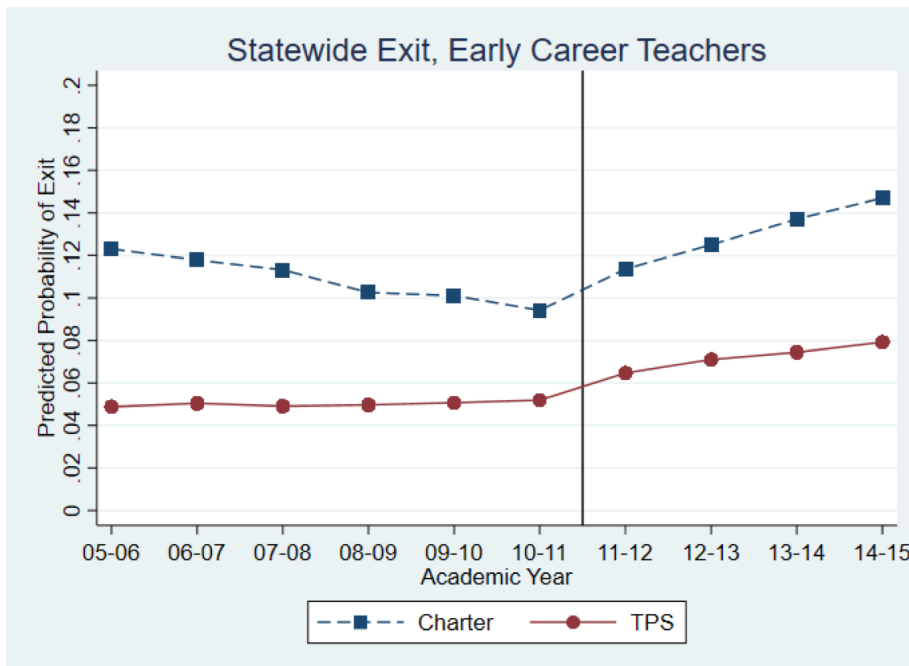
In our analysis, an early career teacher is defined as a teacher within his or her first five years of teaching. In Figure 5, we see a low and relatively constant likelihood of transfer from traditional public schools to the charter sector, similar to many other groups of TPS teachers. Early career charter teachers had a slight decline in transfer rates prior to the reform that increased in the first two years post-reform and then gradually levelled off. This could signify that policy reforms made TPS schools more attractive for these less experienced charter teachers.

Figure 5
Statewide transfer rates, teachers with 1-5 years of experience



Note. Figure represents predicted probabilities of sector transfer for early career teachers separately by sector and by year, calculated via the multinomial probit model presented in Table 5. Predicted probabilities obtained from the statewide sample.

Figure 6
Statewide exit rates, teachers with 1-5 years of experience

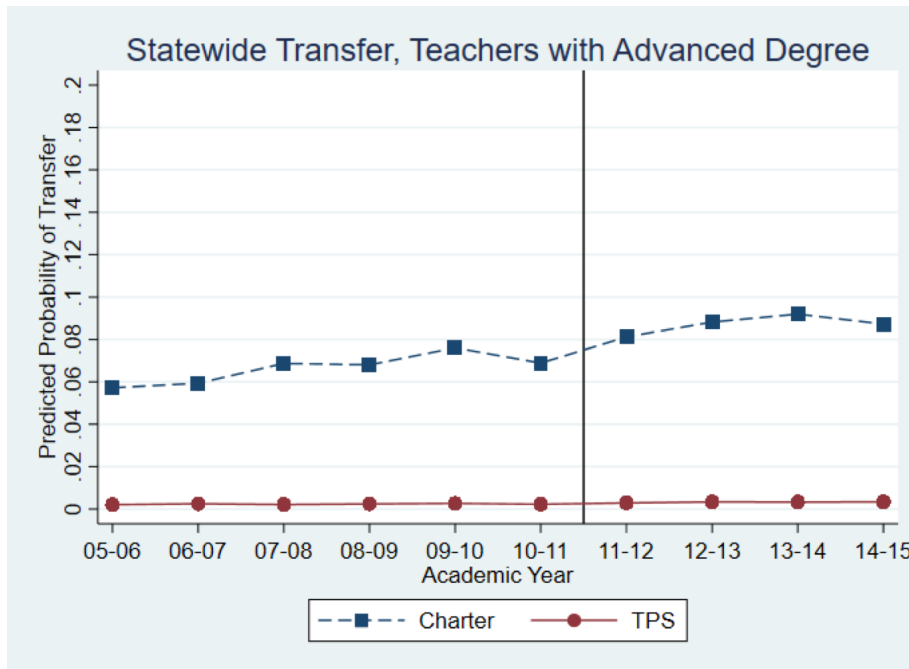


Note. Figure represents predicted probabilities of permanent exit for early career teachers separately by sector and by year, calculated via the multinomial probit model presented in Table 5. Predicted probabilities obtained from the statewide sample.

Exit rates for teachers early in their careers can be found in Figure 6. Note, early career teachers in both sectors have marginally higher rates of exit than teachers statewide. This difference is more noticeable in the charter sector; more novice charter teachers early in the panel have nearly twice the predicted probability of exit as the sector statewide. Also of particular interest is the declining trend in exits pre-reform for less-experienced charter teachers that turned sharply positive post-reform. Whether or not this was a ramification of Michigan’s policy reform, it seems clear that less experienced teachers are more likely to exit the profession—particularly those in the charter sector—after the reforms were passed.

