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Impacts of the Michigan Merit Curriculum on Student Outcomes: Preliminary Findings from the First Cohort

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What is the Michigan Merit Curriculum?

In 2006 the state of Michigan adopted a comprehensive set of high school graduation requirements known as the Michigan Merit Curriculum (MMC). These requirements were designed to increase the rigor of high school course-taking in Michigan and better prepare Michigan students for postsecondary success. The MMC is more specific and academically challenging in its required coursework than the previous state requirements, as well as those of most other states. The first students covered by the MMC started ninth grade in the fall of 2007 and would have been scheduled for an on-time graduation in spring 2011.

The MMC emphasizes academic preparation in mathematics and science. Students are required to take Algebra 1, Geometry, and Algebra 2, as well as Biology 1 and either Chemistry or Physics. Students must also take four years of English Language Arts and complete two years of a foreign language.¹ These courses are in contrast to requirements prior to the MMC, when only about a third of districts required four years of math and three years of science.² By mandating well over 50 percent of the courses that students must take, the MMC brings a greater level of standardization to the high school academic experience across Michigan. The policy does, however, allow flexibility in elective choices and allows struggling students to meet the MMC requirements through a “personal curriculum” option, available on a very limited basis.

Table 1

Michigan Merit Curriculum High School Graduation Requirements	
Mathematics – 4 credits	
Algebra I	Geometry
Algebra II	One math course in final year of HS
English Language Arts – 4 credits	
English Language Arts 9	English Language Arts 11
English Language Arts 10	English Language Arts 12
Science – 3 credits	
Biology	One additional science credit
Chemistry or Physics	
Social Studies – 3 credits	
½ credit in Civics	½ credit in Economics
U.S. History and Geography	World History and Geography
Physical Education & Health – 1 credit	
Visual, Performing and Applied Arts – 1 credit	
Online Learning Experience	
World Language – 2 credits (Class of 2016)	

Accountability for ensuring that students meet requirements comes in the form of end-of-course exams that students must pass. These exams are developed and benchmarked at the local level. Students are also required to take the Michigan Merit Exam (MME), a standardized test administered in the spring of the eleventh grade year. This exam, first administered in spring 2007, is intended to be aligned with the MMC. Further, the MME includes the ACT, a nationally-normed college entrance examination.



Background of High School Reform

High school academic performance in the United States has been stagnant since the 1970s, with the scores for seventeen-year-olds flat over this period.³ Recent evidence suggests that, when calculated appropriately, high school graduation rates have been *declining* over the past forty years, with the gap in majority/minority graduation rates holding steady.⁴ The United States consistently lags behind other industrialized countries on international tests of the academic performance of high school students. On the 2009 PISA exam, fifteen-year-olds in the United States scored seventeenth in math and twelfth in science relative to students in the other thirty-three OECD countries.⁵

States and districts across the country have begun to focus on high school reform through standardization of curricula, increases in graduation requirements, and the introduction of exit exams. Twenty-six states now require that their high school students complete Algebra 1 and Geometry. Eighteen require that students take Biology in addition to either Chemistry or Physics.⁶ Twenty-four states require that students pass exit exams before high school graduation.

Consequences of High School Reform

There is strong evidence that requiring high school students to take more advanced mathematics and science courses leads to higher earnings as adults.⁷ Well-intentioned reforms can produce unintended consequences, however. Increased academic requirements may lead some schools to re-label existing courses, rather than design more rigorous ones. High-stakes exit exams may increase high school dropout rates, particularly among low-achieving students.⁸ In both Chicago and North Carolina, sharp increases in math requirements led to *declines* in math achievement.⁹

Data

In order to examine the effects of the MMC on a range of student outcomes, we use administrative data from the State of Michigan. These data provide information on first-time ninth grade students from the academic year (AY) 2004-05 to the present.¹⁰ These data include information on students' gender, race/ethnicity, and past academic performance (i.e., eighth grade test scores), as well as information about their high schools. For each student in the sample, we observe high school test scores (the MME and ACT), as well as information about high school completion and college enrollment.

In some of our analyses, we divide students into four groups based on their academic readiness when they entered high school. We use eighth grade test scores, students' demographic characteristics, and school characteristics to sort students into these four groups.

