Online Appendix for Insufficient Accountability? Heterogeneous Effects of Charter Schools across Authorizing Agencies

This online appendix contains additional analyses and commentary to support our manuscript. We have divided the online appendix into four sections, by order of reference in the Results section of our manuscript. The first section contains additional context for the main effects of charter schools across authorizers based on school closures and Tables A1 and A2. The second section includes additional context on the authorizer/operator interactions, with Tables A3-A5. The third section contains robustness checks and alternative model specifications to support our main results, including Tables A6-A9. The fourth section includes descriptive and model information looking at additional student and school subsamples in Tables A10-A14. Overall, the results contained here within support our main findings and conclusions.

Authorizer Main Effects and School Closures

In order to learn more about the schools overseen by each authorizer and which ones remained open by the end of our sample, we ran descriptive statistics and additional models where we split out BSU, IMO, and ICSB schools by whether or not those schools were open by the final year of our data, 2018. Note that these were the only three authorizers with enough schools for us to split the categories while still complying with our data sharing agreement. A substantial number of charter schools in our analysis did close: 16 of 38 BSU schools, 12 of 32 IMO schools, and 5 of 10 ICSB schools (see Table A1). For all three categories the average student in closed schools had lower test scores than those that remained open by 0.1-0.4 SD. However, this descriptive comparison is not an inference that these schools were of lower quality. We also note the student population in closed BSU schools were also more likely to be black than in open schools (42 vs. 29 percent) and receiving free or reduced price lunch (80 vs. 60 percent). In ICSB authorized schools, students attending closed charter schools were more

likely to be special education students (28 vs. 17 percent in open schools) and to have received an out-of-school suspension (40 percent vs. 11 percent). There were minimal differences in the compositions between IMO closed and open charter schools as of 2018, and these schools also had the smallest average achievement differences (less than 0.20 standard deviations).

<Table A1 about here>

In Table A2, we display the modeling results comparing closed vs. open schools for BSU and IMO authorized charters. For BSU, students attending the schools that closed by 2018 had large achievement losses in both subjects through three years, while in open schools, modest losses in math and null impacts in ELA. For IMO, students attending closed schools had large positive impacts in both subjects with more modest positive impacts in open schools. We provide commentary about these findings as part of our results and discussion in the manuscript.

<Table A2 about here>

Authorizer and Operator Type Interactions

Table A3 summarizes the annual school effects by operator type: CMOs, physical EMOs, virtual EMOs, and independently operated schools. Overall, CMOs and physical EMOs tended to have small to moderate positive effects in math across all years. These impacts were similar in ELA, with the exception that the first two years for physical EMOs were null. In contrast, virtual EMOs had large negative effects in math across all years and moderate to large negative effects in ELA in the first two years (the third year estimate is null at our adjusted significance level of 0.0125). Independently operated schools tended to have small to moderate negative effects in math across all years with null effects in ELA. As we discuss in the manuscript, the virtual EMO findings largely drive the negative effects of charters authorized by BSU.

<Table A3 about here>

As a companion to the operator type analysis, we checked whether the fidelity of the matching process held for both virtual and physical BSU schools in Table A4. The results revealed few differences between treatment and comparisons groups in either setting, suggesting the subsamples are also largely balanced. We note the difference in chronic absenteeism at baseline between treatment and comparison comes within the virtual school subsample, though we adjust for these differences in our analytical models. When comparing treatment students, we note meaningful differences on several dimensions. Students attending BSU-authorized virtual charters tend to have higher baseline achievement by about 0.20 standard deviations in both subjects, are much more likely to be white (90 vs. 39 percent), much less likely to be black (5 vs. 45 percent) or Hispanic (3 vs. 14 percent), and less likely to have received free or reduced-price lunch (58 vs. 76 percent) than their peers attending brick-and-mortar BSU-authorized charters. Across these dimensions, BSU virtual charter students come from more advantaged backgrounds than their BSU brick-and-mortar charter peers, which makes the poor performance of students in these virtual charters somewhat surprising.

<Table A4 about here>

We go a step further to compare charter school students across all four types of operator types for BSU and the two main operator types for IMO (CMO and independent) along with their public comparison peers in Table A5. This table provides additional nuance about the students served within each of these authorizer and operator type combinations. We find balance between treatment and comparison students within each of these subgroups, but note some differences in the charter student subsamples. Students attending a BSU-authorized CMO or physical EMO are comparable to one another across the host of baseline characteristics, as is the

case for students in BSU-authorized virtual EMOs and independently operated charters. Thus, similar background differences exist between these two larger groupings (CMO and physical EMO vs. virtual EMO and independent) as described above when discussing Table A4. In IMO authorized charters, students attending schools operated by a CMO have slightly lower baseline achievement (by 0.10 to 0.15 SD) and are much more likely to be black (75 vs. 47 percent) than students attending schools which are independently operated and authorized by the IMO.

<Table A5 about here>

Robustness Checks and Alternative Model Specifications for Authorizer Main Effects

We tested the robustness of our estimates through multiple alternative model specifications, each of which focused on the two largest authorizers, BSU and IMO (see Tables A6 and A7). First, we shrunk the caliper from 0.20 to 0.05 when matching on achievement, which decreased the match rate to 31 percent but should plausibly create treatment and comparison groups that are even more similar in baseline achievement. In the second specification, we reran all models without matching on baseline achievement and relying on controls for baseline achievement alone to condition out differences in student achievement. The match rate here is 91 percent, revealing that the test score caliper is the main factor driving down the analytical sample matching rate (60 percent). In a different specification, we dropped students who left charter schools after one or two posttreatment years in the treatment group to estimate a treatment effect on the treated. A fourth specification involved the inclusion of pre-baseline scores in our model to account for baseline *trends* in achievement (St. Clair et al., 2016; Waddington & Berends, 2018). In a fifth specification, we ran models that only include students who move into charter schools during a structural change in schools (i.e., after finishing the final

grade offered by their former school) to avoid potential bias stemming from a non-structural move. Last, in a sixth alternative specification we account for grade fixed effects.