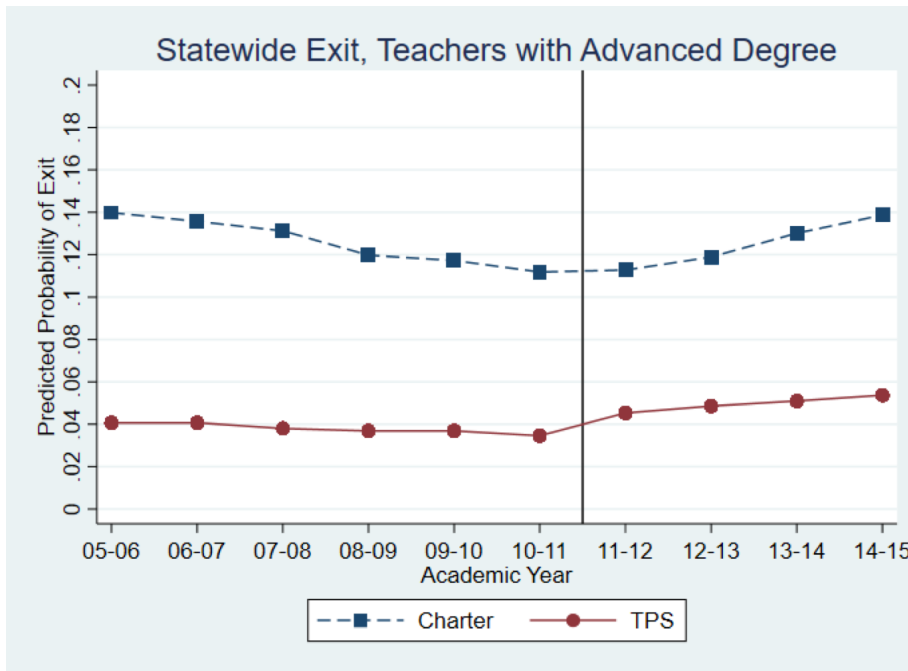
Figures 7 and 8 show transfer and exit predicted probabilities for teachers with a master’s degree or higher, our measure of an advanced education. Looking at transfer probabilities in Figure 7, as seen in earlier figures, behavioral changes are generally muted. The exception is that, in charter schools, we find a modest increase in the predicted probability of transferring to traditional public schools in the early post-reform years, followed by a slight down turn.

Figure 7
Statewide transfer rates, teachers with a master’s degree or higher



Note. Figure represents predicted probabilities of sector transfer for teachers with a master’s degree or higher separately by sector and by year, calculated via the multinomial probit model presented in Table 5. Predicted probabilities obtained from the statewide sample

Figure 8
 Statewide exit rates, teachers with a master’s degree or higher



Note. Figure represents predicted probabilities of permanent exit for teachers with a master’s degree or higher separately by sector and by year, calculated via the multinomial probit model presented in Table 5. Predicted probabilities obtained from the statewide sample.

As for exits, Figure 8 displays mobility changes among teachers with an advanced degree. In the charter sector, predicted probabilities of exit were trending downward prior to the 2011 reforms, at which point the trend reversed. Though an immediate change in exits among these teachers is not apparent, the upward trajectory of exits suggests more educated teachers are increasingly likely to exit the profession following the reforms. For those highly educated teachers in TPS, though, we see little change in the actual trend of exits with a more notable initial level change in 2011. Following the reforms, TPS teachers appear to exit at rates nearly one percentage point higher than they had the year prior.

VI. Discussion

The results above yield several salient takeaways from the evidence on teacher transfer and exit behavior after reforms that potentially narrowed the charter and traditional public school (TPS) labor markets. First, our findings suggest that on the TPS side, the reforms were

associated with an initial increase in sector transfers and exits, as well as an increase in trend. Conversely, on the charter side, teachers were less likely to transfer out of the sector or exit Michigan public schools. This all suggests, perhaps, that the charter sector became more appealing, relative to the TPS sector, following this set of labor market reforms that removed teacher protections, primarily in the TPS sector.

Why would we see a more clear and consistent increase in teacher movement out of their schools in the TPS sector, relative to those in the charter sector? It could be the case that the reforms restricting collective bargaining, restructuring evaluation, and limiting union activity created an environment that was perceived as a “war on teachers,” which resulted in a departure from these schools, either for employment outside of Michigan public schools (although reform effects on TPS teacher exits appeared to only be in disadvantaged districts according to Cowen, et al. 2017) or, marginally, for employment in charter schools.

It does not appear to be the case that the reforms simply made the sectors more similar and enabled more crossover overall, as we actually see that transfers into the TPS sector, from the charter sector, went down. Thus, the overall story seems to be less about blurring the lines between markets and more about making one market (TPS) relatively less attractive. Perhaps a small but significant number of teachers opted not to exit their chosen profession but, upon weakening of some of the protections afforded by the TPS sector historically, saw the marginal utility of TPS careers decline relative to charter teaching.

Such an explanation overall would still mask some important heterogeneity. Our estimates show differential behavior among various subgroups of teachers following the reforms, particularly on the charter side. For example, charter teachers overall were more likely to remain in sector and less likely to transfer and exit, but black teachers had the opposite response. Similarly, early career teachers in the charter sector and those with higher degrees generally responded in opposite ways from their more experienced or less credentialed charter peers, with both of these groups being less likely to stay in sector.

What might this mean for the composition of these sectors? Black charter teachers were more likely to leave Michigan public schools, suggesting that charter schools were losing some of the diversity in their teacher workforce, which was a strength of charter schools in the state, relative to TPS schools.

“Thus, the overall story seems to be less about blurring the lines between markets and more about making one market (traditional public schools) relatively less attractive.”

Given evidence demonstrating that student-teacher racial/ethnic match can help improve outcomes (Egalite, Kisida, & Winters, 2015; Gershenson, Holt, & Papageorge, 2016; Lindsay & Hart, 2017), this trend might be potentially problematic for the efficacy of Michigan charters, which serve a disproportionate share of African American students in particular (Cowen, Creed, & Keesler, 2018). In addition, the composition of the charter teacher workforce was becoming relatively less educated. Thus, it appears as though, post-reform, the charter sector is losing a potentially important group of teachers.