Analytic Approach

We identify the effect of the MMC on student performance, high school graduation, and college enrollment. To do so, we examine trends over time in these outcomes, looking for sharp changes with the introduction of the MMC. Statisticians refer to this approach as an "interrupted time-series" analysis. In this approach we use trends in (for example) high school graduation rates *before* the MMC to predict high school graduation rates *after* the MMC. Deviations from these predicted graduation rates are interpreted as the effect of the MMC. This approach has been used by researchers to evaluate several district- and state-initiated reforms, including comprehensive Accelerated Schools,¹¹ Talent Development,¹² and district-wide high-stakes testing.¹³

The key assumption underlying our analysis is that deviations from the pre-MMC trend in the outcomes of interest are *caused* by the MMC. This assumption would be violated if 1) the student body changed sharply in Michigan just as the MMC was introduced, or 2) other conditions changed sharply in Michigan at the same time as the MMC (e.g., education reforms, economic environment). Either would cause us to mistakenly attribute to the MMC changes that were actually due to changes in students and other policies. Note that, given our approach, slow-moving changes in (for example) student composition will not bias the estimates.

We use a number of analytic approaches to try to minimize such errors. We include in our equations a rich set of student and school characteristics, including individual students' prior achievement. Through our partnership with the state, we have been able to confirm that other statewide education policies did not change in concert with the MMC. Moving forward, we will continue to explore the possibility of confounding policies at the district level. We will also conduct analyses in which we compare the experiences of students in Michigan under the MMC to the outcomes of students in other states with similar reforms.



Early Effects of the MMC: High School Enrollment and Completion

Table 2 summarizes the effect of the MMC on high school graduation and dropout rates. Note that these findings are based on only one cohort's experience with the MMC. This cohort entered high school in 2007-2008 and was scheduled for an on-time graduation in 2010-2011.

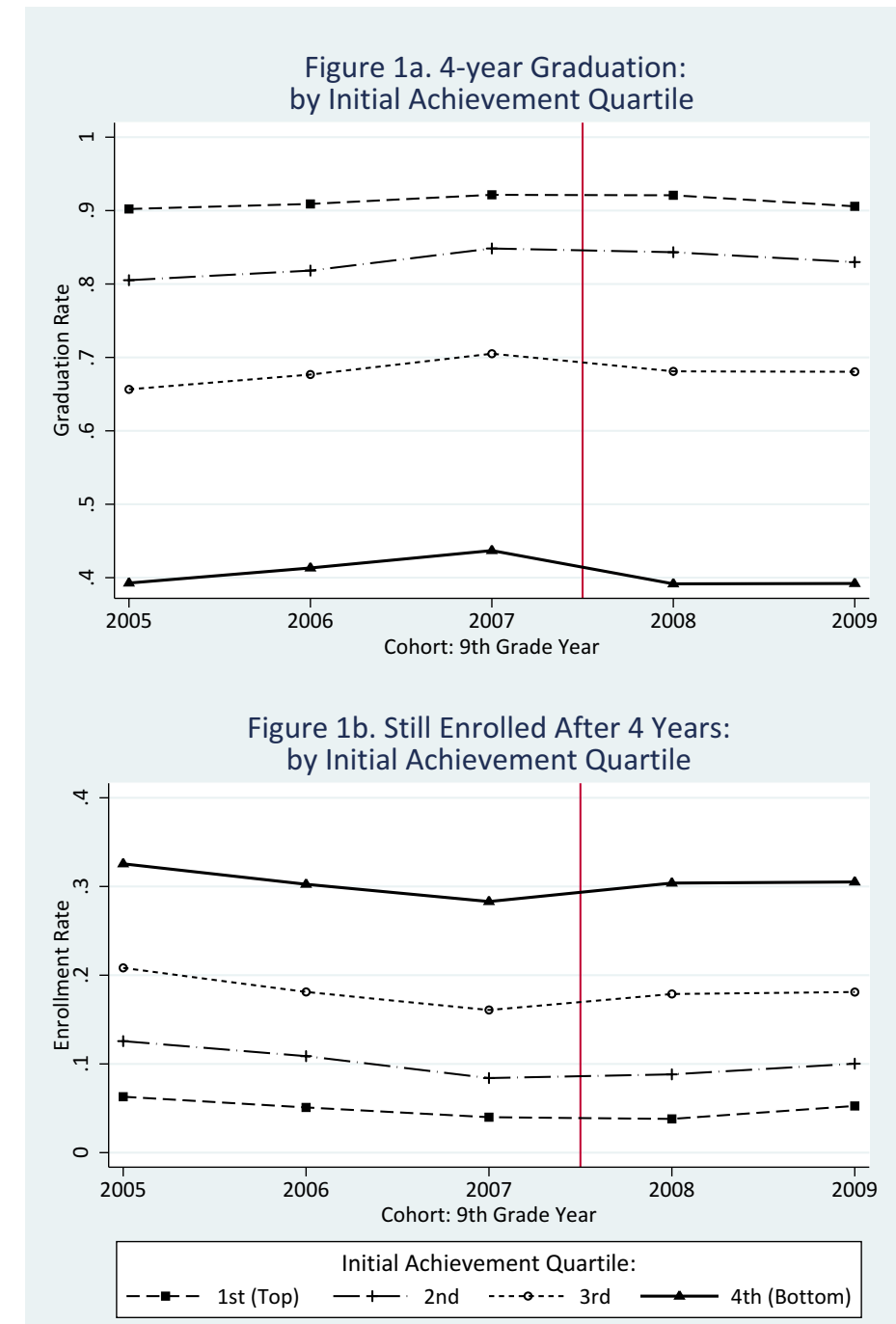
Table 2
Impact of MMC on High School Completion

