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# Do Curriculum-Based External Exit Exam Systems Enhance Student Achievement?

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# Do Curriculum-Based External Exit Exam Systems Enhance Student Achievement?

## **Abstract**

[Excerpt] It is claimed that 'curriculum-based external exit exam systems', CBEEES, based on world class content standards will improve teaching and learning of core subjects. What evidence is there for this claim? New York's Regents Exams are an example of such a system. Do New York students outperform students with similar socio-economic backgrounds from other states? Outside the United States such systems are the rule, not the exception. What impacts have such systems had on school policies, teaching and student learning?

## **Keywords**

national, standard, student, school, teach, achievement, exam, incentive, standards, state, subject

## **Disciplines**

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WORKING PAPER SERIES

# Do Curriculum-Based External Exit Exam Systems Enhance Student Achievement?

John H. Bishop

Working Paper 97 - 28



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## **DO CURRICULUM-BASED EXTERNAL EXIT EXAM SYSTEMS ENHANCE STUDENT ACHIEVEMENT?**

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This paper has not undergone formal review or approval of the faculty of the ILR School. It is intended to make results of Center research, conferences, and projects available to others interested in human resource management in preliminary form to encourage discussion and suggestions.

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## Do Curriculum-Based External Exit Exam Systems Enhance Student Achievement?

Two presidents, the National Governors Association and numerous blue ribbon panels have called for the development of state content standards for core subjects and examinations that assess the achievement of these standards. The Competitiveness Policy Council, for example, advocates that *"external assessments be given to individual students at the secondary level and that the results should be a major but not exclusive factor qualifying for college and better jobs at better wages (1993, p. 30)."* The American Federation of Teachers advocates a system in which:

Students are periodically tested on whether they're reaching the standards, and if they are not, the system responds with appropriate assistance and intervention. Until they meet the standards, they won't be able to graduate from high school or enter college (AFT 1995 p. 1-2).

It is claimed that 'curriculum-based external exit exam systems', CBEEES, based on world class content standards will improve teaching and learning of core subjects. What evidence is there for this claim? New York's Regents Exams are an example of such a system. Do New York students outperform students with similar socio-economic backgrounds from other states? Outside the United States such systems are the rule, not the exception. What impacts have such systems had on school policies, teaching and student learning?

### 1. What's so Different about a Curriculum-Based External Exit Exam System?

Skeptics point out that American students already take lots of standardized tests. They ask "Why should a curriculum-based external exit examination system significantly improve incentives and learning?" The response of CBEEES advocates is that they have uniquely powerful incentive effects because they have the following six characteristics. They:

1. **Produce signals of student accomplishment that have real consequences for the student.**
2. **Define achievement relative to an external standard, not relative to other students in the classroom or the school.** Fair comparisons of achievement across schools and across students at different schools are now possible. Costrell's (1994a) analysis of the optimal setting of educational standards concluded that more centralized standard setting (state or national achievement exams) results in higher standards, higher achievement and higher social welfare than decentralized standard setting (i.e. teacher grading or schools graduation requirements).

3. **Are organized by discipline and keyed to the content of specific course sequences.** This focuses responsibility for preparing students for particular exams on a small group of teachers.
4. **Signals multiple levels of achievement in the subject.** If only a pass-fail signal is generated by an exam, the standard will have to be set low enough to allow almost everyone to pass and this will not stimulate the great bulk of students to greater effort (Kang 1985; Costrell 1994a).
5. **Covers almost all secondary school students.** Exams for a set of elite schools, advanced courses or college applicants will influence standards at the top of the vertical curriculum, but will probably have limited effects on the rest of the students. The school system as a whole must be made to accept responsibility for how students do on the exams. A single exam taken by all is not essential. Many nations allow students to choose which subjects to be examined in and offer high and intermediate level exams in the same subject.
6. **Assess a major portion of what students studying a subject are expected to know or be able to do.** It is, however, not essential that the external exam assess every instructional objective. Teachers can be given responsibility for evaluating dimensions of performance that cannot be reliably assessed by external means.

Commercially prepared achievement tests such as the CAT, CTBS, ITBS, ITED are not curriculum-based external exit exams because they fail requirement #1. Students have no stake in doing well on these tests. Where stakes are attached to results, it is teachers and school administrators who experience the consequences, not individual students.

The minimum competency exams that many American states require students pass before graduation are not CBEEEs because they fail requirements #3 and #4. They are typically first taken in 9<sup>th</sup> or 10<sup>th</sup> grade and most students pass on the first sitting. High school transcripts indicate only whether the student eventually passes the test, not achievement levels above the minimum. Thus, for the great majority of students who pass on the first try, the tests no longer stimulate study. Incentive effects are focused on the small minority who fail on the first try and must repeat the test. Minimum competency exams can be a useful part of a CBEEES, but other much more demanding curriculum-based exams signaling much higher levels of performance are essential.

The requirement (#4) that a CBEEE signal different levels of achievement (not just whether the student has achieved a minimum) is essential because it has major effects on the

incentive effects of exams. By age 13 students differ dramatically in their levels of achievement. On the National Assessment of Educational Progress, 7-9 percent of 13 year olds are four or more grade level equivalents behind their age mates and 15-17 percent are four or more grade level equivalents ahead. When achievement differentials among students are as large as this, incentives for effort are stronger for most students if the full range of achievement is signaled rather than just whether the individual has passed some absolute standard. When only a pass-fail signal is generated by a test, many students pass without exertion and are, thus, not stimulated to greater effort by the reward for passing. Some of the least well prepared students will judge the effort required to achieve the standard to be too great and the benefits too small to warrant the effort. They give up on the idea of meeting the standard. Few students will find the reward for exceeding a single absolute cutoff an incentive for greater effort (Kang 1985). Costrell agrees: "The case for perfect information [making scores on external examinations available rather than just whether the individual passed or failed] would appear to be strong, if not airtight: for most plausible degrees of heterogeneity, egalitarianism, and pooling under decentralization, perfect information not only raises GDP, but also social welfare (1994, p. 970)."

The SAT-I reasoning tests are not curriculum based external exit exams because they do not meet tests #5 and #6. They fail to assess most of the material—history, science, economics, civics, literature, foreign languages and the ability to write an essay—that high school students are expected to learn. The SAT was designed from the beginning to minimize backwash effects on teaching and student study habits. Indeed, Richard Gummere, Harvard College's admissions director at the time the machine scored multiple-choice Scholastic Aptitude Test (SAT) replaced the curriculum-based essay style College Board Examinations, was very candid about why the SAT had been adopted:

Learning in itself has ceased to be the main factor [in college admissions]. The aptitude of the pupil is now the leading consideration (Gummere, 1943 p. 5).