Early career charter teachers also experienced greater attrition, suggesting that charter schools faced increased churn of very new teachers within schools. Teacher turnover can be harmful to students and to schools as organizations (Hanushek, Rivkin, & Schiman, 2016; Ost, 2014; Ronfeldt, Loeb, & Wyckoff, 2013) However, given that the more experienced teachers were more likely to stay in-sector, this suggests more stability of the teacher work force in charters, once teachers make it beyond those earliest years. There were less clear differences in behavior on the TPS side. Most of the subgroups within TPS teachers had the same general behavior (or no estimated changes in behavior). No subgroups of TPS teachers clearly responded in opposite ways, as we saw occurring on the charter side.

In this study, we set out to estimate whether a set of labor market reforms that significantly altered employment protections in traditional public schools had potential spillover effects on the charter teacher labor market in Michigan. We originally hypothesized two possible outcomes: either a perceived “war on teachers” that would increase exit, or an increase in the similarity between traditional public schools and charter schools that might induce crossover of teachers between the sectors. Largely, we find evidence that following this set of reforms, which substantially altered the working conditions for teachers in the TPS sector—and to a much lesser extent—those in charters, teachers were less likely to remain in the TPS sector, relative to similar peers in charter schools.

References

- Baker, B., & Dickerson, J. (2006).** Charter schools, teacher labor market deregulation, and teacher quality: *Evidence from the Schools and Staffing Survey Educational Policy*, 20(5), 752-778.
- Ballou, D., & Podgursky, M. J. (1997).** *Teacher pay and teacher quality*. Kalamazoo, MI: Upjohn Institute for Employment Research.
- Bell-Weixler, L., Harris, D. N., & Barrett, N. (2017).** *Teachers' Perspectives on Learning and Work Environments under the New Orleans School Reforms Technical Report*, Education Research Alliance, Tulane University. Retrieved 8/18/2017 from <http://educationresearchalliancencola.org/publications/teachers-perspectives-on-learning-and-work-environments-under-the-new-orleans-school-reforms>
- Bifulco, R., & Ladd, H. F. (2006).** The impacts of charter schools on student achievement: Evidence from North Carolina. *Education Finance and Policy*, 1(1), 50– 90.
- Bloom, H. S., & Riccio, J. A. (2005).** Using place-based random assignment and comparative interrupted time-series analysis to evaluate the Jobs-Plus employment program for public housing residents. *The ANNALS of the American Academy of Political and Social Science*, 599(1), 19-51.
- Booker, K., Zimmer, R., & Buddin, R. (2005).** *The effect of charter schools on school peer composition*. Rand Working Paper No. WR-306-EDU.
- Burian-Fitzgerald, M., & Harris, D. (2004).** Teacher recruitment and teacher quality? Are charter schools different? Policy Report Number 20. *Education Policy Center, Michigan State University*.
- Carruthers, C. K. (2012).** The qualifications and classroom performance of teachers moving to charter schools. *Education Finance and Policy*, 7(3), 233–68.
- Cowen, J. M., Brunner, E., Strunk, K., & Drake, S. (2017).** *A war on teachers? Labor market responses to statewide reform*. East Lansing, MI: Education Policy Innovation Collaborative, White Paper #1. Retrieved 6/28/2018 from <http://education.msu.edu/epic/documents/White-Paper-1-A-War-on-Teachers.pdf>
- Cowen, J. M., Creed, B., & Keesler, V. (2018).** *Revolving Doors: Student Mobility in Michigan's Public School Choice System*. Education Policy Innovation Collaborative (EPIC) Working Paper
- Cowen, J. M., & Winters, M. A. (2013).** Do Charters Retain Teachers Differently? Evidence from Elementary Schools in Florida. *Education Finance and Policy*, 8(1), 14-42.
- Dee, T. S., & Jacob, B. (2011).** The impact of No Child Left Behind on student achievement. *Journal of Policy Analysis and Management*, 30(3), 418-446.
- Egalite, A. J., Kisida, B., & Winters, M. A. (2015).** Representation in the classroom: The effect of own-race teachers on student achievement. *Economics of Education Review*, 45, 44- 52.

- Gershenson, S., Holt, S. B., & Papageorge, N. W. (2016).** Who believes in me? The effect of student–teacher demographic match on teacher expectations. *Economics of Education Review*, 52, 209-224.
- Hanushek, E. A., Rivkin, S. G., & Schiman, J. C. (2016).** Dynamic effects of teacher turnover on the quality of instruction. *Economics of Education Review*, 55, 132–148.
- Hart, C., & Sojourner, A. J. (2015).** Unionization and productivity: Evidence from charter schools. *Industrial Relations: A Journal of Economy and Society*, 54(3), 422-448.
- Higgins, L. (October 16, 2017).** Detroit charter school teachers vote to unionize. *Detroit Free Press*. Retrieved 1/30/2018 from <https://www.freep.com/story/news/education/2017/10/16/detroit-charter-school-teachers-unionize/767771001/>
- Hoxby, C. M. (1996).** How teachers' unions affect education production. *The Quarterly Journal of Economics*, 111(3), 671-718.
- Hoxby, C. M. (2002).** Would school choice change the teaching profession? *Journal of Human Resources*, 37(4), 846–91.
- Hoxby, C. M., Murarka, S., & Kang, J. (2009).** *How New York City's charter schools affect achievement*. Cambridge, MA: New York City Charter Schools Evaluation Project.
- Janus v. American Federation of State, County, and Municipal Employees, Council 31, et al., 585 U.S. ____ (2018).**
- Koski, W. S., & Horng, E. L. (2007).** Facilitating the teacher quality gap? Collective bargaining agreements, teacher hiring and transfer rules, and teacher assignment among schools in California. *Education Finance and Policy*, 2(3), 262–300.
- Lindsay, C. A., & Hart, C. M. (2017).** Exposure to same-race teachers and student disciplinary outcomes for Black students in North Carolina. *Educational Evaluation and Policy Analysis*, 39(3), 485-510.
- Lovenheim, M. F. (2009).** The effect of teachers' unions on education production: Evidence from union election certifications in three midwestern states. *Journal of Labor Economics*, 27(4), 525-587.
- Malloy, C., & Wohlstetter, P. (2003).** Working conditions in charter schools: What's the appeal for teachers? *Education and Urban Society*, 35, 219-241
- Marianno, B. (2015).** Teachers' unions on the defensive? How recent collective bargaining laws reformed the rights of teachers. *Journal of School Choice*, 9(4), 551-577.
- Marianno, B. D. & Strunk, K. O. (in press).** "The Bad End of the Bargain? Revisiting the Relationship between Collective Bargaining Agreements and Student Achievement." *Economics of Education Review*.
- Matsudaira, J. D. & Patterson, R. W. (2017).** Teachers' unions and school performance: Evidence from California charter schools, *Economics of Education Review*, 61, 35-50.
- Miron, G., & Applegate, B. (2007).** *Teacher attrition in charter schools*. Great Lakes Center for Education Research and Practice. Retrieved 6/28/2018 from http://greatlakescenter.org/docs/Research/Miron_Attrition.pdf