	All Students		Top Quartile		Bottom Quartile	
	4-yr	5-yr	4-yr	5-yr	4-yr	5-yr
Graduated	-	-	0	0	-	-
Still enrolled	+	+	0	0	+	+
Dropped out	0	+	0	0	0	+
Other	0	+	0	0	+	+

Notes: + = positive effect of MMC; - = negative effect of MMC; 0 = no detectible effect of MMC. Effects solely for the first cohort for whom the new graduation requirements were binding - namely the High School Class of 2011.

Based on estimates from our main analytic models and patterns in the raw data (Figures 1a and 1b), we see that the MMC is associated with a decline in the four-year high school graduation rate of about two percentage points (off of a base of 72 percent). This decline in the four-year graduation rate is mirrored by an increase in the proportion of students who are still enrolled in high school after four years.

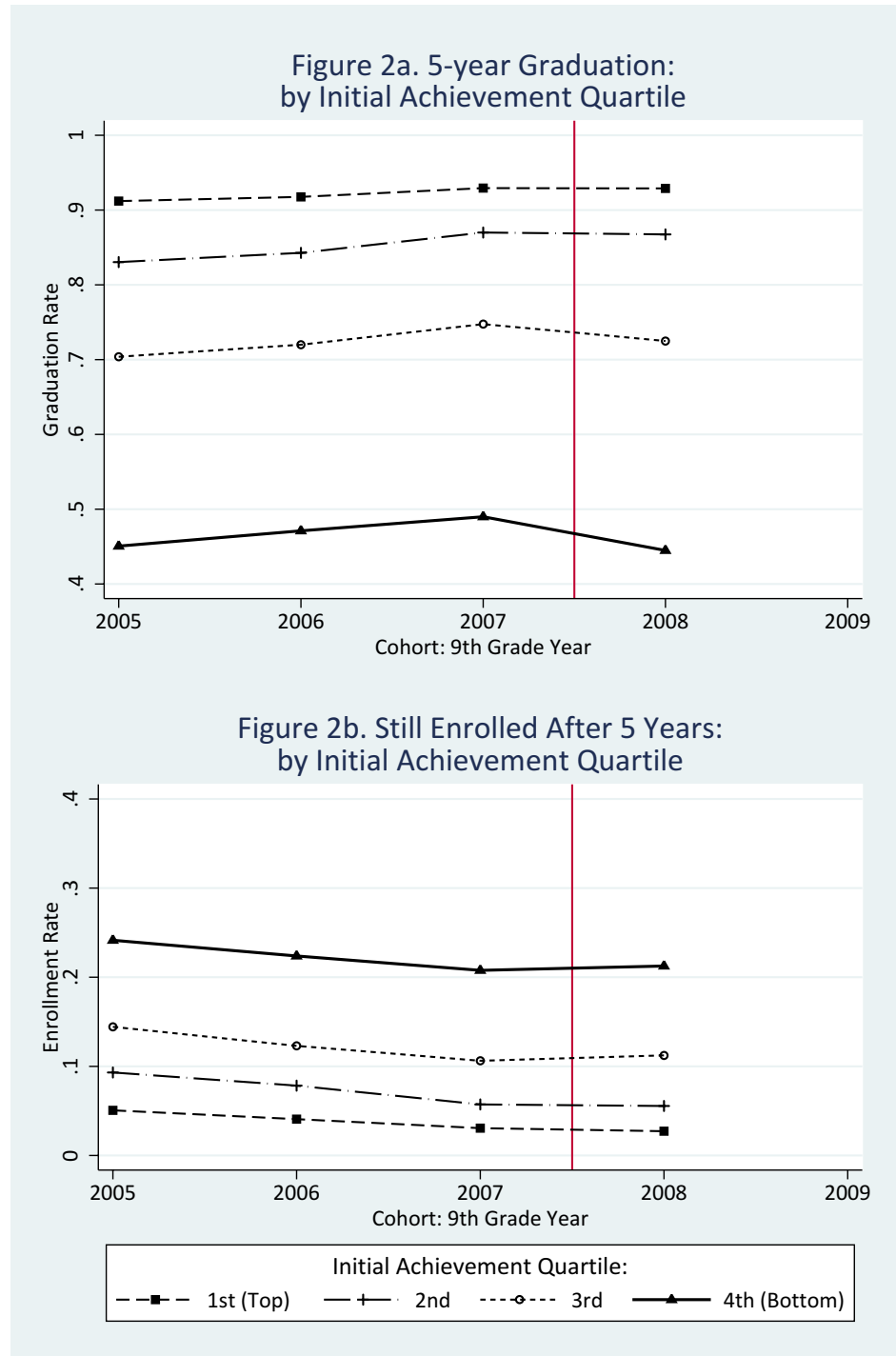