<Tables A6 and A7 about here>

Our main results appear to be robust to all of these alternative specifications, with one exception: in the models that did not match on baseline achievement. Here, the IMO-authorized schools in year three were no longer significant in either subject and across all years the magnitude of effects were reduced by 40 to 60 percent. However, there is also a significant baseline difference of 0.05 to 0.07 standard deviation favoring the comparison group of students, which is roughly the same magnitude of reduction in the post-treatment year positive effects for IMO-authorized charter students. We also note a baseline imbalance for BSU students in math. This underscores the importance of matching on baseline achievement, despite how it constrains the matching rate. In previous work (Fitzpatrick et al., 2020; Waddington & Berends, 2018), we have also tested other specifications such as including polynomial prior achievement terms and more detailed mobility indicators. Our estimates remain consistent with these other specifications, too (results available upon request).

Our sample includes all eligible students who switched from a traditional public school to a charter school. However, the number of students making this switch into each school is not necessarily proportionate to the number of students attending each school. In particular, schools with increasing enrollment over the relevant time period will be over-represented in our sample, since enrollment growth typically stems from students switching into a school. Because of this, we performed another robustness check that adjusts for this potential source of bias. The robustness check, presented in Table A8, reruns our main models without indicators for authorizer category, but with charter school fixed effects. After estimating the model, we extract

the coefficients for each school fixed effect. We present the weighted means and standard deviations across these coefficients for each authorizer category, with weights reflecting overall school enrollment. These weighted means can be directly compared to the coefficients presented in Table 3 of the manuscript. The direction and magnitude of these estimates mirror the main findings, though we cannot estimate statistical significance for these estimates. We note the BSU results appear slightly more positive in both subjects than our preferred model, suggesting that the negative impacts are likely driven by the largest schools (some of the virtual EMOs).

<Table A8 about here>

One final alternative modeling strategy is an analysis where, instead of running separate regression models for each year, we combined all years of data, included year-by-treatment interaction effects, and used student fixed-effects rather than matched-cell fixed effects (see Table A9). The resulting models compare students to themselves pre-switch to charter schools rather than to their matched peers. The results of this strategy mirror the findings of the main analysis for BSU students. The IMO results in this model are similar to the main results in direction and magnitude but become insignificant. We suspect this stems from the increased standard error size resulting from the inclusion of over 50,000 student fixed-effect covariates.

<Table A9 about here>

Taken together, we find little to no evidence in these host of robustness checks that challenges the substance of our main authorizer findings and conclusions in the paper.

Additional Student and School Subsamples

We next probe the baseline descriptive information of various student subsamples to understand whether the charter impacts may be driven by baseline differences within these subgroups. First, we examine how our treatment sample changes across the post-treatment years

for students attending BSU and IMO-authorized charters in Table A10. The sample sizes in the second and third post-treatment years are smaller than the first, almost exclusively due to students aging out of our analysis, either by reaching eighth grade or the final year of data (2018). Students may also no longer be present in these data after the first post-treatment year if they have moved out-of-state or to a non-statewide testing participating entity (e.g., a private school not participating in the statewide voucher program or homeschooled). Students in these latter categories are the exception, however. In examining the results, we note the remarkable consistency in terms of baseline characteristics of the students represented in each post-treatment year of analysis. This suggests we should not be concerned about different student subpopulations driving authorizer results in the second and third post-treatment years.

<Table A10 about here>

Our main analysis used an intent-to-treat logic where students who left charter schools to return to traditional public schools were still included in the treatment. In addition, one of our supplemental analyses used treatment effect on the treated logic and the two methods are in line with each other. To further investigate the differences between the two, we compared treatment students who stayed in charter schools for three years to those who left by year three in Table A11 (students who left the state or began ninth grade were excluded from this comparison). For each authorizer, nearly half of relevant students had returned to traditional public schools by year three, suggesting a high churn rate out of the charter sector. However, there are only a few noteworthy differences between students who leave each authorizer group compared to those who stayed. In BSU schools, leavers are more likely to be white (67 vs. 50 percent) and less likely to be black (24 vs. 34 percent) or Hispanic (6 vs. 15 percent). Otherwise, there are few

noteworthy differences, especially in terms of baseline achievement, suggesting that pre-treatment factors are likely not driving decisions to leave the charter sector.

<Table A11 about here>

As our analyses span multiple grade levels, including across the elementary (3-5) and middle (6-8) grades, we may want to examine whether the composition of students who decide to switch to a charter school within these different grade levels differs. In Table A12, we display these results, and also note the relative similarity of elementary and middle school switchers within each authorizer. This helps to alleviate concerns that students who switch at different grade levels might form a different subpopulation within each school and thus drive differential impacts. We note two minor differences—students switching into BSU-authorized charters are more likely to be black when switching in the elementary grades (31 vs. 20 percent) and students switching into IMO-authorized charters have slightly lower baseline achievement (by 0.07 to 0.09 SD).

<Table A11 about here>

We next turn to a pair of analyses examining different schooling contexts to understand how our findings might be impacted. In order to dig deeper into our findings within a common geographical context, we ran models that only included charter schools within the city limits of Indianapolis. Presumably, this would capture a similar subset of charter (and comparison) students between BSU and IMO, given that all students would be drawn from a similar population of public school students. As anticipated, the IMO results are nearly identical to our main findings (see Table A13). However, we note some differences with the BSU findings. In math, the first two years remain as large achievement losses, but become null by the third year. In ELA, there is a modest first year loss, null second year impacts, and modest positive impacts

by the third year. This suggests that our findings are not simply the result of BSU expanding charter school availability beyond the traditional urban location of charters, and within that urban context, the negative results are somewhat mitigated.