- Miron, G., & Gulosino, C. (2013).** *Profiles of for-profit and nonprofit education management organizations: Fourteenth Edition—2011-2012*. Boulder, CO: National Education Policy Center. Retrieved 1/24/2018 from <http://nepc.colorado.edu/publication/EMO-profiles-11-12>
- Moe, T. M. (2009).** Collective bargaining and the performance of public schools. *American Journal of Political Science*, 53(1), 156–74.
- National Council on Teacher Quality (2015).** *State of the States 2015: Evaluating Teaching, Leading, and Learning*. Retrieved 9/26/2017 from <http://www.nctq.org/dmsView/StateofStates2015>
- Newton, X. A., Rivero, R., Fuller, B., & Dauter, L. (2011).** *Teacher stability and turnover in Los Angeles: The influence of teacher and school characteristics*. University of California, Berkeley. Policy Analysis for California Education.
- Ni, Y. (2012).** Teacher working conditions in charter schools and traditional public schools: A comparative study. *Teachers College Record*, 114(3), 1-26.
- Nicholson-Crotty, S., Grissom, J. A., & Nicholson-Crotty, J. (2012).** Governance and the impact of public employee unions on organizational performance. *Public Performance and Management Review*, 35(3), 422–48.
- Ost, B. (2014).** How do teachers improve? The relative importance of specific and general human capital. *American Economic Journal: Applied Economics*, 6, 127–151.
- Ozek, U., Carruthers, C., & Holden K. (2018).** Teacher Value Added in Charter Schools and Traditional Public Schools. CALDER Working Paper 183. Retrieved 1/27/2018 from: <https://caldercenter.org/publications/teacher-value-added-charter-schools-and-traditional-public-schools>
- Podgursky, M. (2006).** *Teams versus Bureaucracies: Personnel Policy, Wage-Setting, and Teacher Quality in Traditional Public, Charter, and Private Schools*. Education Working Paper Archive.
- Podgursky, M. J., & Springer, M. G. (2007).** Teacher performance pay: A review. *Journal of Policy Analysis and Management*, 26(4), 909-949.
- Ronfeldt, M., Loeb, S., & Wyckoff, J. (2013).** How teacher turnover harms student achievement. *American Educational Research Journal*, 50, 4–36.
- Somers, M., Zhu, P., Jacob, R., & Bloom, H. (September 2013).** *The validity and precision of the comparative interrupted time series design and the difference-in-difference design in educational evaluation*. MDRC Working Paper on Research Methodology. Retrieved 6/28/2018 from https://www.mdrc.org/sites/default/files/validity_precision_comparative_interrupted_time_series_design.pdf
- State of Michigan (2010).** 95th Regular Session of 2010 Public Act 75. Retrieved 6/28/2018 from <http://www.legislature.mi.gov/documents/2009-2010/publicact/pdf/2010-PA-0075.pdf>