These effects are largest among those students with the lowest academic preparation at the start of high school.¹⁴ In Figure 1, between 2007 and 2008, we observe these effects for the bottom quartile by comparing the drop in the bottom line in Figure 1a (graduation) to the increase in the top line in Figure 1b (continued enrollment).





Early Effects of the MMC: High School Enrollment and Completion (continued)

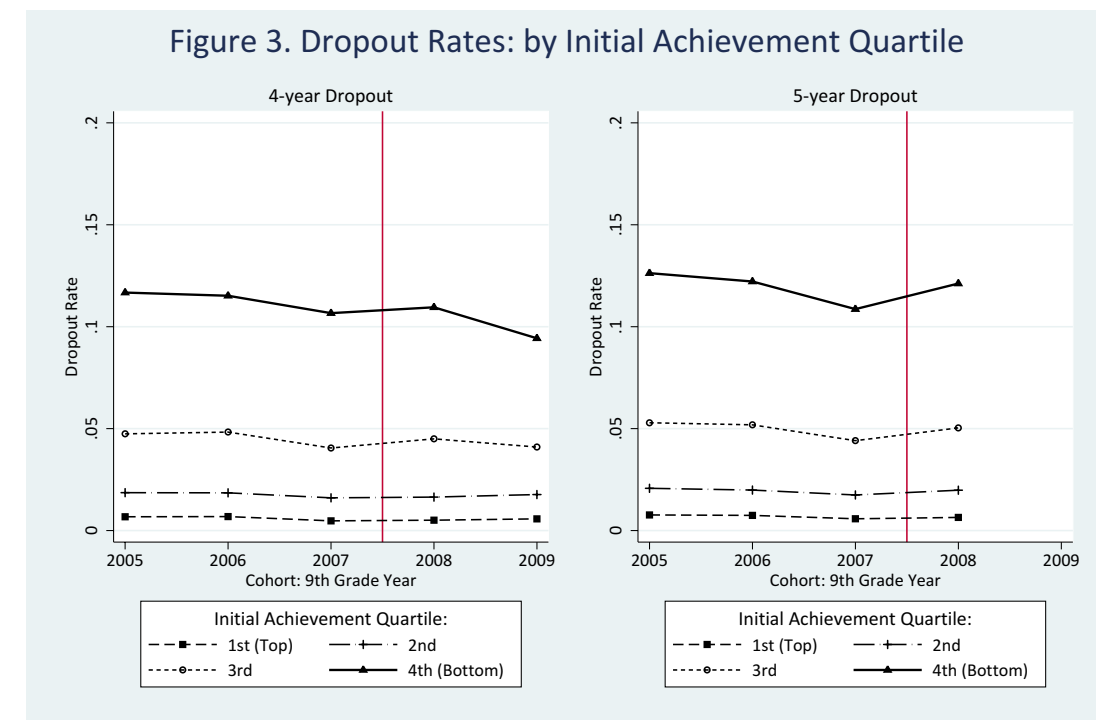
We next examine the effects of the MMC on the five-year high school graduation rate and continued enrollment in high school beyond five years (Figures 2a and 2b). Estimates from our analytic models (not shown) make clear that the MMC is associated with a decline in the five-year high school graduation rate for students in the lowest quartile. However, there is little change in the rate of continued enrollment beyond five years for this same group. This suggests an increase in the five-year dropout rate, which we next examine.