<Table A13 about here>

In our final analysis, we restrict our sample to charter schools that have been open for at least three years upon a student switching into it. This follows a similar approach used by Zimmer et al. (2014) in their examination of charter authorizers and also aligns with state statutory regulations. In Indiana, the minimum initial authorization period for a charter is three years, though some authorizing agencies may grant longer initial charters. By examining only these mature charters, we avoid including new charters and those that have been open at least long enough beyond the state's minimum initial authorization period. We display these results in Table A14 and find little to no differences with our main results for BSU and IMO.

<Table A14 about here>

References

Fitzpatrick, B. R., Berends, M., Ferrare, J. J., & Waddington, R. J. (2020). Virtual illusion: Comparing student achievement and teacher and classroom characteristics in online and brick-and-mortar charter schools. *Educational Researcher*, *49*(3), 161–175.

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Waddington, R. J., & Berends, M. (2018). Impact of the Indiana Scholarship Program: Achievement effects for students in upper elementary and middle school. *Journal of Policy Analysis and Management*, *37*(4), 783–808.

Zimmer, R., Gill, B., Attridge, J., & Obenauf, K. (2014). Charter school authorizers and student achievement. *Education Finance and Policy, 9*(1), 59–85.

Table A1: Descriptive comparison of closed charter schools to schools that remained open in 2018

	BSU		IMO		ICSB	
	Open in 2018	Closed by 2018	Open in 2018	Closed by 2018	Open in 2018	Closed by 2018
ISTEP+ Math Standardized Score	-0.387	-0.784	-0.519	-0.687	-0.756	-1.130
	(0.405)	(0.397)	(0.514)	(0.513)	(0.522)	(0.180)
ISTEP+ ELA Standardized Score	-0.252	-0.583	-0.477	-0.545	-0.585	-0.953
	(0.384)	(0.321)	(0.494)	(0.431)	(0.350)	(0.158)
White	0.523	0.358	0.144	0.140	0.039	0.044
	(0.368)	(0.311)	(0.222)	(0.245)	(0.041)	(0.065)
Black	0.285	0.419	0.605	0.684	0.803	0.771
	(0.342)	(0.343)	(0.314)	(0.326)	(0.205)	(0.166)
Hispanic	0.130	0.138	0.200	0.132	0.114	0.141
	(0.193)	(0.116)	(0.203)	(0.241)	(0.156)	(0.175)
American Indian	0.002	0.002	0.001	0.002	0.003	0.000
	(0.003)	(0.005)	(0.002)	(0.007)	(0.007)	(0.000)
Asian	0.008	0.008	0.001	0.001	0.000	0.000
	(0.012)	(0.023)	(0.002)	(0.002)	(0.000)	(0.000)
Multiracial	0.052	0.074	0.049	0.041	0.042	0.045
	(0.034)	(0.067)	(0.034)	(0.037)	(0.010)	(0.052)
Other Race	0.062	0.085	0.051	0.044	0.047	0.045
	(0.040)	(0.075)	(0.034)	(0.040)	(0.013)	(0.052)
Male	0.523	0.508	0.489	0.499	0.495	0.522
	(0.055)	(0.060)	(0.146)	(0.219)	(0.036)	(0.061)
Free or Reduced-Price Lunch	0.596	0.802	0.865	0.791	0.887	0.828
	(0.298)	(0.187)	(0.108)	(0.131)	(0.074)	(0.151)
Limited English Proficiency	0.027	0.142	0.121	0.088	0.075	0.067
	(0.053)	(0.246)	(0.137)	(0.244)	(0.125)	(0.110)
Special Education	0.237	0.162	0.197	0.150	0.167	0.283
	(0.135)	(0.090)	(0.183)	(0.090)	(0.055)	(0.038)
Received an In-School Suspension	0.091	0.088	0.049	0.067	0.129	0.160
	(0.115)	(0.109)	(0.131)	(0.113)	(0.168)	(0.322)
Received an Out-of-School Suspension	0.163	0.225	0.277	0.304	0.112	0.403
	(0.153)	(0.181)	(0.192)	(0.247)	(0.145)	(0.193)
Expelled	0.013	0.007	0.004	0.003	0.000	0.000
	(0.032)	(0.014)	(0.009)	(0.009)	(0.000)	(0.000)
Chronically Absent	0.194	0.161	0.209	0.149	0.322	0.367
	(0.155)	(0.114)	(0.226)	(0.075)	(0.403)	(0.213)
Number of Schools	22	16	20	12	5	5

Note: This table compares the student populations of schools that closed during the time-period studied compared to those that did not. All averages were computed from school-level average characteristics from the entirety of the student body in each school in the final year in which the school existed in the data. This table was created using data from 2018 for open schools, and data on closed schools came from their final year of operation. Schools authorized by Education One and Grace College are excluded to maintain anonymity - only one school was closed by each.

Table A2. Comparative impact of schools that remained open in 2018 versus those that were no longer open

	Baseline	First year at a charter school	Second year at a charter school	Third year at a charter school
Math achievement				
BSU - Open	-0.001	-0.154***	-0.099***	-0.091***
	(0.001)	(0.014)	(0.015)	(0.020)
BSU - Closed	-0.003	-0.316***	-0.398***	-0.401***
	(0.001)	(0.016)	(0.029)	(0.048)
IMO - Open	-0.002	0.108***	0.075**	0.064
	(0.002)	(0.021)	(0.025)	(0.032)
IMO - Closed	0.000	0.097**	0.307***	0.358***
	(0.003)	(0.032)	(0.055)	(0.063)
ELA achievement				
BSU - Open	-0.001	0.008	0.018	0.017
	(0.001)	(0.013)	(0.014)	(0.019)
BSU - Closed	0.001	-0.273***	-0.243***	-0.235***
	(0.001)	(0.016)	(0.028)	(0.048)
IMO - Open	-0.001	0.120***	0.117***	0.071
	(0.002)	(0.018)	(0.022)	(0.030)
IMO - Closed	0.005	0.168***	0.306***	0.219***
	(0.003)	(0.029)	(0.044)	(0.058)
Baseline covariates	X	X	X	X
Baseline achievement		X	X	X
Matching cell fixed effects	X	X	X	X

Note: Critical values have been adjusted for six possible treatment values: *p≤0.0083; **p≤0.0017; ***p≤0.0001. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. Robust standard errors clustered by baseline cohort (year-grade-school) are in parentheses. Results for ICSB-authorized schools available upon request. Schools authorized by Education One and Grace College are excluded to maintain anonymity - only one school was closed by each.