- State of Michigan (2011).** 96th Regular Session of 2011 Public Acts 100-103 [http://www.legislature.mi.gov/\(S\(shpnxyzcl5gk4bdylhw3wuz\)\)/documents/2011-2012/publicact/pdf/2011-PA-0100.pdf](http://www.legislature.mi.gov/(S(shpnxyzcl5gk4bdylhw3wuz))/documents/2011-2012/publicact/pdf/2011-PA-0100.pdf); [http://www.legislature.mi.gov/\(S\(z1qtzld2isehcowpzfqppzt\)\)/documents/2011-2012/publicact/pdf/2011-PA-0101.pdf](http://www.legislature.mi.gov/(S(z1qtzld2isehcowpzfqppzt))/documents/2011-2012/publicact/pdf/2011-PA-0101.pdf); <https://www.legislature.mi.gov/documents/2011-2012/publicact/html/2011-PA-0102.htm>; [http://www.legislature.mi.gov/\(S\(f4zpymrzyn3defdbjqcjqzwy\)\)/documents/2011-2012/publicact/pdf/2011-pa-0103.pdf](http://www.legislature.mi.gov/(S(f4zpymrzyn3defdbjqcjqzwy))/documents/2011-2012/publicact/pdf/2011-pa-0103.pdf) Accessed 8/7/2015
- State of Michigan (2012).** 96th Regular Session of 2012 Public Act 349. Retrieved 8/7/2015 from <https://www.legislature.mi.gov/documents/2011-2012/publicact/html/2012-PA-0349.htm>
- State of Michigan (2015).** 98th Regular Session of 2015 Public Act 173. Retrieved 6/28/2018 from <https://www.legislature.mi.gov/documents/2015-2016/publicact/pdf/2015-PA-0173.pdf>
- Strunk, K. O. (2011).** Are teachers unions really to blame? *Education Finance and Policy*, 6(3), 354–98.
- Strunk, K. O. (2012).** Policy poison or promise: Exploring the dual nature of California school district collective bargaining agreements. *Educational Administration Quarterly*, 48(3), 506–47.
- Strunk, K. O., Cowen, J., Goldhaber, D., Marianno, B., Kilbride, T., & Theobald, R. (2018).** “It is in the Contract: How the Policies Set in Teachers’ Unions’ Collective Bargaining Agreements Vary Across States and Districts.” *Educational Policy*, 32(3), 280-310.
- Strunk, K. O., & Grissom, J. A. (2010).** Do strong unions shape district policies? *Educational Evaluation and Policy Analysis*, 32(3), 389–406.
- Strunk, K. O., Marsh, J. A., Hashim, A. & Bush, S. C. (2016).** “Innovation and Return to the Status Quo: A Mixed-Methods Study of Reconstitution through the Lens of Organizational Learning.” *Educational Evaluation and Policy Analysis*, 38(3), 549-577.
- Strunk, K. O., Marsh, J. A., Hashim, A., Bush, S. C. & Weinstein, T. (2016).** “The Impact of Turnaround Reform on Student Outcomes: Evidence and Insights from the Los Angeles Unified School District.” *Education Finance & Policy*, 11(3), 251-282.
- Strunk, K. O., & McEachin, A. (2011).** Accountability under constraint: The relationship between collective bargaining agreements and California schools’ and districts’ performance under No Child Left Behind. *American Educational Research Journal*, 48(4), 871–903.
- Stuit, D. A., & Smith, T. M. (2012).** Explaining the gap in charter and traditional public school teacher turnover rates. *Economics of Education Review*, 31(2), 268-279.
- Thomsen, J. (2014).** Teacher performance plays growing role in employment decisions. Education Commission of the States. Retrieved 4/1/2015 from <http://www.ecs.org/clearinghouse/01/12/42/11242.pdf>

- Torres, A. C. (2016).** Is this work sustainable? Teacher turnover and perceptions of workload in charter management organizations. *Urban Education*, 51(8), 891-914.
- Witte, J., Weimer, D., Shober, A., & Schlomer, P. (2007).** The performance of charter schools in Wisconsin. *Journal of Policy Analysis and Management*, 26(3), 557-7.
- Wong, M., Cook, T. D., & Steiner, P. M. (2011).** *No Child Left Behind: An interim evaluation of its effects on learning using two interrupted time series each with its own non-equivalent comparison series.* Working Paper WP-09-11. Institute for Policy Research, Northwestern University. Retrieved 6/28/2018 from <http://www.ipr.northwestern.edu/publications/docs/workingpapers/2009/IPR-WP-09-11.pdf>

Appendix A

We begin with all TPS and charter teachers in Michigan over the course of our panel (N=145,431 unique teachers and 1,024,321 teacher-year observations). We first remove teachers with incomplete or inconsistent exit data (row 2 of Appendix Table A). In developing an indicator for teacher exit, there exist observations for which a teacher does not appear in the data the following year but without a provided termination date. There are also cases for which the date of termination does not match the final year they appear in the data. For accurate identification of termination of employment, we required a match between the termination date and apparent exit year based on the last year of employment observed. All observations for any teachers that did not meet these criteria were dropped. This amounts to 26,968 teacher-year observations (approximately 2.6%) and drops 2,971 teachers entirely from our sample.

To reduce noise created by exits due to retirements or unusual teachers who enter the profession before the age of 21, we exclude 1,205 teacher-year observations or about 0.12% of our total sample for teachers older than 70 years of age or younger than 21. This drops 277 unique teachers entirely from the sample. This is shown in the third row of Appendix Table A.

Next, the operationalization of our outcome variables requires dropping two years from the end of our panel (see row 4). Our key outcomes of interest are permanent exit from teaching in a Michigan public school (either TPS or charter), and transfer to the other sector. We identify exit in year t based on whether a teacher is missing permanently from the data in years later than time t (permanent exit), and we identify sector transfer based on whether a teacher is observed in the other sector in the observation following that in t . We exclude the 2015-16 and 2016-17 school years because our definition of exit requires that a teacher never return to teach in a Michigan public school in future years. A large number of teachers may leave in any given year and then return two years later, perhaps for personal or family reasons, so we do not want to count these teachers as true “exits.” Thus, we use data from 2015-16 and 2016-17 to help us identify teacher exits for earlier years, but do not include these years in our main analysis.

Similarly, our definition of transfer includes both immediate transfers and transfers into the sector in future years. In this case, the 2015-16 transfer rate would likely be understated, because some teachers leave the data for a year and then appear in the other sector two or more years later. In 2016-17, the last year of our data, behavior in the following year cannot be observed at all. Dropping the 2015-16 and 2016-17 school years from our analysis removes 153,704 observations (15.0%) and 7,661 unique teachers completely from the data.

In row 5 of Appendix Table A, to account for a program that greatly increased the likelihood of exit from the profession and was much more likely to affect TPS teachers, we exclude teachers who were eligible for Michigan’s early retirement incentive, Public Act 75 of 2010 (State of Michigan, 2010) in academic year 2009-2010. To be eligible, the sum of a teacher’s age and years of experience had to be at or above 80, or the teacher had to be at least 60 years old with 10 or more years of experience. The eligible teachers overwhelmingly taught in TPS schools—of the 73,119 observations dropped due to this sample restriction, 72,349 (98.9%) were for TPS teachers.

Our final restriction further seeks to limit the sample so that careful comparisons can be made across the two sectors. As noted above, charter teachers tend to be younger and less experienced than those in traditional public schools. In our sample, teachers with more than 15 years of experience are overwhelmingly in the TPS sector—176,848 observations out of 178,087, or 99.3%. There are likely to be unobservable characteristics about the relatively few charter teachers with high levels of experience, and attempting to make comparisons across these groups would likely introduce omitted variables bias. Thus, to more appropriately compare labor market behaviors, we drop all teachers with more than 15 years of experience (see row 6).