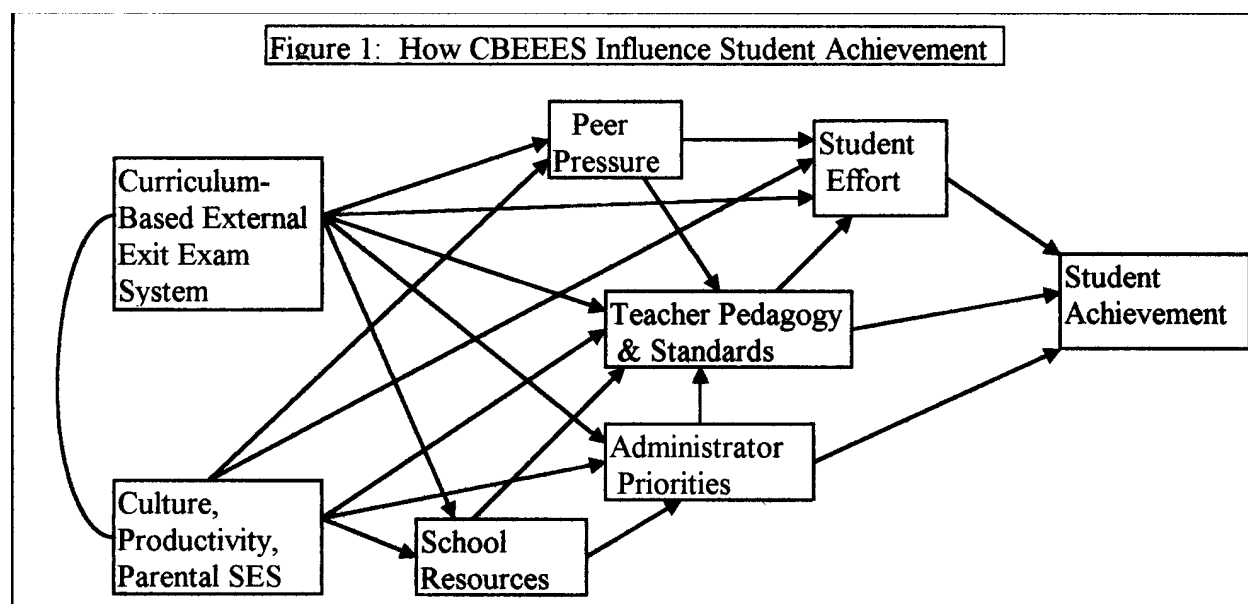
The subject specific SAT-II achievement tests fail tests #1 and #5. Stakes are very low—few colleges consider SAT-II results in admissions decisions—and few students take them. In 1982-83 only 6 percent of SAT-I test takers took a science SAT-II and only 3 to 4 percent took one in history or a foreign language. Schools do not assume responsibility for preparing students for SAT-II tests.

The Advanced Placement (AP) examinations are the one exception to the generalization that the U.S. lacks national curriculum-based external exit examinations. While growing rapidly, AP is still a very small program. In 1995 only 3.2 percent of juniors and seniors took AP English or AP history exams and only 2 percent took AP calculus or science exams (National Education

Goals Panel 1995). Low participation means that AP exams fail requirement #5 and are, consequently, not a CBEEE system. They can, however, serve as a component of a larger system.

## 2. How are CBEEES Hypothesized to Increase Achievement?

CBEEES fundamentally change the signaling of student achievement. By doing so they transform the incentives faced by students, parents, teachers and school administrators. CBEEES are, consequently, hypothesized to influence the resources made available to schools and the priorities of school administrators, teacher pedagogy, parental encouragement and student effort. The many paths by which CBEEES influence student achievement are illustrated in Figure 1.



**Impacts on Students:** Curriculum-based external exit exam systems (CBEEES) improve the signaling of academic achievement. As a result, colleges and employers are likely to give greater weight to academic achievement when they make admission and hiring decisions, so the rewards for learning should grow and become more visible. CBEEES also shift attention towards measures of absolute achievement and away from measures of relative achievement such as rank in class and teacher grades. By doing so, CBEEES ameliorate the problem of peer pressure against studying.

Interviews I have conducted during 1996 and 1997 with middle school students in Collegeville, a small city dominated by two universities, indicate that most students (males especially) internalize a norm against "sucking up" to the teacher. How does a student avoid being thought a "Suck up?" He:



- Avoids giving the teacher eye contact,
- Does not hand in homework early for extra credit,
- Does not raise his hand in class too frequently, and
- Talks or passes notes to friends during class (this signals that you value friends more than your rep with the teacher).

Steinberg, Brown and Dornbush conclude similarly that "The adolescent peer culture in America demeans academic success and scorns students who try to do well in school (1996, p. 19)."

Why are the studious called *suck ups*, *dorks* and *nerds* or accused of "*acting white*"? In part, it is because, since exams are graded on a curve, their study effort is making it more difficult for others to get top grades. When exams are graded on a curve or college admissions are based on rank in class, joint welfare is maximized if no one puts in extra effort. In the repeated game that results, side payments—friendship and respect—and punishments—ridicule, harassment and ostracism—enforce the cooperative "don't study" solution. If, by contrast, students are evaluated relative to an outside standard, they no longer have a personal interest in getting teachers off track or persuading each other to refrain from studying. Peer pressure demeaning studiousness should diminish.

**Impacts on School Administrators:** When there is no external assessment of academic achievement, students and their parents benefit little from administrative decisions that opt for higher standards, more qualified teachers or a heavier student work load. The immediate consequences of such decisions—higher taxes, more homework, having to repeat courses, lower GPA's, complaining parents, a greater risk of being denied a diploma—are all negative.

When student learning is not assessed externally, the positive effects of choosing academic rigor are negligible and postponed. If college admission decisions are based on rank in class, GPA and aptitude tests, not externally assessed achievement in secondary school courses, upgraded standards will not improve the college admission prospects of next year's graduates. Graduates will probably do better in difficult college courses and will be more likely to get a degree, but that benefit is uncertain and far in the future. Maybe over time the school's reputation and, with it, the college admission prospects of graduates will improve because the current graduates are more successful in local colleges. That, however, is even more uncertain and postponed. Publishing data on proportions of students meeting targets on standardized tests probably speeds the process by which real improvements in a school's performance influence its local reputation. However, other indicators such as SAT test scores, proportions going to various types of colleges and the socioeconomic background of the students tend to be more prominent. As a result, school reputations are determined largely by things that teachers

and administrators have little control over: the socio-economic status of the student body and the proportion of graduates going to college.

American employers have historically paid little attention to student achievements in high school or school reputations when selecting young workers (Bishop 1989, 1993, Hollenbeck and Smith 1984). Those that do pay attention to achievement use indicators of relative performance such as GPA and rank in class rather than results on an external exam as a hiring criterion. Consequently, higher standards do not benefit students as a group, so parents as a group have little incentive to lobby strongly for higher teacher salaries, higher standards and higher school taxes.

External exams in secondary school subjects transform the signaling environment. Hiring better teachers and improving the school's science laboratories now yields a visible payoff—more students passing the external exams and being admitted to top colleges. This in turn is likely to lead to more spending on schools, more rigorous hiring standards for secondary school teachers and a higher priority assigned to student learning in the allocation of school budgets.

Additionally, reform minded administrators have used CBEEES results to shame and inspire teachers to raise standards for all students. The superintendent of a suburban New York district that has been nationally recognized for raising student achievement levels put it as follows:

*"[External validators like Regents exams and International Baccalaureate] were the best and only way in which we could get teachers and staff to see themselves as others might see them and not just keep looking in the mirror and seeing themselves as they would like to see themselves. (Interview with superintendent of an All-Regents High school, August 1997)"*

**Impacts on Teachers:** Thirty percent of American teachers say they "feel pressure to give higher grades than students' work deserves" and "feel pressure to reduce the difficulty and amount of work you assign" (Peter D. Hart Research Associates, 1994). Under a system of external exams, teachers and local school administrators lose the option of lowering standards to reduce failure rates and raise self-esteem. The only response open to them is to demand more of their students so as to maximize their chances of being successful on the external exams.

A further benefit of CBEEES is the professional development that teachers receive when they are brought to centralized locations to grade the extended answer portions of examinations. In May 1996 I interviewed a number of teacher's union activists about the examination system in the Canadian province of Alberta. Even though the union and these

teachers opposed the exams, they universally reported that serving on grading committees was "...a wonderful professional development activity (Bob, 1996)." Having to agree on what constituted excellent, good, poor, and failing responses to essay questions or open ended math problems resulted in a sharing of perspectives and teaching tips that most found very helpful.