Table A3. Annual effects of charter schools by operator type on student achievement

	Baseline	First year at a charter school	Second year at a charter school	Third year at a charter school
Math achievement				
CMO	-0.003	0.091***	0.105***	0.077*
	(0.001)	(0.016)	(0.020)	(0.026)
Physical EMO	-0.003	0.060	0.079	0.184**
	(0.003)	(0.033)	(0.045)	(0.056)
Virtual EMO	-0.001	-0.366***	-0.317***	-0.248***
	(0.001)	(0.013)	(0.018)	(0.026)
Independent	-0.001	-0.147***	-0.095***	-0.079**
	(0.002)	(0.015)	(0.019)	(0.026)
Observations	46,507	46,507	26,202	13,440
Adjusted r^2	0.002	0.133	0.104	0.091
ELA achievement				
CMO	0.001	0.107***	0.107***	0.091**
	(0.001)	(0.014)	(0.017)	(0.025)
Physical EMO	-0.003	0.165***	0.145***	0.216***
	(0.004)	(0.030)	(0.035)	(0.047)
Virtual EMO	-0.001	-0.226***	-0.113***	-0.060
	(0.001)	(0.013)	(0.019)	(0.027)
Independent	0.001	-0.021	-0.011	-0.038
	(0.002)	(0.015)	(0.018)	(0.023)
Observations	46,042	46,042	26,108	13,485
Adjusted r^2	0.002	0.119	0.093	0.074
Baseline covariates	X	X	X	X
Baseline achievement		X	X	X
Matching cell fixed effects	X	X	X	X

Note: Critical values have been adjusted for four possible treatment values: *p≤0.0125; **p≤0.0025; ***p≤0.000125. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. Robust standard errors clustered by baseline cohort (year-grade-school) are in parentheses.

Table A4. Descriptive baseline comparison of average characteristics of treatment and comparison students for the virtual and B&M Ball State University charter schools

	Virtual		***B&M***	
	Treatment	Comparison	Treatment	Comparison
Baseline Math Standardized Scores	-0.127	-0.149	-0.322	-0.368
Baseline ELA Standardized Score	-0.089	-0.067	-0.326	-0.339
White	0.902	0.902	0.386	0.386
Black	0.051	0.051	0.447	0.447
Hispanic	0.030	0.030	0.143	0.143
American Indian	0.000	0.000	0.000	0.000
Asian	0.002	0.002	0.002	0.002
Multiracial	0.014	0.014	0.022	0.022
Other Race	0.017	0.017	0.024	0.024
Free or Reduced-Price Lunch	0.582	0.582	0.762	0.762
Female	0.456	0.456	0.515	0.515
Limited English Proficiency	0.018	0.009	0.067	0.066
Special Education	0.142	0.165	0.135	0.121
Received an In-School Suspension	0.065	0.090	0.062	0.084
Received an Out-of-School Suspension	0.057	0.098	0.133	0.167
Expelled	0.001	0.002	0.002	0.002
Chronically Absent	0.055	0.232	0.068	0.071
Number of Students	4,274	16,633	3,714	10,095

Note: This table compares treated students within Ball State-authorized charters who attend virtual vs. brick-and-mortar schools to the average baseline characteristics of the comparison students to whom they were matched. Means are unweighted as each treated student is assigned a single set of average characteristics summarizing all the students to which they are matched. This table was created using the math sample – the results are similar for the ELA sample.

Table A5. Descriptive baseline comparison of students attending Ball State and Indianapolis Mayor's Office authorized charters by operator type

	BSU CMO		BSU Physical EMO		BSU Virtual EMO		BSU Independent	
	Treat	**Comp**	**Treat**	**Comp**	**Treat**	**Comp**	**Treat**	**Comp**
Baseline Math Standardized Scores	-0.556	-0.627	-0.458	-0.508	-0.127	-0.149	-0.078	-0.101
Baseline ELA Standardized Score	-0.512	-0.568	-0.460	-0.410	-0.089	-0.067	-0.126	-0.113
White	0.124	0.124	0.181	0.181	0.902	0.902	0.669	0.669
Black	0.753	0.753	0.598	0.598	0.051	0.051	0.134	0.134
Hispanic	0.110	0.110	0.208	0.208	0.030	0.030	0.161	0.161
American Indian	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Asian	0.001	0.001	0.000	0.000	0.002	0.002	0.003	0.003
Multiracial	0.012	0.012	0.012	0.012	0.014	0.014	0.034	0.034
Other Race	0.013	0.013	0.012	0.012	0.017	0.017	0.037	0.037
Free or Reduced-Price Lunch	0.898	0.898	0.946	0.946	0.582	0.582	0.600	0.600
Female	0.480	0.480	0.529	0.529	0.456	0.456	0.544	0.544
Limited English Proficiency	0.057	0.064	0.079	0.094	0.018	0.009	0.074	0.062
Special Education	0.129	0.100	0.158	0.082	0.142	0.165	0.136	0.148
Received an In-School Suspension	0.050	0.067	0.030	0.042	0.065	0.090	0.079	0.108
Received an Out-of-School Suspension	0.181	0.224	0.142	0.151	0.057	0.098	0.086	0.117
Expelled	0.003	0.003	0.000	0.000	0.001	0.002	0.001	0.002
Chronically Absent	0.081	0.082	0.071	0.051	0.055	0.232	0.055	0.065
Number of Students	1,640	4,133	342	847	4,274	16,633	1,732	5,115