The restrictions described thus far are the key sample restrictions that produce our state-wide analytic sample (row 7), which includes 105,540 unique teachers and 591,238 teacher-year observations. This sample represents about 73% of the original number of teachers in the data, and about 58% of the original number of teacher-year observations.

In addition to the state-wide sample in row 7, alternate specifications use a sample restricted to areas with relatively high charter concentration. For this alternative sample, we restrict the sample to the teacher-year observations for teachers located in Intermediate School Districts (ISDs) in the top quintile of charter density in the year prior to reform. The ISD-level charter density is calculated as the proportion of 2010 teachers within a given ISD who taught in charter schools in 2010, the last pre-reform year. Charter teachers comprise 7% or more of their ISD teaching force in the top quintile of charter density when using this constant, 2010 measure. This restriction narrows our analysis to geographic labor markets with theoretically more meaningful inter-sector competition.

Appendix Table A
 Sample size comparisons due to data restrictions

	Unique Teachers	Teacher-year observations	
	<i>n</i>	<i>n</i>	
(1) All teachers in Michigan traditional public schools or charter schools	145,431	1,024,321	
(2) Observations for teachers with incomplete exit data	2,971	26,968	} Numbers reflect omissions resulting from the given category
(3) Observations for teachers older than 70 or younger than 21 years of age	277	1,205	
(4) Observations for 2015-16 and 2016-17 as we cannot appropriately identify exit	7,661	153,704	
(5) Observations eligible for Michigan's 2009 Early Retirement Incentive	11,190	73,119	
(6) Observations for teachers with more than 15 years of experience	17,792	178,087	
(7) State Analytical Sample	105,540	591,238	
(8) Restrict to the top quintile of charter density as measured by the proportion of teachers in an ISD serving in a charter school in 2010	58,812	354,350	
(9) Top Quintile Sample	46,728	236,888	

Note: Omissions are sequential from top to bottom. Percentages calculated based on starting sample. Separate analyses are estimated using the State Analytical Sample and the Top Quintile Sample.

Appendix Table B

	2005-2010			2011-2014		
	TPS	Charter	Difference	TPS	Charter	Difference
Age	38.1	35.5	-2.6	38.7	35.5	-3.2
Years of Experience	7.8	3.8	-4.0	8.8	4.5	-4.3
% Female	73.8%	80.0%	6.2%	74.3%	79.5%	5.2%
% Male	26.2%	20.0%	-6.2%	25.7%	20.5%	-5.2%
% Urban	22.2%	50.6%	28.4%	20.5%	53.0%	32.6%
% Suburban	42.9%	32.8%	-10.1%	45.0%	32.5%	-12.6%
% Other Locale	34.9%	16.6%	-18.3%	34.5%	14.5%	-20.0%
School Enrollment	719.4	532.7	-186.7	693.1	585.7	-107.4
School % FRL	37.5%	59.4%	21.9%	46.8%	71.5%	24.7%
% White	92.3%	78.3%	-14.0%	91.9%	80.1%	-11.8%
% Black	5.9%	18.8%	12.9%	4.4%	14.1%	9.8%
% Hispanic	0.9%	1.3%	0.3%	1.3%	1.5%	0.3%
% Other Race	0.9%	1.6%	0.7%	2.5%	4.3%	1.8%
Master's Degree or Higher	53.1%	21.8%	-31.2%	56.9%	27.4%	-29.5%
Observations	333,389	32,659		194,773	30,417	

Note: The numbers and proportions above represent the populations of teachers within their respective sector-year group. Years identified as the fall in which the academic year starts (e.g. "2005" = 2005-06). Observations are for the statewide analytical sample (n = 591,238). This sample excludes teachers older than 70 or younger than 21, teachers eligible for Michigan's Early Retirement Incentive in 2009, teachers with inconsistent exit data, teachers with 16 or more years of experience, and observations from 2015-16 and 2016-17. Difference columns are calculated with TPS as the reference group. FRL = eligible for free- or reduced-price lunch.