On the other hand, many fear that external exams will negatively effect teaching. Opponents argue that "preparation for high stakes tests often emphasizes rote memorization and cramming of students and drill and practice teaching methods" and that "some kinds of teaching to the test permits students to do well in examinations without recourse to higher levels of cognitive activity (Madeus 1991 p. 7-8)."

CBEEES advocates counter by challenging the assumption implicit in the above argument that examinations developed by the committees of teachers working for state departments of education are/will be worse than the tests developed by individual teachers. In fact, the tests that teachers develop for themselves are generally of very low quality. Fleming and Chambers (1983) study of tests developed by high school teachers found that "over all grades, 80% of the items on teachers' tests were constructed to tap the lowest of [Bloom's] taxonomic categories, knowledge (of terms, facts or principles)" (Thomas 1991, p. 14). Rowher and Thomas (1987) found that only 18 percent of history test items developed by junior high teachers and 14 percent items developed by senior high teachers required the integration of ideas, required such integration. College instructors, by contrast, required such integration in 99 percent of their test items. Secondary school teachers test low level competencies because that is what they teach.

If care is taken in designing external exams, they can induce improvements in instructional practice. Sherman Tinkelman, New York State's Assistant Commissioner for Examinations and Scholarships, describes one such instance:

For years our foreign language specialists went up and down the State beating the drums for curriculum reform in modern language teaching, for change in emphasis from formal grammar to conversation skills and reading skills. There was not very great impact until we introduced, after notice and with numerous sample exercises, oral comprehension and reading comprehension into our Regents examinations. Promptly thereafter, most schools adopted the new curricular objectives (Tinkelman, 1966 p. 12).

### **3. Do CBEEES Increase Achievement? A look at the Evidence.**

The hypothesis that curriculum-based external exit examination systems improve achievement will be tested by comparing nations, states and provinces that do and do not have such systems. Four different data sets will be examined: science and mathematics achievement

of 70, and 801 graders in the 40 nation Third International Math and Science Study, science and math scores of 13 year olds on the International Assessment of Educational Progress (IAEP) for 16 nations and 9 Canadian provinces, and SAT test and NAEP math scores for New York State vs. the rest of the United States. The theory predicts that CBEEESs affect societal decisions about education spending, administrator decisions about school priorities, and teachers' decisions about standards and pedagogy and student decisions about studying. Much of the ultimate impact of CBEEESs on student achievement derives from the changes they induce in spending, priorities and pedagogy. Most of the components of the full Figure 1 model have been estimated in data on Canadian schools and students in Bishop (1996). In this paper, educational systems are the units of observation and in most analyses the objective is to assess the total effect of CBEEES on achievement (the sum of all the paths leading from CBEEES to student achievement in Figure 1). Total effects are estimated by a reduced form model that controls for parental SES, productivity and national culture, not the endogenous administrator teacher and parent behaviors.

### 3.1 Third International Mathematics and Science Study--TIMSS:

The just released TIMSS provides 1994-95 data for 7<sup>th</sup> and 8<sup>th</sup> graders for 39 countries. Comparative education studies, government documents and education encyclopedias were reviewed and education ministry officials, embassy personnel and Cornell graduate students from the country were interviewed to determine which of the TIMSS nations have curriculum-based externally-set exit examinations in secondary school.<sup>i</sup> Twenty-two national school systems were classified as having CBEEES for both subjects in all parts of the country: Austria, Bulgaria, Columbia, Czech Republic, Denmark, England, Hong Kong, Hungary, Ireland, Iran, Israel, Japan, Korea, Lithuania, the Netherlands, New Zealand, Russia, Scotland, Singapore, Slovak Republic, Slovenia and Thailand. Three countries—France, Iceland and Romania—had CBEEES in mathematics but not in science. Five countries—Australia, Canada, Germany, Switzerland and the United States—had CBEEES in some provinces but not in others. Norway has regular exit examinations in mathematics, but examines science only every few years. Latvia had an external examination system until very recently, so it was given a .5 on the CBEEES variable. The countries classified as not having a CBEEES in either subject were Belgium (both Flemish and French speaking systems), Cyprus, Greece, Philippines, Portugal, Spain and Sweden. Following Madeus and Kelleghan (1991), the university entrance examinations in Greece, Portugal, Spain, Cyprus and the ACT and SAT in the U.S. were not considered to be CBEEES. University entrance exams should have much smaller incentive effects because students headed into work do not take them and teachers can avoid

responsibility for their students' exam results by arguing that not everyone is college material or that examiners have set an unreasonably high standard to limit enrollment in higher education.

Figures 2 and 3 array the 40 TIMSS countries by the science and mathematics achievement of their 13-year-olds. The U.S. ranks #15 in science and #31 in mathematics. The gaps between the vertical grid lines represent one U.S. grade level equivalent—the difference between 7<sup>th</sup> and 8<sup>th</sup> grade TIMSS test score means for the U.S. Achievement differentials across nations are very large. In science Singapore, Korea, Bulgaria and Flemish Belgium are more than 1 GLE ahead of the U.S. and Columbia, Philippines, Lithuania, Romania and Portugal are more than 3 GLEs behind. In mathematics Singapore, Korea, Japan and Hong Kong are 4 or more grade level equivalents ahead of the U.S., while Columbia, Philippines and Iran are more than 3 GLEs behind. The countries represented by a solid black bar in the figures have a curriculum-based external exit exam in the subject. Countries represented by white bars do not. Note that the countries with a CBEEES in the subject tend to have higher TIMSS scores.

Regression Analysis: The mean 7<sup>th</sup> and 8<sup>th</sup> grade science and mathematics test scores were regressed on average per capita gross domestic product in 1987 and 1990 deflated by a purchasing power parity price index, a dummy for East Asian nation and a dummy for CBEEES. The results presented in Table 1 indicate that test scores are significantly higher in more developed nations, East Asian nations and in nations with a CBEEES in the subject.

The analysis of achievement at a particular grade level may be biased, however, by differing policies regarding grade retention, age of school entry and which grade was chosen for assessment. CBEEES, for example, might be associated with high rates of grade retention. Therefore, a preferable dependent variable is a measure of student achievement at some fixed age. The third and fourth rows of each panel present estimated models predicting the median test score for each nation's 13-year-olds (Beaton et al, 1996a,b, Table 1.5). For countries not included in this table, the 13-year-old median was estimated by age adjusting the 7<sup>th</sup> and 8<sup>th</sup> grade means.<sup>2</sup> Switching to the age constant achievement somewhat reduces the estimated impact of the CBEEES but the effects remain statistically significant. Using two tail *t* tests, the CBEEES coefficient has a  $P = .08$  in the mathematics model and a  $P = .01$  in the science model. The estimated impacts are substantively important: 1.3 U.S. grade level equivalents in science and 1.0 U.S. grade level equivalents in mathematics.

One of the ways CBEEES may improve achievement is by inducing greater social investments in education. Row 4 presents results of regressions that add the share of GDP spent on education to the standard model. Coefficients on this variable are positive for both outcomes and significantly so for science. The estimated impact of spending is modest,

however. A one percentage point increase in the share of GDP devoted to education increases the science achievement of 13-year-olds by one half a grade level equivalent.

The bottom row of each panel assesses the impact of CBEEES on measures of science and math learning between ages 9 and 13.<sup>3</sup> Coefficients on the CBEEES dummy are positive for both math and science, but statistically significant only for mathematics. The exams are taken during upper secondary school or at the end of lower secondary school, so CBEEES may have larger effects on learning during secondary school than during primary school. This prediction is supported for math but not for science. For mathematics the coefficients suggest that about two-thirds of the effect of CBEEES on achievement at age 13 was generated in the previous four years. Since exams are also likely to affect learning during upper secondary school, total effects at the end of 12<sup>th</sup> grade are likely to be larger still.