	IMO CMO		IMO Independent	
	Treat	**Comp**	**Treat**	**Comp**
Baseline Math Standardized Scores	-0.531	-0.578	-0.389	-0.439
Baseline ELA Standardized Score	-0.558	-0.584	-0.433	-0.474
White	0.120	0.120	0.417	0.417
Black	0.746	0.746	0.474	0.474
Hispanic	0.114	0.114	0.096	0.096
American Indian	0.000	0.000	0.000	0.000
Asian	0.000	0.000	0.000	0.000
Multiracial	0.021	0.021	0.013	0.013
Other Race	0.021	0.021	0.013	0.013
Free or Reduced-Price Lunch	0.891	0.891	0.797	0.797
Female	0.495	0.495	0.507	0.507
Limited English Proficiency	0.100	0.088	0.082	0.066
Special Education	0.144	0.116	0.166	0.138
Received an In-School Suspension	0.043	0.060	0.043	0.056
Received an Out-of-School Suspension	0.125	0.170	0.107	0.149
Expelled	0.000	0.001	0.000	0.003
Chronically Absent	0.058	0.069	0.056	0.099
Number of Students	1,600	4,117	157	407

Note: This table compares treated students within each authorizer-operator combination to the average baseline characteristics of the comparison students to whom they were matched. Means are unweighted as each treated student is assigned a single set of average characteristics summarizing all the students to which they are matched. This table was created using the math sample – the results are similar for the ELA sample. Results for ICSB-authorized schools (CMO and independent), Education One (independent only), and Grace College (physical EMO or independent) available upon request. The IMO-authorized school operated by a physical EMO, the Education One-authorized school operated by a CMO, and the Education One-authorized school operated by a virtual EMO are excluded to maintain anonymity - only one school was operated by a specific operator type within each authorizer.

Table A6. Robustness checks of main outcomes for BSU-authorized charters

	Pre-Baseline	Baseline	1st Year in virtual charter	2nd Year in virtual charter	3rd Year in virtual charter
Math achievement					
0.05 SD caliper		-0.000	-0.171***	-0.143***	-0.155***
		(0.000)	(0.018)	(0.021)	(0.029)
		17,833	17,833	10,355	5,327
Not matched on test score		-0.065***	-0.257***	-0.213***	-0.162***
		(0.010)	(0.009)	(0.012)	(0.016)
		192,593	192,593	76,829	30,521
TET		-0.002	-0.211***	-0.196***	-0.190***
		(0.001)	(0.012)	(0.017)	(0.025)
		46,507	46,507	26,025	13,290
5-year sample	0.028*	-0.002	-0.238***	-0.180***	-0.159***
	(0.011)	(0.001)	(0.012)	(0.015)	(0.023)
	35,360	35,360	35,360	18,466	8,159
Structural changes only		0.001	-0.198***	-0.137***	-0.173***
		(0.002)	(0.018)	(0.020)	(0.030)
		8,161	8,161	6,873	3,120
With grade fixed effects		-0.002	-0.215***	-0.166***	-0.130***
		(0.001)	(0.012)	(0.014)	(0.019)
		46,507	46,507	26,202	13,440
ELA achievement					
0.05 SD caliper		-0.000	-0.101***	-0.050	-0.035
		(0.000)	(0.017)	(0.020)	(0.027)
		16,988	16,988	9,793	5,167
Not matched on test score		-0.003	-0.134***	-0.080***	-0.057***
		(0.010)	(0.008)	(0.011)	(0.015)
		192,593	192,593	76,813	30,476
TET		-0.000	-0.094***	-0.055**	-0.023
		(0.001)	(0.011)	(0.015)	(0.023)
		46,042	46,042	25,928	13,338
5-year sample	0.027	-0.001	-0.095***	-0.052**	-0.038
	(0.011)	(0.001)	(0.013)	(0.016)	(0.022)
	34,893	34,893	34,893	18,413	8,236
Structural changes only		-0.001	-0.063**	-0.047	-0.083*
		(0.002)	(0.020)	(0.021)	(0.030)
		7,939	7,939	6,652	2,974
With grade fixed effects		0.000	-0.099***	-0.042**	-0.015
		(0.001)	(0.011)	(0.013)	(0.018)
		46,042	46,042	26,108	13,485

Note: Critical values have been adjusted for five possible treatment values: *p≤0.01; **p≤0.002; ***p≤0.0001. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. Robust standard errors clustered by baseline cohort (year-grade-school) are in parentheses, with the model's sample size underneath. Tables including the other three authorizers are available upon request. Overall model sample sizes displayed.