Early Effects of the MMC: High School Dropout Rates

We now examine trends in four- and five-year dropout rates (Figure 3). For students with better preparation at high school entry (i.e., those in the top two quartiles of academic readiness), there is little effect of the MMC on dropout. For less prepared students (i.e., those in the third and fourth quartiles), we observe increases in the five-year dropout rate.

Despite the increases in the rate of continuing into a fifth year of high school among the least-prepared students, by the end of five years we see an increase in their dropout rate and a decrease in their graduation rate. We estimate a decline of five percentage points in the five-year graduation rate for students in the bottom quartile of academic readiness (off of a base of 44 percent).



This decline in the graduation rate is comprised of an increase in the documented dropout rate of about one to two percentage points, plus an increase of between one and two percentage points for students classified as having an “unknown” status. Students with a status of “unknown” have simply disappeared from our data by the end of year five (i.e., they left Michigan public schools, or have not graduated, officially dropped out, or otherwise indicated their whereabouts). Therefore, the increase in the five-year dropout rate for low-performers subsequent to the MMC could be as high as four or five percentage points.



Early Effects of the MMC: College Enrollment

We next explore impacts of the MMC on the college-going of Michigan high school students. Mirroring the patterns we saw in high school graduation rates, college enrollment in the year immediately following high school graduation has decreased slightly subsequent to the MMC. It is not yet clear whether this decrease represents a permanent decline in college enrollment or simply reflects the fact that students are extending their stay in high school following the adoption of the MMC. As we acquire data on additional ninth grade cohorts of students bound by the requirements of the MMC, we will be able to paint a clearer picture of the impacts of the MMC on college enrollment and persistence.

Early Effects of the MMC: High School Test Scores

Since the Michigan Merit Examination (MME) includes the ACT exam, we examine students' scores on both the ACT and the full state test. Table 3 summarizes the estimated effects of the MMC on the ACT and MME. This table illustrates the impacts of the MMC on test scores controlling for other factors that could influence student achievement.¹⁵

Table 3
Summary of Achievement Effects of MMC

	Top Quartile		Bottom Quartile	
	ACT	MME	ACT	MME
Science	+	+	0	-
Math	+	0	-	-
Reading	+	+	0	0/-
Writing	-		-	