### 3.2 Analysis of the 1991 International Assessment of Educational Progress

The 1991 International Assessment of Educational Progress (IAEP) is the second data set in which CBEEE effects can be tested. Fifteen nations are available for the analysis: England, France, Hungary, Ireland, Israel, Emilia Romagna/Northern Italy, Korea, Portugal, Scotland, Slovenia, Soviet Union, Spain, Switzerland, Taiwan and the United States.

The average percent correct (adjusted for guessing) for 13 year old students was regressed on the same set of variables as in the analysis of the TIMSS data. The results are presented in the second panel of Table 1. For mathematics the effect of curriculum-based external exams is highly significant and quite large. Since the U.S. standard deviation was 26.8 percentage points in mathematics, the CBEEE effect on math was more than one-half of a U.S. standard deviation or about 2 U.S. grade level equivalents. CBEEEs had a smaller non-significant effect on science achievement. East Asian students scored significantly higher than students in Europe and North America did. Coefficients on per capita GDP were positive but not statistically significant.

These results are consistent with the causal hypotheses presented above. Causation is not proved, however, because other explanations can no doubt be proposed. Other sources of variation in curriculum based exams need to be analyzed. Best of all would be studies that hold national culture constant. Two such studies will be presented: one comparing Canadian provinces, the other comparing U.S. states.

### 3.3 Comparing Canadian Provinces

In 1990-91, the year the IAEP data was being collected, Alberta, British Columbia, Newfoundland, Quebec, and Francophone, New Brunswick had curriculum-based provincial examinations in English, French, mathematics, biology, chemistry, and physics during the senior

year of high school. These exams accounted for 50 percent of that year's final grade in Alberta, Newfoundland and Quebec and 40 percent in British Columbia. The other provinces did not have curriculum-based provincial external exit examinations in 1990-91. Ontario eliminated them in 1967, Manitoba in 1970 and Nova Scotia in 1972. Anglophone New Brunswick had provincial exams in language arts and mathematics but exam grades were not reported on transcripts or counted in final course grades. Canadian provincial exams are medium stakes, not high stakes tests. They influence grades but passing the examination is not essential for graduation. Employers appear uninterested in exam scores. Job application forms do not request that applicants report exam scores or grades.

The principals of schools sampled by IAEP completed questionnaires describing school policies, school resources and the qualifications of 8<sup>th</sup> grade mathematics and science teachers. Students were asked about books in the home, number of siblings, language spoken at home, hours of TV, hours doing homework pleasure reading, watching science programs on TV, parental oversight of school work and teaching methods of teachers.

The effects of curriculum-based provincial exit exams taken by 12<sup>th</sup> graders on achievement and the behavior of Canadian 13 year olds, their parents, teachers and school administrators were examined by estimating models predicting these behaviors using schools as observations. The data set comprises 1354 Canadian and 106 U.S. schools. The model contained 9 variables: logarithm of the mean number of books in the home, the mean number of siblings, the proportion of the school's students whose home language was different from the language of instruction, logarithm of the number of students per grade in the school and dummies for religiously controlled school, secular non-public schools, French speaking schools, a dummy for U.S. school and EXAM province.

Table 2 presents regression results predicting 4 achievement outcomes, 12 measures of school administrator behavior, 9 teacher behaviors and 11 student/parent attitudes and behaviors. The first column presents the hypothesized sign of the relationship between CBEEES and that variable. The means and standard deviations across schools of each dependent variable are presented in columns 2 and 3. The  $R^2$  corrected for degrees of freedom is reported in column 14. The coefficient for EXAM and its T statistic are presented in columns 4 and 5. Provincial exit exams had very large effects on achievement: 24 percent of an U.S. standard deviation (about four-fifths of an U.S. grade level equivalent) in mathematics and 17.6 percent of a standard deviation (about three-fifths of a grade level equivalent) in science.

**Effect of CBEEES on Behavior of Students, Teachers and Administrators:** Exit exams also affected the behavior of parents, teachers and school administrators. Schools in exit

exam provinces scheduled significantly more hours of math and science instruction, assigned more homework, had better science labs, were significantly more likely to use specialist teachers for math and science and more likely to hire math and science teachers who had studied the subject in college. Eighth grade teachers in exam provinces gave tests and quizzes more frequently. Hours in the school year, class size and teacher prep time were not significantly affected by CBEEES.

Opponents of externally set curriculum-based examinations predict that they will cause students to avoid learning activities that do not enhance exam scores. This hypothesis was operationalized by testing whether exam systems were associated with less reading for pleasure and less watching of science programs like NOVA and Nature. Neither of these hypotheses is supported. Indeed students in exam provinces spent significantly more time reading for pleasure, more time watching science programs on TV, while watching significantly less TV overall. Parents in these provinces were more likely to talk to their children about their math and science classes and their children were more likely to report that their parents "are interested in science" or "want me to do well in math."

Do CBEEES skew teaching in undesirable ways? Apparently not. Students did more (not fewer) experiments in science class and emphasis on computation using whole numbers—a skill that should be learned by the end of 5<sup>th</sup> grade—declined significantly. Apparently, teachers subject to the subtle pressure of a provincial exam four years in the future adopt strategies that are conventionally viewed as "best practice," not strategies designed to maximize scores on multiple choice tests.

Students responded to the improved teaching by becoming more likely to report that science was "useful in everyday life." The data provided no support for our hypothesis that CBEEES would induce employers to pay greater attention to high school achievement, students in exam provinces were not more likely to believe that math was important in getting a good job and were less likely to believe that science was important in job hunting.

One possible skeptical response to these findings is to point out that the correlation between EXAM and other outcomes may not be causal. Maybe the people of Alberta, British Columbia, Newfoundland, Quebec, and Francophone, New Brunswick—the provinces with exam systems—place higher priority on education than the rest of the nation. Maybe this trait also results in greater political support for examination systems. If so, we would expect that schools in the exam provinces should be better than schools in other provinces along other dimensions such as discipline and absenteeism, not just by academic criteria. Bishop (1996) predicts, to the contrary, that exam systems induce students and schools to redirect resources and attention to



learning/teaching exam subjects and away from the achievement of other goals such as low absenteeism and good discipline. These competing hypotheses are evaluated in the 3<sup>rd</sup> and 4<sup>th</sup> row of Table 2. Contrary to the "provincial taste for education" hypothesis, principals in exam provinces did not report significantly fewer discipline problems and were significantly more likely to report absenteeism problems.

**Effectiveness of Non-Public Schools:** In their influential 1990 book, John Chubb and Terry Moe argued that the constraints placed on public schools by bureaucracy and democratic government make them inherently less effective than non-public schools that must compete for students and that are, thus, required to survive a market test. Clearly, however, their theory does not apply to Canada. Most of Canada's nonpublic schools were started by religious denominations. When background characteristics of the students are controlled, students at religiously controlled schools knew considerably less math and science at age 13 than public school students. This occurred despite that fact that the students at parochial schools were more likely to believe that math and science were useful in everyday life and important in getting a good job and had parents who were more interested in their school performance. The difference appears to result from the quality and amount of instruction students at parochial schools received. Students got 13 percent less science instruction time and worked in laboratories that were clearly inferior to those in public middle schools. Their teachers were less likely to be specializing in teaching the subject and less likely to have studied the subject in college.