Appendix Table C

Full results corresponding to Table 4

	<u>Stay in Sector</u>		<u>Transfer Sectors</u>		<u>Exit</u>	
	Statewide	Q5	Statewide	Q5	Statewide	Q5
Trend	0.003** (0.000)	0.004** (0.001)	-0.002** (0.000)	-0.003** (0.000)	-0.001 (0.000)	-0.001* (0.001)
Post	-0.024** (0.003)	-0.033** (0.008)	0.009** (0.001)	0.015** (0.002)	0.015** (0.003)	0.018** (0.006)
Years Since Reform	-0.006** (0.002)	-0.006 (0.005)	0.002** (0.000)	0.003* (0.001)	0.003* (0.001)	0.003 (0.004)
Charter * Trend	-0.013** (0.001)	-0.015** (0.001)	0.005** (0.000)	0.008** (0.000)	0.007** (0.001)	0.007** (0.001)
Charter * Post	0.035** (0.004)	0.041** (0.005)	-0.014** (0.001)	-0.019** (0.002)	-0.022** (0.003)	-0.022** (0.005)
Charter * YSR	0.011** (0.001)	0.013** (0.003)	-0.005** (0.000)	-0.008** (0.001)	-0.006** (0.001)	-0.005 (0.003)
School Closure	-0.045** (0.002)	-0.055** (0.004)	0.013** (0.001)	0.023** (0.002)	0.032** (0.002)	0.032** (0.002)
School Opening	a (0.000)	0.001** (0.000)	a (0.000)	a (0.000)	a (0.000)	a (0.000)
Log Enrollment	0.005** (0.001)	0.005 (0.003)	-0.002** (0.000)	-0.003** (0.001)	-0.002* (0.001)	-0.002 (0.003)
School % FRL	-0.040** (0.004)	-0.053** (0.006)	0.016** (0.002)	0.026** (0.003)	0.024** (0.003)	0.027** (0.004)
School % SE	0.004 (0.005)	0.003 (0.006)	-0.006* (0.003)	-0.006* (0.003)	0.001 (0.003)	0.004 (0.004)
Median Income (\$000s)	a (0.000)	a (0.000)	a (0.000)	a (0.000)	a (0.000)	a (0.000)
Unemployment	0.001 (0.001)	a (0.002)	a (0.001)	-0.001 (0.001)	a (0.001)	a (0.001)
Missing Census Data	-0.028 (0.015)	-0.052 (0.054)	0.013* (0.007)	0.004 (0.027)	0.015 (0.011)	0.048 (0.030)
ISD Charter Density	-0.089** (0.034)	-0.152 (0.086)	0.042 (0.023)	0.098 (0.066)	0.047* (0.021)	0.054* (0.024)
Urban	-0.010** (0.002)	-0.012** (0.004)	0.003** (0.001)	0.007** (0.002)	0.007** (0.002)	0.006 (0.003)
Suburban	a (0.002)	a (0.004)	0.001 (0.001)	0.005 (0.003)	-0.002 (0.002)	-0.005* (0.002)
<u>Years Experience</u>	0.007** (0.000)	0.008** (0.000)	-0.002** (0.000)	-0.002** (0.000)	-0.006** (0.000)	-0.006** (0.001)
Experience Squared	a (0.000)	a (0.000)	a (0.000)	a (0.000)	a (0.000)	a (0.000)

Appendix Table C (Cont'd)

Full results corresponding to Table 4

Age	0.012** (0.000)	0.013** (0.000)	a (0.000)	a (0.000)	-0.012** (0.000)	-0.013** (0.000)
Age Squared	a (0.000)	a (0.000)	a (0.000)	a (0.000)	a (0.000)	a (0.000)
Female	0.007** (0.001)	0.010** (0.002)	-0.002** (0.000)	-0.003** (0.001)	-0.006** (0.001)	-0.007** (0.002)
Black	-0.023** (0.002)	-0.027** (0.002)	0.007** (0.000)	0.011** (0.001)	0.016** (0.002)	0.016** (0.002)
Hispanic	-0.012** (0.002)	-0.013** (0.002)	0.005** (0.001)	0.007** (0.002)	0.007** (0.002)	0.007** (0.002)
Other Race	-0.046** (0.002)	-0.045** (0.003)	0.003** (0.001)	0.004** (0.001)	0.043** (0.003)	0.041** (0.003)
Master's or Higher	-0.001 (0.001)	-0.002 (0.002)	-0.002** (0.000)	-0.002** (0.000)	0.003** (0.001)	0.004* (0.002)
Observations	591,238	236,888	591,238	236,888	591,238	236,888

Note: Marginal effects calculated using predicted probabilities for a multinomial ~~probit~~. Individual controls include race, gender, an indicator for the possession of a master's degree or higher, age, and experience. School controls include enrollment, % FRL, and % special education. Higher level controls include school openings, closures, charter density in ISD, county-level median income (in thousands \$US), and unemployment. An "a" indicates the estimate is <0.001. Four-year effect calculated as (Post + (3*Years Since Reform)). Standard errors clustered at ISD level. ** p <0 .01, * p <0 .05

Appendix Table D

Subgroup analyses based on teacher race, corresponding to Table 5

	<u>Stay in Sector</u>		<u>Transfer Sectors</u>		<u>Exit</u>	
	Statewide	Q5	Statewide	Q5	Statewide	Q5
Post	-0.023** (0.004)	-0.035** (0.008)	0.011** (0.001)	0.020** (0.003)	0.012** (0.003)	0.015* (0.007)
Years Since Reform	-0.007** (0.001)	-0.011** (0.002)	0.002** (0.000)	0.005** (0.001)	0.005** (0.001)	0.006* (0.003)
Charter * Post	0.039** (0.004)	0.048** (0.008)	-0.016** (0.001)	-0.024** (0.003)	-0.023** (0.003)	-0.023** (0.007)
Charter * YSR	0.014** (0.001)	0.020** (0.003)	-0.006** (0.001)	-0.010** (0.001)	-0.008** (0.001)	-0.009** (0.002)
Black * Post	0.008* (0.003)	0.013 (0.009)	-0.009** (0.001)	-0.015** (0.002)	0.001 (0.003)	0.002 (0.008)
Black * YSR	0.015** (0.004)	0.024** (0.003)	-0.003** (0.001)	-0.006** (0.001)	-0.013** (0.004)	-0.018** (0.003)
Charter * Black * Post	-0.030** (0.006)	-0.031** (0.010)	0.016** (0.002)	0.020** (0.002)	0.015** (0.005)	0.012 (0.010)
Charter * Black * YSR	-0.030** (0.002)	-0.037** (0.002)	0.006** (0.002)	0.007** (0.002)	0.025** (0.003)	0.030** (0.003)
Hispanic * Post	0.016 (0.009)	0.027 (0.018)	-0.009 (0.006)	-0.017 (0.012)	-0.007 (0.008)	-0.009 (0.009)
Hispanic * YSR	-0.001 (0.004)	0.005 (0.004)	-0.001 (0.001)	-0.002 (0.002)	0.002 (0.003)	-0.004 (0.003)
Charter * Hispanic * Post	-0.034* (0.014)	-0.041* (0.020)	0.019* (0.008)	0.033* (0.015)	0.015 (0.012)	0.008 (0.012)
Charter * Hispanic * YSR	-0.003 (0.005)	-0.008 (0.005)	0.006* (0.002)	0.013** (0.002)	-0.003 (0.005)	-0.005 (0.005)
Other Race * Post	-0.049** (0.009)	-0.055** (0.016)	-0.013** (0.003)	-0.021** (0.007)	0.061** (0.009)	0.076** (0.018)
Other Race * YSR	0.022** (0.003)	0.026** (0.006)	-0.003** (0.001)	-0.005** (0.002)	-0.019** (0.003)	-0.021** (0.005)
Charter * Other Race * Post	-0.032 (0.021)	-0.021 (0.017)	0.020** (0.004)	0.022** (0.007)	0.012 (0.019)	-0.002 (0.022)
Charter * Other Race * YSR	-0.022** (0.008)	-0.026 (0.014)	0.004 (0.003)	0.004 (0.005)	0.017** (0.006)	0.022* (0.010)
Observations	591,238	236,888	591,238	236,888	591,238	236,888