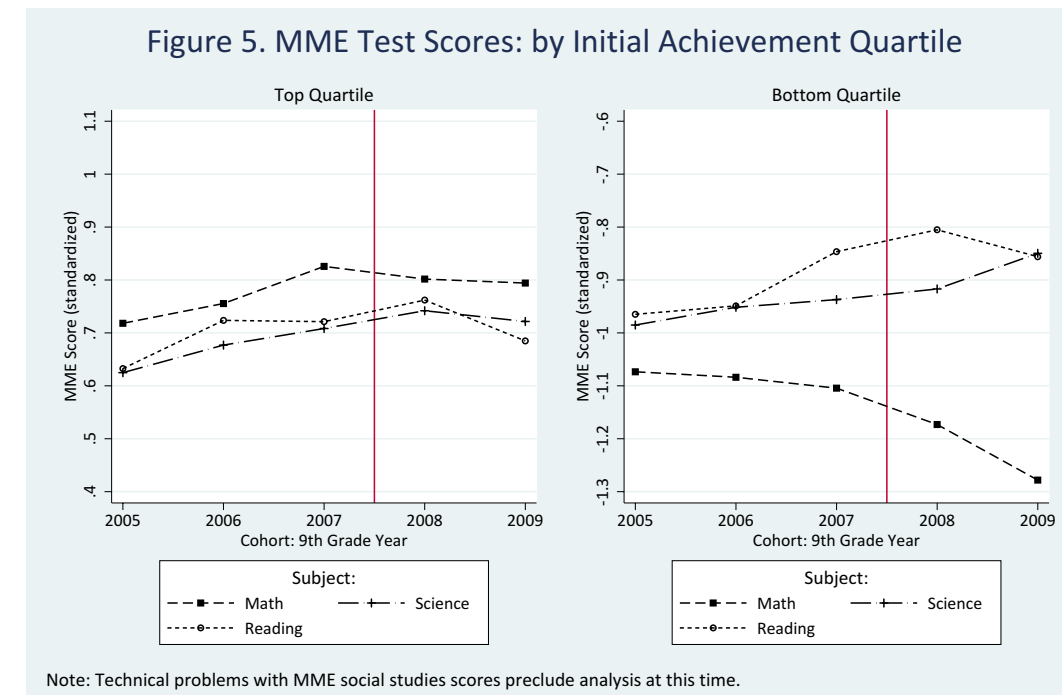
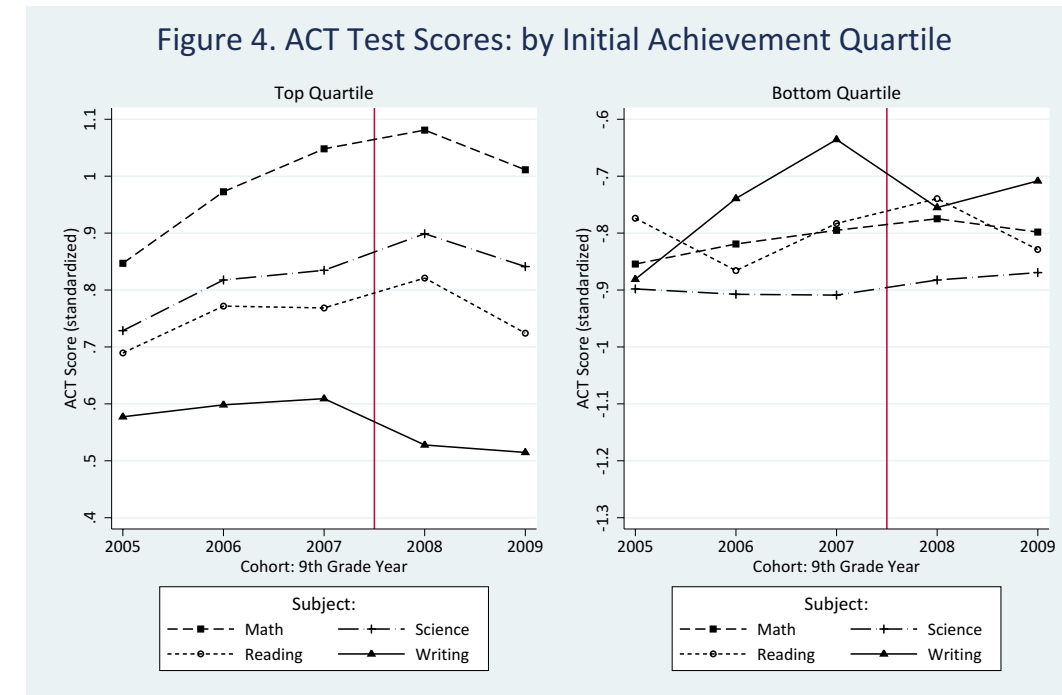
Notes: + = positive effect of MMC; - = negative effect of MMC; 0 = no detectible effect of MMC; Technical problems with MME social studies scores preclude analysis at this time. Effects solely for the first cohort for whom the new graduation requirements were binding - namely the High School Class of 2011.