### 3.4 **The Impact on New York State Regents Examinations**

In the early 1990s, New York State was the only state with a CBEEE System. It has been administering curriculum-based Regents Examinations to high school students ever since June 1878. As Sherman Tinkelman, Assistant Commissioner for Examinations and Scholarships described in a 1966 report:

The Regents examinations are closely related to the curriculum in New York State. They are, as you can see, inseparably intertwined. One supports and reinforces the other.... These instruments presuppose and define standards.... They are a strong supervisory and instructional tool—and deliberately so. They are effective in stimulating good teaching and good learning practices (Tinkelman, 1966 p. 12).

The examinations are taken throughout one's high school career. A student taking a full schedule of college preparatory Regents courses would typically take Regents exams in mathematics and earth science at the end of 9<sup>th</sup> grade; mathematics, biology and global studies

exams at the end of 10<sup>th</sup> grade; mathematics, chemistry, American history, English and foreign language exams at the end of 11<sup>th</sup> grade and physics exams at the end of 12<sup>th</sup> grade.

In 1993, about 56 percent of 9<sup>th</sup> graders took the Mathematics Course 1 exam and, of these, 24 percent scored below the 65% passing grade. Similar proportions of 10<sup>th</sup> and 11<sup>th</sup> graders took the global studies, biology and English exams. Failure rates were 20 percent in global studies, 18 percent in biology and 13 percent in English. Those not taking Regents exams were typically in courses that was considerably less challenging than Regents level courses. A system of minimum competency tests in specific subjects set a minimum standard for those not taking Regents courses but, as in other states, the passing standard was low.

#### Impacts on SAT Test Scores

New York's students are more disadvantaged, more heavily minority and more likely to be foreign-born than students in most other states. Among northern states, only Maryland, Delaware, and Illinois have a larger share of African-American pupils. Nationwide, only California has a higher share of its population foreign born and only California, Texas, Arizona, New Mexico and Colorado have larger Hispanic population shares. Literacy levels among adults are substantially below the national average (NEGP 1993, Vol. 2).

Consequently, when one compares student achievement levels, family background must be taken into account. Considering the high incidence of at-risk children, New York students do remarkably well. The proportion of students taking algebra, calculus, chemistry and physics is generally above national averages. A larger proportion of New York's 11<sup>th</sup> and 12<sup>th</sup> graders are taking and passing (9.4 percent) AP exams in English, science, math or history than any other state except Utah (NGEP 1993, Vol. 2).

Graham and Husted's (1993) analysis of SAT test scores in the 37 states with reasonably large test taking populations found that New York State students did better than comparable students in other states. They did not, however, test the statistical significance of the New York State effect and used an unusual log-log specification.

Table 3 presents the results of a linear regression predicting 1991 mean SAT-M + SAT-V test scores for the 37 states for which data are available. With the exception of the dummy variable for New York State, all right hand side variables are proportions-generally the share of the test taking population with the characteristic described. Clearly, New Yorkers do significantly better on the SAT than students of the same race and social background living in other states. When this model is estimated without the NYS dummy variable, New York has the largest positive residual in the sample. The next largest (Wisconsin's) positive residual is 87 percent of New York's residual. Illinois and Nevada have positive residuals that are about 58 percent of

New York's value. Arizona, California, Colorado, Florida, New Mexico, Ohio, Rhode Island, Texas and Washington have negative residuals greater than 10 points. Many of these states have large populations of Hispanics and recent immigrants, a trait that was not controlled for in the analysis. This makes New York's achievement all the more remarkable when one considers that Hispanics and immigrants are a large share of its school children.

For individuals the summed SAT-V + SAT-M has a standard deviation of approximately 200 points. Consequently, the differential between New York State's SAT mean and the prediction for New York based on outcomes in the other 36 states is about 20 percent of a standard deviation or about three-quarters of a grade level equivalent.

Adding the teacher-pupil ratio and spending per pupil to the model reduces the NYS coefficient by 25 percent. It remains significantly greater than zero, however. The significant coefficient on teacher-pupil ratio suggests that heavy investment in K-12 schooling in New York State (possibly stimulated in part by the Regents exam system) may be one of the reasons why New York state student perform better than comparable students in other states.

#### Impacts on Mathematics Achievement of 4<sup>th</sup> and 8<sup>th</sup> Graders

The New York is exceptional hypothesis can also be tested by analyzing data from the 1992 administration of the NAEP mathematics assessment to representative samples of 4<sup>th</sup> and 8<sup>th</sup> grade students in 41 states and the District of Columbia. As with the analysis of SAT scores, state test score means were regressed on variables controlling for the socio-economic characteristics of the state's population and a dummy for New York State. The five variables that controlled for student background were: the proportion of people under age 18 who live in poverty, a schooling index for the adult population, percent foreign born, percent public school students who are black and percent public school students who are Hispanic. The results are presented in Table 4. Parents education, the poverty rate, percent black and percent foreign born all had significant effects on math achievement in the expected direction. New York State's mean NAEP math score was a statistically significant 9.6 points (or about one grade level equivalent) above the level predicted by the regression model.

One of the ways Regents exams may improve performance is by inducing the public to hire extra teachers to reduce class size and provide special help. Models were estimated with pupil-teacher ratios on the right hand side. Pupil-teacher ratios have significant effects on math achievement in 4<sup>th</sup> grade but not in 8<sup>th</sup> grade.

#### Impacts on High School Dropout Rates

Table 4 also presents the results of cross-state regressions predicting school enrollment rates at age 17 and high school graduation rates. New York State's high school dropout rate is

not significantly different than that of other states with students from similarly disadvantaged backgrounds. Additional staff appears to facilitate higher graduation rates. A 10 percent reduction in the pupil-teacher ratio increases the high school graduation rate by 1.5 percentage points.

#### Does New York State Invest More in K-12 Education?

The theory predicts that the existence of CBEEES will induce New York State to spend more on K-12 education and focus that spending on instruction. Indeed, New York's ratio of K-12 teacher salaries to college faculty salaries is significantly above average. New York teachers are also more likely to have masters' degrees than the teachers of any state except Connecticut and Indiana. New York ranks number 7 in both the teacher-pupil ratios and the ratio of per pupil spending to gross state product per capita (Bishop 1996).

Clearly, New York invests a great deal in its K-12 education system. If the cause of the high spending were a strong general commitment to education or legislative profligacy, we would expect spending to be high on both K-12 and higher education. This is not the case. New York is number 1 in the ratio of K-12 spending per pupil to higher education spending per college student.

The Regents exams are currently "low to medium" stakes tests, not "high" stakes tests. Exam grades count for less than a quarter of the final grade in the course and influence only the type of diploma received. Employers ignore exams' results when making hiring decisions. During the 1980s, scholarships sponsored by the Regents were based on aptitude test scores, not Regents exam results. A passing score on Regents exams is not necessary for admission to community colleges or out of state colleges. Students were aware that they could avoid Regents courses and still go to college. Indeed some perceived an advantage to avoiding them:

*My counselor wanted in me to take Regents history and I did for a while. But it was pretty hard and the teacher moved fast. I switched to the other history and I'm getting better grades. So my average will be better for college. Unless you are going to a college in the state, it doesn't really matter whether you get a Regent's diploma. (Ward, 1994)*

Indeed, the small payoff to taking Regents exams may be one of the reasons why so many students have not been taking Regents courses.

This is about to change. The Board of Regents has announced that students graduating in the year 2000 must take a new Regents English examination and pass it at the 55 percent level. The class of 2001 has the additional requirement of passing an examination in algebra and geometry. The class of 2002 must also pass separate Regents examinations in global studies and American history. When laboratory science exams come on stream, the phase in of

all five new required Regents exams will be completed with the graduating class of 2003. Once the system has adjusted to the new exams, the Regents intend to raise passing scores from 55 percent to 60 percent and then to 65 percent.