Table A7. Robustness checks of main outcomes for IMO-authorized charters

	Pre-Baseline	Baseline	1st Year in virtual charter	2nd Year in virtual charter	3rd Year in virtual charter
Math achievement					
0.05 SD caliper		0.001	0.150***	0.146***	0.144**
		(0.001)	(0.025)	(0.033)	(0.043)
		17,833	17,833	10,355	5,327
Not matched on test score		-0.071***	0.060***	0.077***	0.041
		(0.017)	(0.014)	(0.018)	(0.025)
		192,593	192,593	76,829	30,521
TET		-0.001	0.108***	0.200***	0.213***
		(0.002)	(0.018)	(0.028)	(0.036)
		46,507	46,507	26,025	13,290
5-year sample	0.013	0.000	0.142***	0.160***	0.201***
	(0.018)	(0.002)	(0.020)	(0.028)	(0.039)
	35,360	35,360	35,360	18,466	8,159
Structural changes only		0.004	0.133***	0.121	0.188*
		(0.004)	(0.033)	(0.048)	(0.070)
		8,161	8,161	6,873	3,120
With grade fixed effects		-0.001	0.090***	0.096***	0.096**
		(0.002)	(0.018)	(0.023)	(0.065)
		46,507	46,507	26,202	13,440
ELA achievement					
0.05 SD caliper		0.000	0.102***	0.115***	0.084
		(0.001)	(0.025)	(0.030)	(0.042)
		16988	16,988	9,793	5,167
Not matched on test score		-0.048*	0.096***	0.094***	0.043
		(0.016)	(0.012)	(0.016)	(0.024)
		192,593	192,593	76,813	30,476
TET		0.001	0.133***	0.240***	0.203***
		(0.002)	(0.016)	(0.023)	(0.034)
		46,042	46,042	25,928	13,338
5-year sample	0.017	-0.001	0.162***	0.155***	0.140***
	(0.018)	(0.002)	(0.019)	(0.025)	(0.037)
	34,893	34,893	34,893	18,413	8,236
Structural changes only		0.001	0.168***	0.200***	0.128
		(0.004)	(0.036)	(0.041)	(0.065)
		7,939	7,939	6,652	2,974
With grade fixed effects		0.001	0.118***	0.133***	0.087**
		(0.002)	(0.016)	(0.020)	(0.028)
		46,042	46,042	26,108	13,485

Note: Critical values have been adjusted for five possible treatment values: *p≤0.01; **p≤0.002; ***p≤0.0001. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. Robust standard errors clustered by baseline cohort (year-grade-school) are in parentheses, with the model's sample size underneath. Tables including the other three authorizers are available upon request. Overall model sample sizes displayed.

Table A8. Weighted analysis of charter school effects by authorizer

	Math achievement				ELA achievement			
	Baseline	**First year at a charter school**	**Second year at a charter school**	**Third year at a charter school**	**Baseline**	**First year at a charter school**	**Second year at a charter school**	**Third year at a charter school**
BSU	-0.003	-0.162	-0.106	-0.055	0.000	-0.036	-0.004	0.035
	[0.007]	[0.235]	[0.237]	[0.248]	[0.008]	[0.181]	[0.165]	[0.189]
	38	38	38	35	38	38	38	35
IMO	-0.001	0.017	0.067	0.091	0.001	0.078	0.122	0.079
	[0.019]	[0.284]	[0.249]	[0.134]	[0.012]	[0.192]	[0.168]	[0.177]
	30	30	27	22	30	30	27	23
ICSB	-0.003	0.047	-0.179		0.005	0.189	0.002	
	[0.019]	[0.413]	[0.136]		[0.024]	[0.281]	[0.180]	
	10	10	8		10	10	8	
Education One	0.001	-0.314	-0.177	-0.111	-0.002	-0.200	-0.101	-0.079
	[0.004]	[0.222]	[0.223]	[0.141]	[0.006]	[0.203]	[0.080]	[0.048]
	4	4	4	4	4	4	4	4
Grace College	-0.003	-0.203	-0.413		-0.005	-0.126	-0.188	
	[0.002]	[0.073]	[0.007]		[0.002]	[0.143]	[0.038]	
	4	4	3		4	4	3	

Note: The weighted means across school fixed effects are presented alongside standard deviations, in brackets, as well as the number of schools. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. The means and standard deviations are weighted using the enrollment in each school in the most recent year they existed in the data. Unless a school closed during the relevant time period, enrollment information came from the most recent year of data (the 2017-2018 academic year).

Table A9. "Stacked" Analysis with five years of data included in a student fixed-effects and year-treatment interaction effects

	Pre-Baseline	Baseline	1st Year in charter	2nd Year in charter	3rd Year in charter
Math achievement (student-year cases=230,137)					
BSU	0.030	-0.004	-0.296***	-0.249***	-0.195***
	(0.021)	(0.021)	(0.022)	(0.023)	(0.024)
IMO	0.006	0.036	0.032	0.065	0.079
	(0.048)	(0.048)	(0.049)	(0.050)	(0.051)
ICSB	0.001	-0.075	-0.246	-0.266	-0.103
	(0.125)	(0.118)	(0.118)	(0.124)	(0.130)
Education One	0.026	0.049	-0.272***	-0.135	0.028
	(0.065)	(0.067)	(0.070)	(0.071)	(0.078)
Grace College	0.085	0.076	-0.124	-0.295	
	(0.090)	(0.084)	(0.086)	(0.116)	
ELA achievement (student-year cases=228,564)					
BSU	-0.020	-0.026	-0.215***	-0.143***	-0.099***
	(0.024)	(0.024)	(0.024)	(0.025)	(0.026)
IMO	-0.019	-0.003	0.048	0.073	0.070
	(0.034)	(0.036)	(0.036)	(0.038)	(0.040)
ICSB	0.019	-0.007	-0.018	-0.043	-0.006
	(0.084)	(0.093)	(0.082)	(0.100)	(0.115)
Education One	0.015	0.056	-0.139	-0.019	0.027
	(0.060)	(0.058)	(0.061)	(0.061)	(0.070)
Grace College	-0.094	-0.099	-0.232*	-0.257*	
	(0.083)	(0.086)	(0.087)	(0.094)	

Note: Critical values have been adjusted for five possible treatment values: *p≤0.01; **p≤0.002; ***p≤0.0001. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. Robust standard errors clustered by baseline cohort (year-grade-school) are in parentheses, with the model's sample size underneath. These models interact the school authorizer variable with a "timeline" variable, and the above estimates are predicted effects that combine the relevant interaction effects. Cell sizes smaller than twenty treatment students have been deleted due to concerns about data identifiability.