In Figures 4 and 5, we present trends in the ACT and MME, respectively. We show results separately for students who entered high school with high and low levels of academic preparation (the top and bottom quartiles). We focus on these two groups of students since effects for the third and second quartiles are similar to the fourth and first quartiles, respectively, but the size of these effects are smaller (in absolute value).

For the ACT (Figure 4), we see a slight increase in the math performance of the best-prepared students as well as an increase in their science and reading scores. After controlling for other factors with our analytic models (Table 3), we also estimate increases in math, science, and reading scores for this group. Based on the raw ACT trends for the least-prepared students (Figure 4, right panel), we see little change in math, science, and reading scores. When we control for other factors (Table 3), we estimate a slight decline in ACT math scores and no impact on science and reading scores for this group.

We estimate negative effects of the MMC on ACT writing scores for all groups. We can see this in the raw data (Figure 4) by noting the drop in the solid trend line as we move from 2007 to 2008. This drop does not appear to be a continuation of pre-MMC trends.

For the MME (Figure 5), we see no effect on the math performance of the best-prepared students and an increase in their science and reading scores. We see a decrease in the science and math scores of the least-prepared students, and zero to negative effect on their reading scores. Note that there is no writing score on the MME.



Note: Technical problems with MME social studies scores preclude analysis at this time.



Early Effects of the MMC: High School Course-Taking Patterns

Students taking the ACT are asked to complete a questionnaire in which they list all the courses they have taken or plan to take during high school. Because all Michigan students were required to take the ACT starting in 2007, these student reports provide a convenient way to obtain an approximate picture of course-taking trends in the state. In ongoing work, we are collecting official transcript data from a representative sample of Michigan high schools to study the implementation of the MMC more formally.

Table 4 shows percentages of students who said that they took, were taking, or would take different groups of math and science courses. We use data on students in the graduating classes of 2008 through 2012 who took the ACT (and filled out the course-taking questions). The first line under each subject is the set of rigorous courses mandated by the MMC. The sets of classes that follow attempt to illustrate what students were taking, if these courses were not the specific math and science courses required by the MMC.

Table 4

Student Course Taking (Self-Reported to ACT)

Class of...	Year				
	2008	2009	2010	2011	2012
Math					
4 years of math, including Alg1, Alg2, and Geom	29	31	32	38	36
4 years of math, but not Alg1, Alg2, and Geom	21	24	25	28	30
3 years of math (Alg 1, Alg 2, and Geom)	18	19	20	18	18
3 years of math (other)	5	5	5	6	7
<3 years math	20	18	14	4	3
Did not report course-taking	7	3	4	6	6
Total	100	100	100	100	100
Science					
3+ years of science, including Bio + (Chem or Phy)	61	68	70	80	81
3 years of science (other)	4	4	4	6	6
<3 years of science	28	25	21	8	7
Did not report course-taking	7	3	5	6	6
Total	100	100	100	100	100

Source: ACT, Inc. Table 3.1 in annual reports for 2008-2012. Accessed September 28, 2012, at <http://www.act.org/newsroom/data/2012/pdf/profile/Michigan.pdf> and 2008-2011 URLs of the same form.

The percentages of students taking the full slate of math and science courses mandated by the MMC increased between 2010 and 2011 by six and ten percentage points, respectively. Yet, for the classes of 2011 and 2012, the percentages of students taking (or planning to take) these required courses are still far from 100 percent, especially in math. We also see a decline in the percentage of students taking less than three years of math (and science) courses along with an increase in the percentage taking four years of math (but not Algebra 1, Algebra 2, and Geometry). Students appear to be taking more math courses than prior to the MMC – but these additional courses include combinations of both MMC-required and non-required classes. Taken together, the patterns in Table 4 are suggestive of a gradual implementation of the MMC requirements.