### Conclusions

Our review of the evidence suggests that the claims by advocates of standards based reform that curriculum-based external exit examinations significantly increase student achievement are probably correct. Students from countries with such systems outperform students from other countries at a comparable level of economic development. Not only did students from Canadian provinces with such systems know more science and mathematics than students in other provinces; they watched less TV and talked with their parents more about school work. Schools in provinces with external exams were more likely to:

- Employ specialist teachers of mathematics and science
- Hire math and science teachers who had studied the subject in college
- Have high quality science laboratories
- Schedule extra hours of math and science instruction
- Assign more homework in math, in science and in other subjects
- Have students do or watch experiments in science class and
- Schedule frequent tests in math and science class.

When student demography is held constant, New York State, the only state with a CBEEE system in the early 1990s, does significantly better than other states on the SAT test and the NAEP math assessments without experiencing a reduction in high school graduation rates.

CBEEES are, however, not the only important determinant of achievement levels. General productivity levels and standards of living and an East Asian culture appear to have even larger effects. CBEEES are common in developing nations where achievement levels are often quite low [e.g., Columbia and Iran]. Belgium, by contrast, has a top quality education system without having a CBEEES. The analysis of TIMSS data found that GDP per capita and location in East Asia had bigger effects on achievement than CBEEES. More research on the system level determinants of the average achievement levels is clearly in order.

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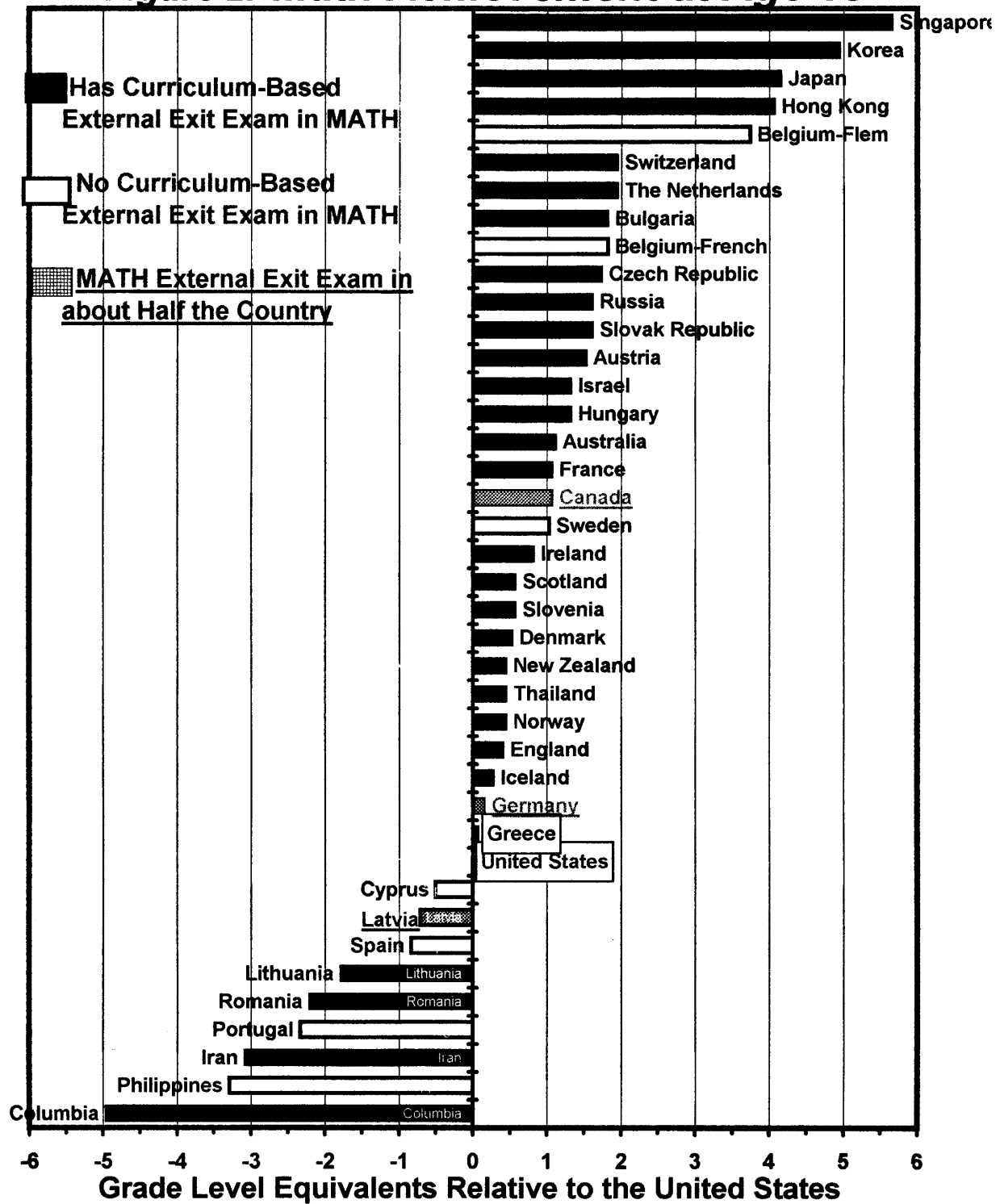
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**Figure 2. Math Achievement at Age 13**