Table A10. Descriptive baseline comparison of students attending Ball State and Indianapolis Mayor's Office authorized charters by post-treatment year

	BSU After 1 Year		BSU After 2 Years		BSU After 3 Years	
	Treat	**Comp**	**Treat**	**Comp**	**Treat**	**Comp**
Baseline Math Standardized Scores	-0.217	-0.250	-0.175	-0.214	-0.127	-0.170
Baseline ELA Standardized Score	-0.198	-0.192	-0.176	-0.177	-0.143	-0.141
White	0.665	0.665	0.636	0.632	0.618	0.610
Black	0.233	0.233	0.244	0.247	0.252	0.255
Hispanic	0.082	0.082	0.095	0.096	0.106	0.108
American Indian	0.000	0.000	0.001	0.000	0.001	0.000
Asian	0.002	0.002	0.003	0.002	0.002	0.002
Multiracial	0.018	0.018	0.022	0.022	0.022	0.024
Other Race	0.020	0.020	0.026	0.025	0.025	0.026
Free or Reduced-Price Lunch	0.665	0.665	0.634	0.590	0.618	0.623
Female	0.483	0.483	0.507	0.508	0.527	0.528
Limited English Proficiency	0.040	0.035	0.047	0.044	0.051	0.046
Special Education	0.139	0.145	0.136	0.146	0.133	0.142
Received an In-School Suspension	0.064	0.087	0.046	0.060	0.030	0.043
Received an Out-of-School Suspension	0.092	0.130	0.076	0.102	0.061	0.091
Expelled	0.001	0.002	0.001	0.001	0.001	0.002
Chronically Absent	0.061	0.158	0.053	0.125	0.048	0.102
Number of Students	7,988	26,728	5,170	13,654	2,874	6,242

	IMO After 1 Year		IMO After 2 Years		IMO After 3 Years	
	Treat	**Comp**	**Treat**	**Comp**	**Treat**	**Comp**
Baseline Math Standardized Scores	-0.493	-0.542	-0.439	-0.492	-0.414	-0.472
Baseline ELA Standardized Score	-0.526	-0.562	-0.480	-0.530	-0.467	-0.523
White	0.200	0.200	0.200	0.199	0.195	0.193
Black	0.668	0.668	0.658	0.656	0.663	0.664
Hispanic	0.113	0.113	0.117	0.119	0.118	0.120
American Indian	0.000	0.000	0.000	0.000	0.000	0.000
Asian	0.000	0.000	0.000	0.000	0.000	0.000
Multiracial	0.020	0.020	0.024	0.027	0.023	0.023
Other Race	0.020	0.020	0.024	0.027	0.023	0.023
Free or Reduced-Price Lunch	0.865	0.865	0.806	0.839	0.801	0.840
Female	0.496	0.496	0.498	0.497	0.503	0.501
Limited English Proficiency	0.097	0.086	0.106	0.094	0.101	0.095
Special Education	0.147	0.125	0.139	0.115	0.134	0.108
Received an In-School Suspension	0.041	0.057	0.031	0.038	0.026	0.029
Received an Out-of-School Suspension	0.122	0.167	0.097	0.128	0.091	0.113
Expelled	0.000	0.002	0.000	0.002	0.001	0.002
Chronically Absent	0.057	0.078	0.047	0.061	0.046	0.048
Number of Students	2,460	6,351	1,698	3,470	1,000	1,691

Note: This table compares treated students by year post-treatment to the average baseline characteristics of the comparison students to whom they were matched. Means are unweighted as each treated student is assigned a single set of average characteristics summarizing all the students to which they are matched. This table was created using the math sample – the results are similar for the ELA sample. Results for ICSB, Education One, and Grace College authorized charters available upon request, with the third year of Grace College excluded to maintain anonymity as there are fewer than 20 students.

Table A11. Descriptive baseline comparison of treated students who exit their initial charter authorizer to those who remain after three years

	BSU - Stay	BSU - Leave	IMO - Stay	IMO - Leave	Ed One - Stay	Ed One - Leave
Baseline Math Standardized Scores	-0.238	-0.246	-0.474	-0.565	-0.344	-0.463
Baseline ELA Standardized Score	-0.181	-0.222	-0.527	-0.612	-0.363	-0.333
White	0.495	0.671	0.176	0.162	0.586	0.395
Black	0.335	0.240	0.674	0.719	0.343	0.430
Hispanic	0.149	0.061	0.125	0.096	0.051	0.081
American Indian	0.000	0.001	0.000	0.000	0.000	0.000
Asian	0.002	0.002	0.000	0.000	0.010	0.035
Multiracial	0.019	0.026	0.026	0.023	0.010	0.058
Other Race	0.021	0.028	0.026	0.023	0.020	0.093
Free or Reduced-Price Lunch	0.628	0.669	0.866	0.839	0.646	0.767
Female	0.528	0.542	0.512	0.511	0.586	0.477
Limited English Proficiency	0.061	0.028	0.102	0.070	0.061	0.047
Special Education	0.136	0.156	0.122	0.117	0.172	0.151
Received an In-School Suspension	0.029	0.062	0.036	0.041	0.020	0.116
Received an Out-of-School Suspension	0.089	0.108	0.132	0.149	0.071	0.105
Expelled	0.001	0.002	0.002	0.005	0.000	0.000
Chronically Absent	0.099	0.121	0.044	0.058	0.061	0.093
Number of Students	1,806	1,625	665	617	99	86

Note: This table compares treated students in Ball State, Indianapolis Mayor's Office, and Education One authorized charter schools who have three years of post-treatment data and who either remained in schools authorized by the agency into which they originally switched or who exited to the public sector. This table was created using the math sample – the results are similar for the ELA sample. Schools authorized by Education One and Grace College are excluded to maintain anonymity, as at least one of the cells (stay or leave) for each has fewer than 20 students.