Note: Marginal effects calculated using predicted probabilities for a multinomial ~~probit~~. Individual controls include race, gender, an indicator for the possession of a master's degree or higher, age, and experience. School controls include enrollment, % FRL, and % special education. Higher level controls include school openings, closures, charter density in ISD, county-level median income (in thousands \$US), and unemployment. YSR = Years Since Reform. Four-year effect calculated as (Post + (3*Years Since Reform)). Standard errors clustered at ISD level. ** p < 0.01, * p < 0.05

Appendix Table E

Subgroup analyses based on teaching experience, corresponding to Table 5

Average Marginal Effects After Four Years: Multinomial Probit Regression						
	Stay in Sector		Transfer Sectors		Exit	
	Statewide	Q5	Statewide	Q5	Statewide	Q5
Post	-0.023** (0.003)	-0.028** (0.005)	0.005** (0.001)	0.006** (0.001)	0.017** (0.003)	0.023** (0.005)
YSR	-0.004 (0.003)	-0.001 (0.005)	0.001 (0.001)	0.001 (0.001)	0.003 (0.002)	0.001 (0.005)
Charter * Post	0.050** (0.006)	0.054** (0.012)	-0.016** (0.002)	-0.020** (0.004)	-0.034** (0.005)	-0.034** (0.010)
Charter * YSR	0.019** (0.002)	0.021** (0.003)	-0.008** (0.001)	-0.012** (0.002)	-0.011** (0.002)	-0.009** (0.003)
Early Career * Post	0.009** (0.002)	0.013** (0.004)	-0.002 (0.002)	0.006** (0.002)	-0.007* (0.004)	-0.019** (0.004)
Early Career * YSR	0.002 (0.002)	-0.004 (0.003)	-0.002* (0.001)	0.001 (0.001)	a (0.002)	0.003 (0.003)
Charter * Early Career * Post	-0.060** (0.006)	-0.063** (0.010)	0.018** (0.002)	0.016** (0.003)	0.043** (0.005)	0.047** (0.008)
Charter * Early Career * YSR	-0.028** (0.002)	-0.026** (0.003)	0.010** (0.001)	0.013** (0.001)	0.018** (0.002)	0.014** (0.003)
Observations	591,238	236,888	591,238	236,888	591,238	236,888

Note: Marginal effects calculated using predicted probabilities for a multinomial probit. Individual controls include race, gender, an indicator for the possession of a master's degree or higher, age, and experience. School controls include enrollment, % FRL, and % special education. Higher level controls include school openings, closures, charter density in ISD, county-level median income (in thousands \$US), and unemployment. An "a" indicates the estimate is <0.001. YSR = Years Since Reform. Four-year effect calculated as (Post + (3*Years Since Reform)). Standard errors clustered at ISD level. ** p <0.01, * p < 0.05

Appendix Table F

Subgroup analyses based on teacher degree level, corresponding to Table 5

Average Marginal Effects After Four Years: Multinomial Probit Regression						
	Stay in Sector		Transfer Sectors		Exit	
	Statewide	Q5	Statewide	Q5	Statewide	Q5
Post	-0.027** (0.004)	-0.040** (0.007)	0.011** (0.001)	0.020** (0.002)	0.016** (0.003)	0.019** (0.007)
YSR	-0.006** (0.001)	-0.010** (0.003)	0.002** (0.000)	0.006** (0.001)	0.003** (0.001)	0.005 (0.003)
Charter * Post	0.035** (0.004)	0.041** (0.005)	-0.015** (0.002)	-0.022** (0.002)	-0.020** (0.004)	-0.019** (0.005)
Charter * YSR	0.011** (0.002)	0.014** (0.003)	-0.005** (0.000)	-0.009** (0.001)	-0.006** (0.002)	-0.006 (0.003)
Master's Plus * Post	0.012** (0.003)	0.020** (0.004)	-0.009** (0.002)	-0.018** (0.003)	-0.003 (0.003)	-0.002 (0.004)
Master's Plus * YSR	0.003 (0.002)	0.011** (0.002)	-0.003** (0.001)	-0.007** (0.001)	a (0.002)	-0.004 (0.002)
Charter * Master's Plus * Post	-0.026** (0.007)	-0.029** (0.009)	0.015** (0.003)	0.023** (0.006)	0.011 (0.006)	0.006 (0.006)
Charter * Master's Plus * YSR	-0.013** (0.003)	-0.017** (0.002)	0.005** (0.001)	0.008** (0.000)	0.009** (0.003)	0.009** (0.002)
Observations	591,238	236,888	591,238	236,888	591,238	236,888

Note: Marginal effects calculated using predicted probabilities for a multinomial probit. Individual controls include race, gender, an indicator for the possession of a master's degree or higher, age, and experience. School controls include enrollment, % FRL, and % special education. Higher level controls include school openings, closures, charter density in ISD, county-level median income (in thousands \$US), and unemployment. An "a" indicates the estimate is <0.001. YSR = Years Since Reform. Four-year effect calculated as (Post + (3*Years Since Reform)). Standard errors clustered at ISD level. ** p < 0.01, * p < 0.05