**Figure 3: Science Achievement at Age 13**

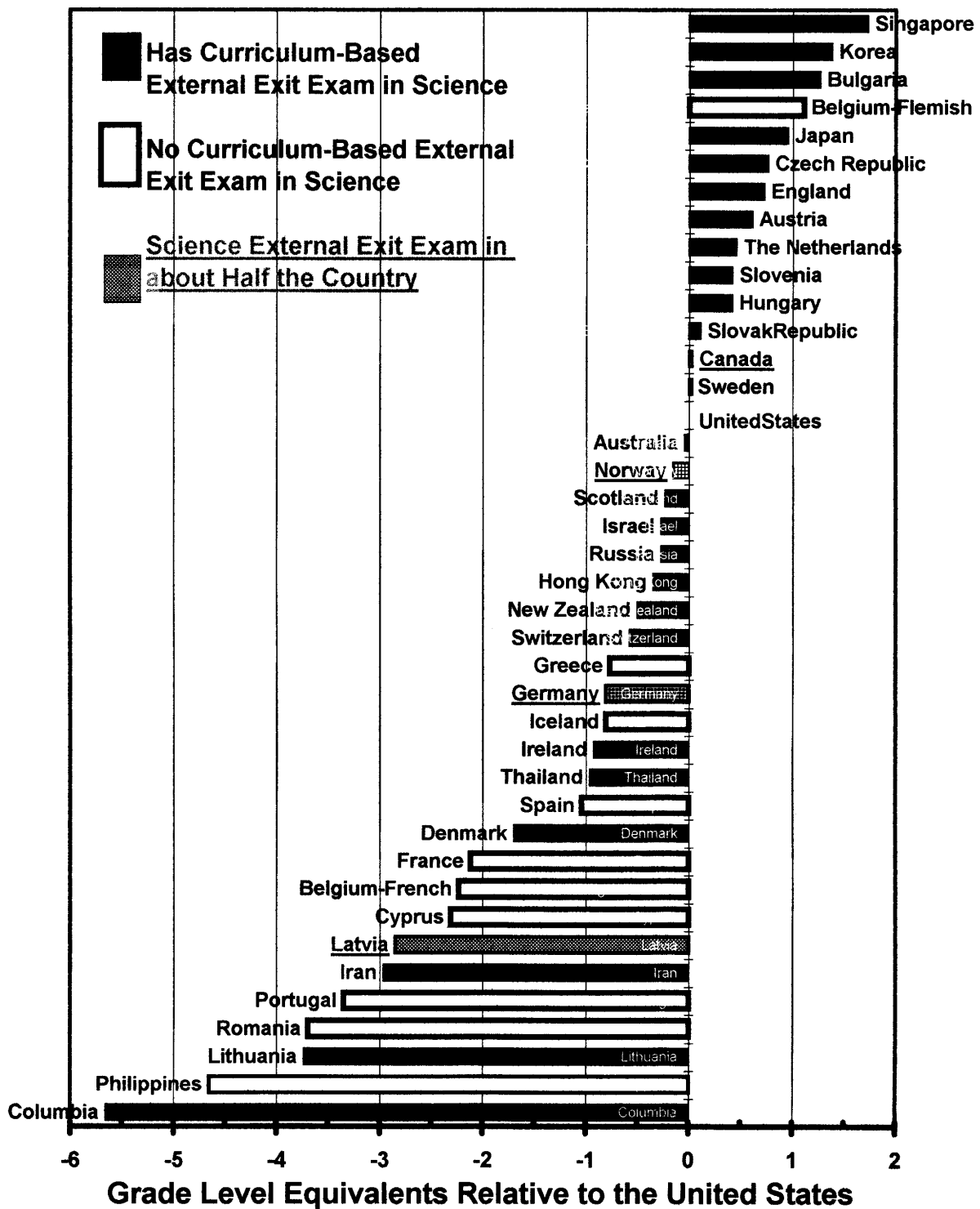


Table 1  
The Effect of Curriculum-Based External Exams  
on Science and Mathematics Achievement

	External Exit Exam	LnGDP/Pop 1987 & 90	East Asia	\$K-12 /GDP	AdjR2/ RMSE
<u>TIMSS Science-1994</u>					
(U.S. GLE = 26)					
Mean for 7 <sup>th</sup> Graders	38.0*** (2.93)	33.8*** (3.44)	20.1 (1.24)		.317 35.4
Mean for 8 <sup>th</sup> Graders	42.4*** (3.40)	36.2*** (3.80)	14.4 (.92)		.364 34.4
Median for 13 Yr Olds	34.9*** (2.77)	45.0*** (4.68)	21.5 (1.35)		.402 34.7
Median for 13 Yr Olds	32.0*** (2.57)	38.0*** (3.71)	33.7* (2.01)	13.6* (1.86)	.442 33.9
Diff-13 minus 9 Yr Olds	7.6 (.54)	-32.2*** (3.11)	5.5 (0.39)		.258 26.4
<u>TIMSS Mathematics-1994</u>					
(U.S. GLE = 24)					
Mean for 7 <sup>th</sup> Graders	29.6** (2.09)	46.6*** (4.60)	66.0*** (4.01)		.469 36.2
Mean for 8 <sup>th</sup> Graders	36.0** (2.54)	48.7*** (4.81)	62.0*** (3.75)		.476 36.6
Median for 13 Yr Olds	24.7* (1.82)	56.0*** (5.77)	9.4*** (4.37)		.537 35.1
Median for 13 Yr Olds	21.5 (1.55)	53.9*** (5.07)	75.9*** (4.41)	5.7 (.75)	.545 35.1
Diff-13 minus 9 Yr Olds	17.1** (2.28)	-3.4 (.66)	22.5*** (3.28)		.450 13.2
<u>IAEP-1991</u>					
Science % Correct (U.S. GLE = 6)	4.3 (1.72)	1.7 (.61)	9.6** (2.81)		.436 4.0
Math % Correct (U.S. GLE = 8)	15.7*** (3.85)	3.7 (.25)	16.1** (2.81)		.641 6.0

Table 2---Effects of Curriculum-Based External Exams in Canada

	Hyp.	Mean	StdDev	Curric Exam	U.S.	French	Relig	Indep	LnHumb	LnBook	Avg. Num.	Different	Adj.
			Schl	Coef	U.S.	Speaky	School	School	InGrade	In Rome	Siblings	Imm. Lang.	R2
Achievement													
Mathematics	+	.464	.135	.061 (9.4)	-.023*	.074***	-.045***	.074***	.006*	.156***	-.025***	.017*	.381
Science	+	.541	.096	.035 (7.1)	.020**	.017**	-.039***	-.016	-.006**	.119***	-.023***	-.062***	.353
Discipline Problems	0/+	.765	.720	-.009 (.2)	.034	.18***	-.159***	-.236**	.117***	-.299	.067	-.308***	.090
Absenteeism Problems	0/+	.822	.766	.179 (4.1)	.070	-.19***	-.068	-.288**	.153***	-.411***	.165***	-.004	.122
School Administrator Behavior													
Math Specialist Teachers	+	.48	.50	.23 (8.8)	.47***	.07*	-.201***	.057	.128***	.105***	-.041	-.056	.279
Science Specialist Teachers	+	.49	.50	.19 (7.2)	.35***	-.05	-.134***	.056	.167***	.152***	-.028	.068	.284
Took Math Courses in Univ	+	.66	.39	.19 (8.3)	.23***	-.07**	-.127***	.011	-.007	.075**	.048**	-.060	.121
Took Science Courses in Univ	+	.70	.38	.22 (9.9)	.15***	-.22***	-.182***	.037	.005	.064**	.013	.133***	.183
Math Class Hours	+	3.97	.89	.37 (7.0)	.19*	.26***	-.028	-.095	-.088***	-.282***	-.104*	-.749***	.102
Science Class Hours	+	3.00	.82	.23 (4.9)	.97***	-.11	-.415***	-.268**	.009	.009	.080	-.103	.171
Library Books per Student	?	21	21	2.48 (1.9)	5.36**	8.00***	-1.82	7.04**	-6.99***	3.73**	1.15	5.19*	.120
Computers per Student	?	.052	.043	.006 (2.5)	.008*	-.009*	-.013***	-.006	-.012***	.004	.004	.016**	.086
Specialized Science Labs	+	1.95	.95	.43 (9.0)	.06	.000	-.251***	.256**	.216***	.110	.008	.032	.158
Hours in School Year	+	949	89	1.0 (0.2)	42.6***	-10.0	-16.2***	3.7	-5.4	5.3	5.2	45.5***	.029
Class Size	-	24.8	6.1	-.38 (1.2)	-2.3***	-.27	3.3***	4.4***	3.6***	.42	-.45	-2.27***	.347
Teacher Preparation Time	+	.31	.27	.01 (1.5)	-.01	-.03**	.000	.080***	.063***	-.012	-.025**	-.042**	.192
Teacher Behavior													
Total Homework--Hours/wk	+	4.41	1.62	.66 (7.1)	1.33***	-.33	.821***	1.90***	.131***	.110	-.299***	1.024***	.168
Math Homework--Hours/wk	+	1.66	.64	.20 (5.0)	.18*	-.02	.165***	.219**	-.015	.115**	-.131***	.346***	.051
Science Homework--Hours/wk	+	1.04	.47	.19 (6.3)	.12***	-.06	.125***	.051	.016	.091**	-.007	.211**	.054
Emph Whole Number Compute	-	1.68	.49	-.11 (3.7)	-.09	.10**	-.009	-.149**	-.010	-.038	-.010	.029	.026
Math Quiz Index	+	1.62	.52	.12 (4.5)	.37***	.67***	-.077***	.173**	.107***	-.040	-.006	-.113*	.394
Science Quiz Index	+	.89	.38	.11 (5.3)	.66***	.32***	-.089***	.026	.024**	-.044**	.032	.147***	.336
Science Do Experiments Ind.	+	1.52	.63	.26 (7.3)	-.18***	.35***	.137***	-.088	.059***	-.019	-.028	.138	.165
Science Watch Experiments	+	2.42	.47	.15 (5.3)	-.12**	.21***	.086**	-.012	.042***	-.100***	-.006	-.024	.116
Science Watch Films Index	-	.94	.48	-.05 (1.7)	.31***	-.05*	-.054	.004	.061***	.002	.038	.001	.070
Home Behavior & Attitudes													
TV-School Avg.--Hours/wk	-	14.7	2.85	-.73 (5.1)	.31	-2.0***	.50***	-2.53***		-3.48**	-.23	-.85**	.276
Read for Fun Index	?	1.85	.28	.04 (2.8)	-.09***	.09***	.003	-.006		.265***	.033*	.230***	.143
Watch Science programs on TV?	?	.97	.38	.06 (2.7)	.05	.24***	.071***	.028		-.094***	-.032	-.178***	.113
Parent Talk about Math Class	+	.62	.17	.05 (5.1)	.08***	.03*	.030***	.042*		.028**	-.029***	-.029	.043
P. Talk about Science Class	+	.47	.17	.06 (6.4)	.06***	-.02	.004	.046*		.053***	-.007	.032	.050
P. want me do well in Math	+	3.54	.22	.06 (4.9)	.05**	-.03	.088***	.120***		.035*	-.077***	-.058***	.084
P. interest in Science(0-4)	+	2.18	.34	.07 (3.6)	.02	.08***	.088***	.017		.179***	-.060***	.073	.065
Math Imp. to get Job(0-4)	+	3.57	.21	-.01 ( .7)	-.02	-.05**	.106***	.049		.019	-.043***	-.098***	.054
Science Imp. to get Job(0-4)	+	2.93	.33	-.05 (2.5)	-.13***	-.20***	.183**	-.019		.039	-.015	-.125***	.126
Math Useful Solving Prob.	+	3.03	.31	.01 (0.6)	-.05	.21***	.108***	.037		.103***	-.043**	-.146***	.095
Sci. Useful Everyday Life	+	2.46	.31	.06 (2.8)	-.02	.17***	.141***	.075		-.140***	.013	-.179***	.114