Conclusions and Next Steps

Based on the first cohort of students exposed to the requirements of the MMC for their entire high school career, we find that the MMC led to small increases in the academic performance of already high-achieving students, with positive effects in science and reading, as well as in ACT math. We find little or negative impacts on the academic performance of low-achieving students, with the largest negative effects appearing in non-MMC subjects (e.g., ACT writing).

The MMC appears to have caused some students to extend their stay in high school beyond the traditional four years, perhaps in an effort to meet the more rigorous curricular requirements. The MMC also slightly increased the five-year dropout rate. As more ninth-graders move through high school, we will be better able to estimate the MMC's impact on the college-going behavior of recent Michigan graduates.

Going forward, we plan to closely examine patterns of student-level course-taking to understand if and how the effects of the MMC vary by district. We will also compare the experiences of Michigan students under the MMC to students in other states with similar reform efforts.



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- ¹ For a full description of the MMC requirements, see Table 1.
- ² This is according to a state-administered survey of Michigan districts in 2005, prior to the MMC. Of the 647 Michigan districts with high schools, 293 (45 percent) responded to the survey.
- ³ Rampey, B. D., Dion, G. S., & Donahue, P. L. (2009). NAEP 2008: Trends in Academic Progress. NCES 2009-479.
- ⁴ Heckman, J. J. & LaFontaine, P. A. (2007). "The American High School Graduation Rate: Trends and Levels," NBER Working Paper No. 13670.
- ⁵ Highlights from PISA 2009: Performance of U.S. Five-year-Old Students in Reading, Mathematics, and Science Literacy in an International Contest. NCES 2011-004. U.S. Department of Education.
- ⁶ Education Commission of the States, <http://mb2.ecs.org/reports/Report.aspx?id=735>.
- ⁷ Goodman, J. (2012). "The Labor of Division: Returns to Compulsory Math Coursework," HKS Faculty Research Working Paper Series RWP12-032; Rose, H., & Betts J. R., (2004). The Effect of High School Courses on Earnings. *Review of Economics and Statistics*, 86(2), 497-513.
- ⁸ Dee, T. S., & Jacob, B. A. (2007). "Do High School Exit Exams Influence Educational Attainment or Labor Market Performance?" in A. Gamoran (Ed.), *Standards-Based Reform and the Poverty Gap* (pp. 154-197). Washington, DC: Brookings Institution; Papay, J.P., Murnane, R. J., & Willett, J. B. (2010). The Consequences of High School Exit Examinations for Low-Performing Urban Students: Evidence from Massachusetts. *Educational Evaluation and Policy Analysis*, 32(1), 5-23.
- ⁹ Nomi, T. (2012). The Unintended Consequences of an Algebra-for-All Policy on High-Skill Students: Effects on Instructional Organization and Students' Academic Outcomes. *Educational Evaluation and Policy Analysis*, forthcoming; Clotfelter, C., Ladd, H. and Vigdor, J. (2012) "The Aftermath of Accelerated Algebra: Evidence from a District policy Initiative," CALDER Working Paper 69.
- ¹⁰ For more detailed information about our base analytic sample, please consult the Technical Appendix (a separate document). This document provides means for all of our student outcomes by ninth grade cohort and academic readiness quartile.
- ¹¹ Bloom, H. S., Ham, S., Melton, L., & O'Brien, J. (2001). Evaluating the Accelerated Schools Approach: A Look at Early Implementation and Impacts on Students Achievement in Eight Elementary Schools. MDRC.
- ¹² Kemple, J, Herlihy, C. M. & Smith, T. J.,(2005). Making Progress Toward Graduation: Evidence from the Talent Development High School Model. MDRC.
- ¹³ Jacob, B. A. (2005). Accountability, Incentives and Behavior: the Impact of High-Stakes Testing in the Chicago Public Schools. *Journal of Public Economics*, 89(5-6), 761-796.
- ¹⁴ We divide students into quartiles of baseline achievement using their eighth grade test scores and demographic characteristics.
- ¹⁵ Technical problems with MME social studies scores preclude analysis at this time. Moving forward we will investigate the impacts of the MMC on students' social studies performance.



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