Table A12. Descriptive baseline comparison of students attending Ball State and Indianapolis Mayor's Office authorized charters by grade level of first post-treatment year

	BSU Elementary		BSU Middle	
	Treat	**Comp**	**Treat**	**Comp**
Baseline Math Standardized Scores	-0.217	-0.257	-0.216	-0.246
Baseline ELA Standardized Score	-0.199	-0.183	-0.197	-0.195
White	0.608	0.608	0.688	0.688
Black	0.313	0.313	0.201	0.201
Hispanic	0.062	0.062	0.090	0.090
American Indian	0.000	0.000	0.000	0.000
Asian	0.001	0.001	0.002	0.002
Multiracial	0.015	0.015	0.019	0.019
Other Race	0.017	0.017	0.021	0.021
Free or Reduced-Price Lunch	0.698	0.698	0.651	0.651
Female	0.524	0.524	0.466	0.466
Limited English Proficiency	0.034	0.032	0.043	0.036
Special Education	0.150	0.149	0.134	0.143
Received an In-School Suspension	0.025	0.034	0.079	0.108
Received an Out-of-School Suspension	0.057	0.093	0.106	0.144
Expelled	0.001	0.000	0.002	0.003
Chronically Absent	0.050	0.111	0.065	0.177
Number of Students	2,344	5,407	5,644	21,277

	IMO Elementary		IMO Middle	
	Treat	**Comp**	**Treat**	**Comp**
Baseline Math Standardized Scores	-0.544	-0.593	-0.452	-0.501
Baseline ELA Standardized Score	-0.565	-0.608	-0.495	-0.525
White	0.188	0.188	0.209	0.209
Black	0.669	0.669	0.668	0.668
Hispanic	0.127	0.127	0.101	0.101
American Indian	0.000	0.000	0.000	0.000
Asian	0.000	0.000	0.000	0.000
Multiracial	0.017	0.017	0.022	0.022
Other Race	0.017	0.017	0.022	0.022
Free or Reduced-Price Lunch	0.898	0.898	0.838	0.838
Female	0.505	0.505	0.488	0.488
Limited English Proficiency	0.111	0.105	0.086	0.071
Special Education	0.149	0.120	0.145	0.128
Received an In-School Suspension	0.040	0.047	0.043	0.065
Received an Out-of-School Suspension	0.096	0.121	0.143	0.203
Expelled	0.000	0.002	0.000	0.002
Chronically Absent	0.049	0.062	0.064	0.090
Number of Students	1,103	2,123	1,357	4,190

Note: This table compares treated students by the grade level at which they switched into a charter school to the average baseline characteristics of the comparison students to whom they were matched. Means are unweighted as each treated student is assigned a single set of average characteristics summarizing all the students to which they are matched. This table was created using the math sample – the results are similar for the ELA sample. Results for ICSB, Education One, and Grace College authorized charters available upon request.

Table A13. Replicating the main analysis for only Indianapolis schools

	Baseline	First year at a charter school	Second year at a charter school	Third year at a charter school
Math achievement				
BSU	0.001	-0.287***	-0.232***	-0.088
	(0.003)	(0.030)	(0.043)	(0.061)
IMO	-0.001	0.108***	0.128***	0.128**
	(0.002)	(0.024)	(0.032)	(0.040)
ICSB	0.000	-0.262	-0.394**	0.265
	(0.017)	(0.140)	(0.129)	(0.263)
Observations	10,323	10,323	5,950	3,178
ELA achievement				
BSU	-0.001	-0.130***	-0.026	0.128*
	(0.003)	(0.031)	(0.039)	(0.053)
IMO	0.001	0.123***	0.151***	0.166***
	(0.002)	(0.022)	(0.027)	(0.039)
ICSB	-0.002	-0.120	-0.149	-0.205
	(0.019)	(0.109)	(0.164)	(0.223)
Observations	10,287	10,287	6,043	3,238
Baseline covariates	X	X	X	X
Baseline achievement		X	X	X
Matching cell fixed effects	X	X	X	X

Note: Critical values have been adjusted for three possible treatment values: *p≤0.017; **p≤0.0033; ***p≤0.0003. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. Robust standard errors clustered by baseline cohort (year-grade-school) are in parentheses. Results from Education One authorized charters are excluded to preserve anonymity as the organization only authorized one school in Indianapolis during the time period of our study. Grace College has not authorized any schools located in Indianapolis.

Table A14. Impacts across authorizer only for charter schools open at least three years prior to a student's switch into a charter

	Baseline	First year at a charter school	Second year at a charter school	Third year at a charter school
Math achievement				
BSU [36 schools]	-0.002	-0.194***	-0.151***	-0.117***
	(0.001)	(0.014)	(0.016)	(0.023)
IMO [25 schools]	-0.002	0.148***	0.127***	0.117**
	(0.002)	(0.021)	(0.027)	(0.036)
ICSB [4 schools]	-0.004	-0.092	-0.175	-0.372
	(0.016)	(0.144)	(0.189)	(0.476)
Observations	33,339	33,339	18,296	8,951
ELA achievement				
BSU [36 schools]	0.000	-0.104***	-0.026	-0.020
	(0.001)	(0.013)	(0.016)	(0.022)
IMO [25 schools]	-0.002	0.147***	0.150***	0.105**
	(0.002)	(0.019)	(0.024)	(0.034)
ICSB [4 schools]	-0.018	0.173	0.245	-0.256
	(0.016)	(0.134)	(0.179)	(0.496)
Observations	32,919	32,919	18,136	8,986
Baseline covariates	X	X	X	X
Baseline achievement		X	X	X
Matching cell fixed effects	X	X	X	X

Note: Critical values have been adjusted for three possible treatment values: *p≤0.017; **p≤0.0033; ***p≤0.0003. ISTEP+ math and ELA achievement measured in standard deviation units, relative to the Indiana state mean and standard deviation within each grade and year. Robust standard errors clustered by baseline cohort (year-grade-school) are in parentheses. Results for ICSB-authorized schools available upon request. Schools authorized by Education One and Grace College are excluded to maintain anonymity - only one school by each was open for three years or more upon a student switching.