Source: Regressions predicting the characteristics of 1366 to 1460 Canadian and American secondary schools. Provinces with external exams included in final course grade were Alberta, British Columbia, Newfoundland, Quebec and the Francophone schools in New Brunswick. Mean school characteristics had to be based on samples of at least 8 students.

**Table 3**  
**Determinants of Mean Total SAT-I Scores for States**

	NYS	Partic Rate	Parents AA-BA+	Private School	Prop. Black	Large School	3+Math Courses	3+Eng. Courses	lnTeach /stud	lnExpend /stud	R2 RMSE
	46** (2.7)	-68** (2.6)	370*** (6.4)	60 (1.6)	-135*** (3.2)	-44* (1.8)	85 (1.3)	-36 (.3)			.926 14.8
	35* (2.0)	-88*** (3.3)	367*** (6.6)	69* (1.9)	-113 (2.6)	-36 (1.5)	45 (.7)	-45 (.4)	48* (1.7)	13 (.8)	.933 14.2
<b>Mean</b>	.027	.414	.581	.207	.078	.129	.617	.797	-2.822	1.648	<b>SAT-I</b> 925
<b>SD</b>	.164	.240	.097	.082	.064	.113	.067	.038	.113	.215	55

\*\*\* p < .01 on a two tail test  
 \*\* p < .05 on a two tail test  
 \* p < .10 on a two tail test

Table 4

	Math NAEP Mean Test Score for 8th Grade <sup>1</sup>		Percent of 17 Year Olds Enrolled in High School <sup>2</sup>		Secondary School Graduates per 100 Persons 17 Years Old <sup>2</sup>				
New York State	9.59** (2.05)	8.86* (1.86)	7.27 (1.49)	.44 (.36)	.55 (.44)	.0046 (.00)	.36 (.074)	-1.71 (.36)	-3.50 (.72)
Parents Education Index <sup>1</sup>	.68** (2.71)	.65** (2.57)	.85*** (2.89)	.091 (1.58)	.10 (1.63)	.15** (2.28)	.96*** (4.09)	.85*** (3.80)	1.028*** (4.12)
Percent in Poverty (People 18 years or less) <sup>2</sup>	-.52** (2.49)	-.50** (2.38)	-.42* (1.91)	-.034 (.69)	-.035 (.71)	-.017 (.35)	-.017 (.085)	-.035 (.19)	-.092 (.48)
Percent Foreign Born <sup>3</sup>	-.66*** (3.21)	-.63*** (3.04)	-.50** (2.17)	-.18*** (3.39)	-.18*** (3.39)	-.13** (2.23)	-.51** (2.41)	-.42** (2.06)	-.26 (1.14)
Percent of Public School Students Black <sup>4</sup>	-.32*** (6.06)	-.33*** (6.10)	-.36*** (6.21)	-.047*** (3.59)	-.046*** (3.43)	-.045*** (3.90)	-.14*** (2.73)	-.17*** (3.27)	-.19*** (3.62)
Percent of Public School Students Hispanic <sup>4</sup>	-.0092 (.10)	-.0067 (.070)	-.057 (.55)	-.012 (.48)	-.012 (.50)	-.027 (1.07)	-.067 (.68)	-.055 (.59)	-.10 (1.05)
Pupil Teacher Ratio <sup>4</sup>		-.29 (.38)	-.27 (.86)	.037 (.47)	.042 (.56)			-.74** (2.51)	-.73** (2.48)
Hours of Instruction per Year <sup>2</sup>		.030 (1.29)	.0098* (1.76)						.032 (1.49)
Adj R Squared	.8313	.8303	.8336	.5713	.5636	.5840	.5475	.5961	.6071
RMSE	4.232	4.244	4.203	1.111	1.121	1.095	4.510	4.262	4.203
N Observations	42	42	42	51	51	51	51	51	51

\* Statistically significant at 10% level      \*\* Statistically significant at 5% level      \*\*\* Statistically significant at 1% level  
<sup>1</sup> Average of the percent of parents obtaining a secondary school diploma and the percent of parents obtaining a university degree. Education in States and Nations. National Center for Education Statistics. U.S. Department of Education. 1991. Pg. 139.  
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## Endnotes

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<sup>1</sup> Appendix A provides a bibliography of the documents and individuals consulted when making these classifications. The TIMSS report's information about examination systems does not distinguish between university admissions exams and curriculum-based exit exams, so its classifications are not useful for this exercise. The Philippines, for example, is classified as having external exams by the TIMSS report, but its exams are university admissions exams similar to the SAT. South Africa was excluded because its education systems was disrupted for many years by boycotts that were part of the campaign to end apartheid. Kuwait was excluded because of the disruption of its education system by the Iraqi invasion and the Gulf War.

<sup>2</sup> The Philippines, for example, had a math score mean of 399 in 8<sup>th</sup> grade and a mean of 386 in 7<sup>th</sup> grade. The mean age of 8<sup>th</sup> graders was 14 and the mean age of 7<sup>th</sup> graders was 12.9. The math score for 13.5 year olds was estimated by interpolation between 7<sup>th</sup> and 8<sup>th</sup> grade means. Math 13.5 = 386 + (399-386)\*((13.5-12.9)/(14-12.9)).

<sup>3</sup> This indicator of learning between age 9 and 13 can only be constructed for the 25 countries that participated in both the primary school and middle school TIMSS studies. The small size of the sample lowers the power of our statistical tests.